

A stylized, modernist illustration of a woman with long dark hair, wearing a yellow and black striped top and a blue skirt. She is holding a large bouquet of dark flowers with light centers in her right hand and a thick red book in her left arm. The background is a solid red color.

Bergen Scholarly Journal

Judith K. Winn School of Honors
Bergen Community College

Vol. II. 2015

Bergen Scholarly Journal

Judith K. Winn School of Honors
Bergen Community College

Bergen Community College

B. Kaye Walter, Ph.D.

President

William P. Mullaney, Ph.D.

Vice President of Academic Affairs

**Judith K. Winn School of
Honors Director**

Dr. Maria H. Makowiecka

Student Editor

Joan Connelly

Faculty Editors

Dr. Thomas Lapointe

Dr. Maria Makowiecka

Dr. Geoffrey Sadock

Dr. Andrew Tomko

Faculty Advisor

Dr. Maria Makowiecka

Paper Selection Committee

Dr. Dorothy Altman

Dr. Ruth Feigenbaum

Dr. Anne Maganzini

Dr. Maria Makowiecka

Dr. Kathleen Williams

Dr. Sarah Shurts

Faculty Readers

Dr. Jacqueline Behn

Dr. Ruth Feigenbaum

Dr. Randolph Fosstrom

Dr. Anne Maganzini

Dr. Maria Makowiecka

Dr. Geoffrey Sadock

Dr. Sarah Shurts

Dr. Anthony Yankowski

Design

Office of Public Relations

Cover Art Selection

Dr. Suzaan Boettger

Cover Art Fernand Leger,

Woman with a Book, 1923, @ collection of The Museum of Modern Art

Contents

I. Introduction, Joan G. Connelly, Student Editor and President of the Honors Association

II. PAPERS

1. "‘I 5683’ You:” *Dating and Relationships in the Technology Age*9
Adriana Abad
2. "Snow White and Other Fairies, and the Roles of Women"18
Maria De Abreu
3. "The Manipulation of Masks: the Rhetoric and Deceit of Shakespeare’s Character Iago"27
Laura DeLuca
4. "The Quest to the Empty Chapel and the Restoration of the Reader in ‘The Waste Land’"36
Sarde Gumalo
5. "Is Stress a Trigger for Schizophrenia?"45
Jan Siess
6. "A Series Representation Formula for $a^p - b^p$ "57
Pavel Sokolov

I. INTRODUCTION

The JKW School of Honors Student: "A Real Gardener"

Joan G. Connelly

Everyone must leave something behind when he dies, my grandfather said. A child or a book or a painting or a house or a wall built or a pair of shoes made. Or a garden planted. Something your hand touched some way so your soul has somewhere to go when you die, and when people look at that tree or that flower you planted, you're there. It doesn't matter what you do, he said, so long as you change something from the way it was before you touched it into something that's like you after you take your hands away. The difference between the man who just cuts lawns and a real gardener is in the touching, he said. The lawn-cutter might just as well not have been there at all; the gardener will be there a lifetime.

Ray Bradbury, *Fahrenheit 451*

Students at Bergen Community College come from a variety of social and cultural backgrounds, representing our country and the world, and each has a set of unique experiences. With such a diverse student body comes a diverse range of interests – both academic and personal. Six talented students' research papers, written in Honors classes and also presented at the JKW School of Honors Student Conference, have been selected for inclusion in this volume of *The Bergen Scholarly Journal*.

Although the topics of the selected papers vary, the need to question and challenge the established ideas remains a shared theme. The writers understand that the new, emerging perspectives shed new light on the interpersonal communication patterns and the nature of relationships today, as illustrated by Ariana Abad's "'I '5683' You:" Dating and Relationships in the Technology Age." In her paper, Ariana analyzes teen dependence on cell phones and how detrimental it is to their personal relationships and communication skills. Ariana has compared traditional relationships to those of today and found that getting to know someone was recently intimate and personal,

but has now been diluted to simply scrolling through a person's profile on social media. With the click of a button, one can find out a person's interests, education, and of course their appearance to gage the degree of suitability of the potential partner. Technology may prevent individuals, and many of us, from developing the social skills needed to effectively keep relationships.

The second paper in this volume, written by the Class of 2014 Valedictorian, Maria de Abreu, is titled "Snow White and Other Fairies, and the Roles of Women." Maria has commented on the recurring theme of "damsel in distress," a girl character incapable of getting out of a bind without male interjection in some of the most popular fairy tales such as "Snow White," "Sleeping Beauty," and "Little Red Riding Hood." Helpless and often catatonic, those characters are idolized by little girls, who will learn that in order to be desired, a woman must submit to the wishes of a man, not to oppose his actions, and of course be beautiful and innocent, all unattainable if not harmful standards for young women.

"The Manipulation of Masks: The Rhetoric and Deceit of Shakespeare's Character Iago" is an analysis of Shakespeare's *Othello* by Laura DeLuca. Throughout the tragedy, Iago manipulates Othello by spreading rumors and hurting all of those closest to him, for a seemingly unclear reason. The humanity of the play's protagonist, Iago, is questioned by many of Shakespeare's critics. Laura argues that despite his ruthless actions, he is flawed and those very flaws are what make him human and Laura leaves us with the notion that Iago's character in *Othello* serves as an example of what humans are truly capable of.

Next is a paper titled "The Quest to the Empty Chapel and the Restorative Role as Reader in "The Waste Land"" by Sarde Gumalo, in which she delves into T.S. Eliot's "The Waste Land," a poem that criticizes post-war Europe with a metaphor or allusion in nearly every line. Sarde's research tackles Section V, "What the Thunder Said," and explores the symbolism behind the social commentary of the lack of hope, faith, and crippling fear of the unknown amongst the people of Europe at the time.

The fifth entry is by Jan Siess titled "Is Stress a Trigger for Schizophrenia?" in which he explores whether the disorder is innate, or a result of a traumatic experience

that can cause neurons to start reactions in the parts of the brain known to be related to schizophrenia. Jan cites the research of many psychiatrists who have found a definite correlation between people who have endured stressful situations and those who have been diagnosed with schizophrenia. As a future neurosurgeon, Jan has a keen interest in the disorders of the brain and displays extensive knowledge of the subject.

The final entry is a new theorem designed by Pavel Sokolov, entitled “A Series Representation Formula for $a^p - b^p$.” Pavel’s work constitutes original research, something that is not expected of mathematicians prior to their senior year in college and, most often, at the graduate level.

The Bergen Scholarly Journal aims to present a wide array of interests among the brightest of Bergen Community College. The select six students have showcased their talents and interests in thought-provoking submissions. Referring back to the Introduction’s beginning excerpt, written by author Ray Bradbury, these students have ‘grown’ their fledgling academic careers, here, in the JKW School of Honors, and we are very proud of them. Even those unfamiliar with the College, especially high school students evaluating colleges, must admit that we do provide an excellent learning environment for talented and motivated students. The tireless work of both the students and their faculty mentors and reviewers have made this second pioneering issue of *The Bergen Scholarly Journal* a pleasure to read and I hope that, you, the reader, enjoy it as well!

II. PAPERS

"I '5683' you:" Dating and Relationships in the Technology Age

Ariana Abad

There's nothing like a first date. Candlelit dinner, music turned low, fancy clothes Or is it more accurate to say that you would prefer to sit in front of the computer in your pajamas, typing to your significant other over the internet? In this technology age, it is nearly impossible to avoid electronic forms of communication. However, in the dating scene, is technology going too far? With cell phone dependency, Facebook stalking, and online dating, society has turned to technology to replace traditional methods of dating and keeping in contact with one's partner. Those between the ages of 18 to 25, also known as the "emerging adults," are often blamed for this paradigm shift in dating and relationships. Yet, with the growing ability to connect with others in different ways, it is not just one generation's fault. Those who live in this culture are moving towards the belief that there is too much to do and too little time to chat. To make up for the lack of time, society has turned to the mix of wonders and dangers technology has to offer. In this twenty-first century mode of thinking, technology has made traditional relationships almost obsolete.

Traditionally, courting relationships have been seen as something sacred, a bond between a man and a woman. Commitment and trust are earned by talking and spending time with each other, face-to-face. In a study done about the selectivity of relationships in 1986, Peres and Meivar studied 1,800 participants and their dating habits. Through the use of questionnaires and surveys, they found that dating was seen as a precursor to marriage, and it was assessed with several categories: character traits, intellectual traits, appearance, occupation and status, income, and wealth and affluence. Women were found to be slightly more choosy about their mates, but the article lays the foundation of the standards one has in meeting a partner. In the study, the partners met in person and were able to assess each other through face-to-face communication and interaction (Peres, 1986). This study illustrates the typical values shared by prospective dates, as well as the traditional methods of dating.

A different, more recent study done by Ackerman, Griskevicius, and Li researched confessions of love in 2011. The study focused on how one partner confessed love to the other for the first time. The 101 undergraduate and graduate student participants were all eligible for the study, which required that each participant had to be

in a romantic relationship, and there had been at least one confession of love given in person. The results showed that couples who had reported having such confessions also reported having higher levels of face-to-face communication, and they also maintained higher levels of trust as compared to couples without this type of confession. This view of relationships supports the traditional methods of sharing a bond between with another. It supports the notion that connections are created by the gradual process of getting to know someone. However, in the current generation, face-to-face communication is nearly impossible. Hardly anyone wants to take the time to go on dates without knowing that that person could be “the one”; this is where technology steps in.

The onset of electronic communication allows today's generation to put dating and relationships in a new light. Whereas in the past, traditional relationships involved going out to see one's partner face-to-face, there is no longer any need to go further than one's cell phone. Cellular communication dominates almost all other forms of communication today; according to Lee Rainie of the Pew Research Center's Internet and American Life Project (2013), cell phones are now being used by 91% of American adults, and a majority of these users are between the age groups of 18-24, as well as ages 25-34. In terms of dating, cell phones are now the major form of communication between partners. Using this knowledge, studies are now being conducted about cell phone use among emerging adults in both courting and romantic relationships.

In a recent study, Anna R. Bergdall, Kraft, Andes, Carter, Hatfield-Timajchy, and Hock-Long (2012) researched the relationships of emerging adults between the ages of 18 and 25. Each participant was required to keep a journal of his or her encounters, making specific notes about the method of communication and what activity happened during the conversation; these journals were called “coital diaries.” Through interviews and analysis of “coital diaries” from each participant, the study found that more than 90% of participants discussed using cell phones to communicate with partners, including voice calling and text messaging. In serious relationships, participants reported using technology to stay close, address difficult topics, and assess fidelity and relationship quality. One male participant stated: “On Friday I talked to my girlfriend on the phone. She called me from [college], but we always have good conversations. That's another reason why I feel we're real happy . . . If you can hold a good conversation over the phone, that's really important to me” (Bergdall, 2012). Many other participants shared the same thoughts about talking on the phone, often implying

that cell phone communication can easily replace a face-to-face connection. The final results of the study emphasized that all participants used some form of electronic communication to keep in contact with their partner, but the majority of the participants used cell phones. These responses emphasize how important cell phones have become in the current generation, as that they are used in the majority of close relationships.

Further studies have found that cell phone usage has become a necessary component of romantic relationships, complete with a system of unspoken rules and regulations. In a study done by Miller-Ott, Kelly, and Duran (2012), researchers hypothesized that individuals rate cell phones as an important means of communication in their romantic relationships; they also predicted that satisfaction with cell phone usage is significantly and positively associated with relationship satisfaction. Their hypotheses were found to be true. In the study of 227 undergraduate students, cell phone usage was found to contribute positively to the relationship, regardless of phone arguments and conflict between the couple.

However, in specific cases, when “cell phone etiquette” was violated, cell phone usage was looked at in a negative light. Researchers found that phone use etiquette can be narrowed down to four rule groups in a romantic relationship: Contact With Others (rules about limiting calls and texts to other people when the two are together), Relational Issues (rules prohibiting partners from starting relational arguments over the phone), Repetitive Contact (rules about the acceptability of calling or texting partners when they do not first respond), and Monitoring Partner Usage (rules regarding whether it was okay to check each other's text messages and call logs). Of these, Relational Issues and Contact with Others most affected relationships, but negatively. Partners reported happier relationships when they had rules about not discussing interpersonal issues or fighting over the phone. However, in relationships where one person felt one was being restricted by one's partner, the couple reported being less satisfied with their cell phone use. However, that does not decrease the amount of cell phone usage in the relationship (Miller, 2012).

These studies find that cell phone use has become an integral part of the dating community. Even when cell phones add to the conflict of personal relationships, people continue to use them as forms of communication. This research explains how society is so bound by living in tandem with technology that traditional means of communication are seen as things of the past. In a culture that emphasizes new rules

and regulations over a piece of technology, it is important to note how much the “technology age” has affected other aspects of relationships; for example, social media and Facebook.

Facebook, too, is becoming an important part of relationships; it fulfills many of the human basic needs for friendships and outside relationships. In a general sense, Manago, Taylor, and Greenfield (2012) studied college students' use of Facebook. With findings deeming 90% of college students as avid Facebook-users (logging in at least three times a day), they found that students who use Facebook as a means of interaction are more satisfied with their lives. For example, people who used Facebook's status-update tool often expressed their current emotional state, broadcasting themselves to the hundreds of “Facebook friends” they have on their network. The study states: “This finding indicates that self-disclosure, a hallmark of intimacy, has gone public, transforming the nature of intimacy development for emerging adults” (Manago, et al., 2012). With self-disclosing becoming much more public now than ever before, it is increasingly easier to check in on both strangers and friend, alike. It is easier to put oneself out there, to tell the world about one's life, whether it is viewing and sending invitations to a wedding, or posting pictures of a mediocre breakfast. Facebook methods of self-disclosure are clearly not as substantial as face-to-face communication, but they satisfy the basic need for belonging and offer a way to make personal events go public. At the same time, our public relationships seem to affect our more private ones.

In the romantic aspect, Facebook plays a large part in knowing the person before dating, as well as a way to monitor one's partner. “Are we Facebook official?” has become a phrase often said by partners, as an indicator of solidifying their relationship. In a study conducted by Papp, et al. (2012), they researched the link between relationship satisfaction and the different uses of Facebook. Participants and their significant others were given surveys about their relationship satisfaction, and researchers were allowed access to view each couple's individual Facebook accounts for additional assessment. The final results showed that dating partners demonstrated similarity in their Facebook usage, as well as how they portrayed their relationships on their Facebook profiles, such as through a relationship status or if the partner was present in their profile pictures. This may demonstrate the importance of holding a positive image of a romantic relationship in society, and Facebook offers the perfect outlet.

Yet, the study has also shown the darker side of using Facebook in relation-

ships. The issue of jealousy and power is much more easily shown through social media websites. Because of the amount of self-disclosure and constant sharing of information, Facebook makes it much easier to keep others in check, closer than ever, including one's partner. According to the study done by Elphinston and Noller about Facebook intrusion in romantic relationships (2011), there is a direct link between jealousy and Facebook usage. In the study, college students were given surveys to assess their use of Facebook, as well as how they feel about their partner's use of Facebook. The study found that, while feelings of social connection enhance emerging adults' psychological well-being, young people's levels of Facebook intrusion impact their romantic relationships negatively, in the same way addictive behaviors have a negative effect on relationships. Higher reports of Facebook use were found to be linked to more severe expressions of jealousy within a relationship (Elphinston & Noller, 2011). In other words, when one person in the relationship is addicted to Facebook, it can harm the relationship, as one has a constant monitor on the other.

While not specifically stated in the study, these feelings of jealousy may stem from one partner having an overbearing hand in the relationship, making it much easier to check who one's partner is talking to, or what other people are saying to the partner. Jealousy is becoming easier to encounter in relationships with the new spectrum of technologies one may sift through at one's own ease. These findings suggest that our society is becoming reliant on using our own perceptions of outside events, rather than simply trusting one's partner. Yet, Facebook and other forms of social media are still responsible for a large part of the satisfaction of connecting within a relationship amongst emerging adults.

In this technology age, how do adults not of this generation, fare? Studies suggest that the technology age is not only affecting emerging adults, but everyone living in the world today. As American culture is quickly being surrounded by technology, society demonstrates the need to keep in contact electronically; people are becoming dependent on these forms of communication. In the previously mentioned article written by Miller-Ott, et al. (2012), it states: "Recently, Pew (2008) found that of American married couples who both own cell phones, 70% contact each other once per day or more to say hello or chat, and 64% contact each other at least once per day to coordinate their schedules." In this generation, even married couples are giving in to the technology age. It makes communication faster, easier, and more immediate. To an extent, this can enhance healthy relationships. However, people are getting so

used to being around technology that it is becoming a normal routine, and for currently unmarried singles, this generation offers an effortless route to exploring relationships and finding love.

With the onset of online dating, more people are turning to the internet to fulfill their relationship needs. In a recent article published by Time magazine, Lapinski and Webley (2013) look into the success of different online dating websites. Aside from the famous, well-known names of “Match.com” and “eHarmony,” whose annual revenues exceed \$1 billion in America, there are other websites which share the same purpose: to get people in touch with each other and “find love.” The truth is, though, that most people who use these dating websites are over the age of 30, when they feel they are past their prime relationship age and have too little time to go out and find dates (Lapinski, 2013). Dating sites are primarily used as a way to portray oneself in the light that one would like to be seen, as it is easy to manipulate an electronic profile by emphasizing positive aspects and hiding all the negative traits about oneself. Online dating has become a quick and easy way to meet singles, while sifting through partners who do not appeal to one’s tastes; with a simple glance at a profile or a photograph, one can click “skip” and move on to the next available profile. Yet, dating websites alone are not enough to satisfy the minds of this fast-paced culture: of course, as with everything else, “there’s an app for that.”

Online dating apps are on the rise, used by people of all ages. According to an article by Sharon Jayson (2013), the mobile dating market is being used by 13.7 million Americans, which is double the previous year’s 5.8 million. These “on-the-go” dating devices make online dating even easier: Instead of having to sit at a computer or laptop, dating can happen at the touch of an app. In a recent article by Saba Hamedy (2013), she interviews the creators of these dating apps, as well as users. Alexa Marteen, the social media director at Tinder, an anonymous dating app that “matches” people with other users within a 30-mile radius based on mutual interest and Facebook friends, states: “Tinder is a kind of second chance to meet people you wouldn’t naturally meet. There’s nothing too binding about it. What’s scary about other websites is people were afraid and embarrassed to be on it.” While this is a concern, people often overlook the dangers that the overwhelming emphasis of technology can have.

While it has become easier to communicate, technology has taken over so much of our world that it has become second-nature to be “connected” in some way, aside from face-to-face communication. But are we really getting closer, or just being

satisfied with experiencing a more comfortable disconnect? In a study done by Danielle Couch, Pranee Liamputtong, and Marian Pitts (2012), participants who have been involved in online dating were interviewed. Many said that they wished the online community were more honest. A female participant writes: “people lie most of the time and a lot of men say they are looking for relationships when [in fact] they want sex. . . . People lie about their age, have different pictures up or pictures that were taken years ago. People lie about if they are married. They lie about what they do for a living, if they have children or not.” This is just one example of the major concerns of the rising of technology in the world. It is becoming increasingly easier to be deceitful when one cannot speak directly to another. In fact, a twenty-three-year-old man writes that he has two different profiles with different ages to attract different types of women: “well, i have 2 profiles on [website] . . . one is my real age, 23, to meet women 18-31... the other says i’m 32, to meet women 32 + . . . i can be anything I want . . . mostly older women welcome a younger, attractive male [sic].” He admits that he uses the younger profile to find a girlfriend, but he uses the older profile to attract women for sex. On another level, people are becoming increasingly more aware of becoming emotionally attached to someone else, because without verbal cues and body language, it is easy to believe in typed words on a screen. These issues would not have arisen, had dating and technology not been so conjoined in this age.

Yet, in the same way people have strayed away from face-to-face conversations and replaced them with phone calls; even phone calls and texts are becoming less common. Now, the internet is the new way to go. Another participant in Couch, et. al.’s study (2012) states that she feels less inclined to share phone details, because “the net provides more security.” Many participants in the study answered similarly, explaining that they feel more comfortable with less disclosure. In the dating world, the definition of “getting to know someone” is continuing to become more of a grey area. As a society, we continue to put up walls when faced with the growing technology epidemic, becoming more comfortable with being apart from each other, and putting our guards up when in person.

Technology has shifted the dating paradigm, then, from communicating face-to-face, to calling each other from miles away, to offering self-disclosure with people whom one has never met, ultimately to chatting and dating complete, anonymous strangers. Technology has become such an integral part of our lives that people are starting to forget what it means to have serious, face-to-face, traditional relationships.

Society has been thrust into an age where there is too much to do, too little time, and technology is too easily available to everyone. Speaking face-to-face is quickly becoming a thing of the past, as the fast-paced culture constantly pushes people towards instant gratification: When we cannot see significant others in the moment, we can just call; if we are lonely and looking for love, we can sign up for an online dating service and meet other lonely people, also looking for love. In this generation, those who are subject to a technological relationship with one's partner feel as though it is easier to connect with each other over forms of communication, deeming a face-to-face encounter to be sometimes "too awkward" or "not really necessary." With the increasing ease of self-disclosure over websites and cell phones, they have broken the difficulty of barriers that had to be faced by past generations and made dating only a click, tap, or an app away. In this technology age, traditional forms of relationships are becoming obsolete. Yet these studies do pose an interesting question: Are these new modes of communication helping or hurting our personal relationships? Perhaps the answer lies in the angry words of a Facebook status: "To all the [people] in love. Get over yourself... If everyone in the world wanted to know about your love life then we would've asked" ("The most awkwardly public breakups in Facebook history," 2013).

Works Cited

- Ackerman, J. M., Griskevicius, V., & Li, N. P. (2011). Let's Get Serious: Communicating Commitment in Romantic Relationships. *Journal of Personality & Social Psychology*, 100(6), 1079-1094.
- Bergdall, A. R., Kraft, J., Andes, K., Carter, M., Hatfield-Timajchy, K., & Hock-Long, L. (2012). Love and Hooking Up in the New Millennium: Communication Technology and Relationships among Urban African American and Puerto Rican Young Adults. *Journal of Sex Research*, 49(6), 570- 582. doi:10.1080/00224499.2011.604748.
- Couch, D., Liamputtong, P., and Pitts, M. (2012). What are the real and perceived risks and dangers of online dating? Perspectives from online daters. *Health, Risk & Society*, 14(7/8), 697-714.
- Elphinston, R. A., & Noller, P. (2011). Time to Face It! Facebook Intrusion and the Implications for Romantic Jealousy and Relationship Satisfaction. *Cyberpsychology, Behavior & Social Networking*, 14(11), 631-635. doi:10.1089/cyber.2010.0318.
- Hamedy, S. (2013, March 26). Online dating on the go: Apps shake up traditional

- dating Websites. *Christian Science Monitor*. p. N.PAG.
- Jayson, S. @SharonJayson, & USA, T. (n.d). The End of Online Dating. *USA Today*.
- Lapinski, V., & Webley, K. (2013). Courting Success. *Time*, 181(6), 18.
- Manago, A. M., Taylor, T., and Greenfield, P. M. (2012). Me and My 400 Friends: The Anatomy of College Students' Facebook Networks, Their Communication Patterns, and Well-Being. *Developmental Psychology*, 48(2), 369-380. doi:10.1037/a0026338
- Miller-Ott, A. E., Kelly, L., and Duran, R. L. (2012). The Effects of Cell Phone Usage Rules on Satisfaction in Romantic Relationships. *Communication Quarterly*, 60(1), 17-34. doi:10.1080/01463373.2012.642263
- Papp, L. M., Danielewicz, J., and Cayemberg, C. (2012). 'Are We Facebook Official?' Implications of Dating Partners' Facebook Use and Profiles for Intimate Relationship Satisfaction. *Cyberpsychology, Behavior & Social Networking*, 15(2), 85-90. doi:10.1089/cyber.2011.0291
- Peres, Y., & Meivar, H. (1986). Self-Presentation During Courtship: A Content Analysis of Classified Advertisements in Israel. *Journal of Comparative Family Studies*, 17(1), 19-32.
- Rainie, L. (2013, June 6). Cell phone ownership hits 91% of adults. Pew Research Center. *The Most Awkwardly Public Breakups in Facebook History*. November 20. Web.

Snow White and Other Fairies, and the Roles of Women

Maria De Abreu

Fairy tales give the world a gift of fantasy, in which innocence is questionable. Originally meant to be an adult form of entertainment, these short stories are now considered children's literature. Their simplified narratives enable fairy tales to powerfully influence their readers. Fairytales, which take place "once upon a time" instead of in an actual time, often promote negative stereotypes about the role of women in society. Stories such as the Grimm Brothers' versions of "Snow White," "Little Red Riding Hood," Perrault's version of Cinderella, and *The Beauty in the Sleeping Forest*, powerfully delineate the female role. Their images and messages establish a system of reference for our culture, which women are expected to follow. These female characters' actions are the role models available to young girls. Fairy tales influence the female role in three ways: they depict the female protagonist as passive, the female antagonist character as active; they cast the feminine persona in a patriarchal society; and they establish the female physical appearance as the woman's main focus in life.

First, fairy tales are characterized by portraying a passive, innocent little girl contrasted by an active female character who opposes her. "Little Snow White," the direct translation of the German of the Grimm Brothers, represents a pure and submissive child whose beauty triggers the fury of a jealous stepmother. The feminist critics Sandra M. Gilbert and Susan Gubar emphasize the creation of two clearly opposite roles: "Thus the conflict in "Snow White" arises between two oppositional images or arche(stereo) types imposed upon women by Western patriarchal society: the angel and the monster" (qtd. in Barzilai 519). The "Snow White" story portrays the passivity of the angelic girl and the aggression of the demonical queen through the catatonic state of Snow White, her need to be constantly saved, her foolish attitude, and the presence of an opposite, active and bold queen.

The stereotypical angelic girl is passive, so passive that she eventually falls asleep for a long time or enters into a catatonic state, both conditions in which her activities are reduced to nothing. Snow White's character is an example of this dormancy. While she sleeps, the prince falls in love with her. It seems to be a fake start for a real romantic relationship, since the only reason for love is the beautiful appearance of the catatonic Snow White. Andrea Dworkin points out in her book, *Woman Hating*, that this portrayal of a dormant woman is what damages the female position in society: "the only good woman is a dead woman" (41). Not only is the female protagonist's life based on being an object of hatred, for which she may

die or fall asleep, but this inactivity continues when her rescue turns her into an object of adoration. It seems she escapes from a prison, her home, only to reenter the imprisonment painted as a castle. Barzilai cites Gilbert and Gubar, who affirm that, "Snow White merely exchanges 'one glass coffin for another'" (520). Apparently there is no chance to get the happy ending. If Snow White's nap does not appear enough inactivity, Perrault puts his female protagonist, Sleeping Beauty, to sleep for a hundred years only to wake up and make her the perfect wife. It is suggested that the prince does not fall in love with the female protagonist character while she is asleep, but because she is asleep (Dworkin 42). The fairy tale's emphasis on such lifeless characters promotes the goal of a woman to be sleeping, perhaps dreaming. An archetype of a catatonic state woman appealed to Pygmalion, who fell in love with a statue he had carved. He was fascinated by the passivity of a lifeless ivory woman, which confirms the origin of female dormancy based stories to be as ancient as Greek mythology.

Another fact that shows the passivity of the female character is her constant need to be rescued. Dworkin states that the protagonist is not only asleep most of the time, but while she is awake, she appears to be non-existent: "It awake was not readily distinguishable from it asleep" (42). The female persona is never the leader and depends on someone else's being in charge. The Grimms' Snow White character would still be sleeping if the dwarves did not move her coffin. Perrault's Cinderella would still be a servant if the prince did not fit her shoe on her foot. And the Grimms' character Little Red Riding Hood would still be inside the wolf's belly if the huntsman did not appear. Not only is the female character passive but also weak, incapable of living happily, or even living without the help of an external force.

Fairy tales not only promote a female protagonist persona who usually lives in a catatonic state and needs to be saved, but also the woman herself is portrayed as an unwise person. Apart from being quiet and naïve, these little girls, incapable of questioning a situation, are not portrayed as clever. According to Jack Zipes, the version of the "Little Red Riding-Hood" by Walter de la Mare narrates how the little girl tells the wolf the secret sign to enter Grannie's house: "I shall just tap seven times" (353). Red Riding-Hood in this version, who also falls asleep, practically explains to the wolf how to deceive her grandmother. On the other hand, the same anthology of Zipes includes a different version of the story titled "Little Polly Riding Hood," where Catherine Storr offers a totally opposite plot. For the first time, the girl named Polly arrives at Grandma's home before the wolf, who stays outside the door wondering how she does it. "Because this isn't a fairy story," says Polly, "and I'm not Little Red Riding Hood, I am Polly and I can always escape from you, Wolf, however much you try to catch me" (358). Storr plays with the stereotypical concept of fairy tales in which the little girl is naïve, and reverses it,

using a clever female protagonist who makes clear her superior position with respect to the dumb wolf. The use of an experienced, active girl's character contrasts with all the conventional versions of this story and declares that being an active and smart woman is also attractive and frustrates any street wolf's bad intention.

The last element in this stereotypically passive versus active female position is the power given to the dynamic antagonist female character. The queen's character in the Grimms' *Snow White* matches the demonic monster description. She is evil, has cannibalistic desires, and attempts to kill *Snow White* until she succeeds. She is more than a conventional wicked character, according to Gilbert and Gubar, as discussed in Tatar's book *The Annotated Classic Fairytale*. She appears to be a, "plotter, a plot maker, a schemer, a witch, an artist" (88). The two female characters in *Snow White*, the little girl and the queen, compete and the queen is willing to win by dynamic activism. Apart from the meanness of her plans, instead of sleeping or just waiting for something to happen as the little girl does, the queen creatively conspires. According to Dworkin, active women are mean, passive women are virtuous. This accepted formula explains the absence of good mothers in fairy tales: passive women are intended to be mothers; thus, in this function, their only active task, they become cruel and hateful: "Whether called mother, queen, stepmother, or wicked witch, she is the wicked witch, the content of nightmare, the source of terror" (41). The female character is depicted as an object of malice, then an object of adoration, and, finally, a mother, a role in which she does not succeed because it is the first time she has to take the lead.

Second, fairy tales promote a female character that supports a patriarchal society. The emphasis on the actions of these heroines and the irrelevance of the men's interactions support a male-dominated social structure. According to Dworkin, while powerful women are bad and inert women are good, men are always good (45). What the female characters do, or don't do, centers around a male figure who acquires power. The Grimms' version of "*Snow White*" illustrates an example of the importance given to the male characters through several patriarchal elements: the rivalry between the stepmother and daughter over the king figure, the absence of the father represented instead with a judging voice of the mirror, the need of the female to find a prince, and the abundance of male characters as rescuers.

The most obvious fairy tale element that places the male in a dominant position over the female figure is the women's rivalry over the masculine character. From a psychoanalytic perspective, it can be said that the little girl and her stepmother become sexual rivals who compete for the king's affection. According to Bruno Bettelheim, "In '*Snow White*' the pubertal girl's oedipal struggle is not repressed, but acted out around the mother as competitor" (205). The girl battles with her mother for the affection of the father, but, because the female character is

passive, their fight reduces to their beauty. Barzilai confirms that the conflict gets more complicated when the daughter reflects her mother's beauty, because, as Nancy Chorodow comments, mothers more are easily identified with their daughters than with their sons (528). Based on this understanding, some critics see the killing attempts of the queen as intended to regain maternal control. The aggressive attempts are reduced to activities that bind the mother-daughter relationship, such as "dressing, combing and feeding" (532). But they seem to forget these activities all include a poisoned object, a poisoned apple, a toxic comb, or a suffocating lace, making Bettelheim's conception the right one. Women's competition is then intended to eliminate their own genre, not only strangers but also relatives, all because they want a better chance to win the male's affection.

Another proof of the fairy tales' support of a patriarchal society is the absence of the father figure. Mother and daughter have a conflict over the male, but he does not even appear. According to Bettelheim, from a psychoanalytical perspective, the lack of description of Snow White's father, instead of a meaningless relation, signifies placing his figure in a center stage, "denial is an admission and absence a presence" (518). The narrator usually ignores the description of the father's role and, when the story includes him, he is isolated from the conflict. He seems to be too busy governing to notice that his wife hates his daughter. Although he has the power to end the conflict and does nothing to solve it, he always remains as a good man.

Dworkin points out the role of two father figures, Cinderella's and Hansel and Gretel's father, both of them lacking personality. Although, "Cinderella's father saw her every day," he does not do anything to change her humiliated position. In the same way, Hansel and Gretel's father does not prevent his children's abandonment in the middle of the forest (45). When the happy ending of the story arrives, the father does not need to be forgiven because the evil does not come from him.

Another element that supports patriarchal society is the fact that the mirror's voice in the Grimms' version of "Snow White" seems to be a male voice. Both the queen and the little girl are judged by the powerful opinion of the mirror. Barzilai cites Gilbert and Gubar, who confirm the father to be, "the patriarchal voice of judgment that rules the Queen's—and every woman's—self-evaluation" (521). Men have the authority to indicate who has the greatest beauty in the story. Not only do men judge the female but they also choose their victims and actively seduce them. According to Tatar, the wolf's character in "Little Red Riding Hood" represents the attractiveness inside of an actual beast character who, accompanied by fear, portrays a version of a "sexually seductive man" (20). In this way, it seems that men judge and control women.

Additionally, one of the essential parts of the fairy tale is the female's need

to find a Prince Charming. Girls are unable to achieve happiness without the appearance of a male, even if he represents their victimization. Patriarchal protection is necessary for a woman, who cannot defend herself. In addition, the prince has to be handsome. Any other male role, which lacks a physically attractive quality, diminishes his sexual attractiveness. Tatar illustrates this physical requirement with the example of the seven dwarves in the Grimms' version of "Snow White." Their diminutive stature makes them sexually unthreatening" (85). Therefore, the tales suggest the female role should be waiting for the handsome Prince Charming to come. Specifically, they propose the "waiting" action since they are not supposed actively to look for him. Finally, when he appears, the woman is intended to serve him. This idea does not sound like a happy-ever-after story. It seems that classic fairy tales' authors have the power of making these stories sound beautiful on the surface but underneath they signify a whole set of negative gender stereotypes.

Third, fairy tales focus female preoccupation on achieving a beautiful external appearance. It is clear that the female rivalry over the male figure is based on a passive competition judged by physical beauty, but this superficial last element is the key idea for most of the tales. The conflict's origin reduces to the obsession for beauty of the female character. Snow White's stepmother wants to kill her because she is prettier, Cinderella's sisters are envious of the servant's beauty, and the wolf desires to eat a cute petite "Little Red Riding Hood." It seems that there is no fairy tale based on a not so graceful female character. It is more stunning to portray pretty women in these stories, where being beautiful constantly saves them, being young reflects their chance to succeed, being pure represents a repressed beauty power, and achieving perfect beauty is their main life goal. Through these elements fairy tales support a narcissistic concept in which beauty is required to achieve happiness.

The female character's beauty is so powerful that it represents the reason why she receives pity. Girls are living in a dangerous situation: they are saved or rescued because they are too beautiful to die. It appears that an ugly character has no hope of being rescued for not being, "as white as snow, red as blood, black as ebony" (230), as the Grimms' version of "Snow White" portrays her. Snow White is saved by the bell in a moment of compassion by the huntsman, who is ordered to kill her "Snow White was so beautiful that the huntsman took pity at her and said: 'Just run off, poor child'" (231). An unattractive Snow White would end up dead in the middle of the forest. Tatar states, in the Grimm Brothers' words for "Sleeping Beauty," that a prince comes to the rescue of Briar Rose who is, "so beautiful that he could not take his eyes off her, and he bent down to kiss her" (403). On the other hand, a bad-looking princess would still be sleeping. The message for women is clear: they are expected to be beautiful and to do whatever is necessary to achieve ideal beauty. Otherwise, they will probably end up being obliterated. In this way,

fairy tales establish ideas in their readers' minds. This influence on the women's role is powerful and dangerous since, according to Dworkin, "Fairy tales are the primary information of the culture" (34).

In addition to the requirement of being pretty, the female character suffers a generational conflict in which being young represents her bliss and being old represents her misfortune. Fairy tale authors seem to forget that aging includes experience and maturity, and they chose to portray grown characters suffering for getting old. Barzilai quotes Anne Sexton's poem "Transformations" where she confirms the issue of aging as the reason for Snow White's queen's hate towards her daughter. Sexton states, "Her stepmother, /a beauty in her own right, /though eaten, of course, by age" (528). The queen is a pretty woman but her age makes her unable to compete with the little girl's beauty. The requirement of being young becomes worse when the generational conflict of these female characters is not between two mature women, but between a really young girl, maybe seven years old, as in "Snow White," and a grown-up queen. Consequently, the message implies that youth means the ascension of the female character while aging means her deterioration.

Not only does the female character have to be beautiful and young, but, of course, she has to be a virgin. Purity is taken for granted in these little girls, whose conflict starts, precisely, during of their sexual awakening. Hence, the girls are powerfully beautiful but they are not allowed to enjoy it because they must be passive. It appears that women have two options: being beautiful, pure and passive, or being active but considered a whore and ultimately destroyed. In addition, according to Perrault fairy tales reward virtue (34). It seems that instead of promoting sexual abstinence, fairy tales uphold the female's virginity as a prize to the prince at the end of the story. Women have to wait for their adventurous princes to come and welcome them by giving them their purity as a gift.

On the whole, the main concern of the female character is focused on achieving a perfect physical appearance. According to Barzilai, "The central interest of these women's lives reduces to the question of whether they look good or not" (519). This obsession may originate in the fact that the female character's beauty is the only legacy she has from her biological mother. Hence, young women are attached to it as their most valued treasure. However, this is not an excuse for the proposed vanity concept. Fairy tales frequently portray mirrors and glasses, which are used by the female characters to admire themselves. This narcissistic element surrounds the main conflict of the story where women fight among themselves to be the most beautiful of the land. The risk of this vanity message, as Dworkin states, is its influence on adolescents who receive a set of requirements to be accepted as women. They are pushed to transform themselves. Pain is included in the process where young women are forced to, "conform to a self-image which bases itself on

mutilation of the body” (116). As proposed by these tales, it seems that women's beauty should be accompanied by youth, purity, and a set of beauty treatments required to maintain it.

Fairy tales influence our culture with greater power than most sophisticated literary texts. These children's stories create powerful stereotypes about women. Little girls grow up surrounded and influenced by the message conveyed in these classical stories. Women should be passive, which is reflected by keeping a catatonic state, waiting to be saved, being submissive, and inactively facing their opponents. Women should support a patriarchal society, which is promoted by competing over the male figure, presenting absent fathers, needing to find a prince, and portraying men as rescuers. Women should be beautiful, which is encouraged by using their beauty to be rescued, staying young to succeed, preserving their purity to find a prince, and conserving their beauty as their main purpose in life. Society uses fairy tales as magical stories to teach values to children but dismisses the power of these tales not only to construct childhood dreams but also to build the adult world of reality, where women are negatively stereotyped.

Works Cited

- Barzilai, Shuli. “Reading ‘Snow White’: The Mother’s Story.” *Chicago Journals* (1990): 515-534. JSTOR. Web. 11 Sept. 2012.
- Bettelheim, Bruno. *The Uses of Enchantment: The Meaning and Importance of Fairy Tales*. 1976. New York: Vintage, 2010. Print.
- Dworkin, Andrea. *Woman Hating*. New York: Dutton, 1974. Print.
- Grimm, Jacob and Wilhelm. “Snow Drop.” *The Classic Fairy Tales*. Ed. Iona and Peter Opie. New York: Oxford UP, 1974. 230-237. Print.
- Tatar, Maria, ed. and trans. *The Annotated Classic Fairytales*. New York: W. W. Norton & Company, 2002. Print.
- Zipes, Jack, ed. *Norton Anthology of Children’s Literature*. New York: Norton, 2005. Print.

The Manipulation of Masks: The Rhetoric and Deceit of Shakespeare's Character Iago

Laura DeLuca

Good and evil, black and white, heaven and hell, God and Lucifer; Western culture is infatuated with dichotomy and dualism. Pick up any piece of literature and you will find dualist themes in almost every one. Othello is a curious case; the play is a dramatization of racial prejudice and the frailty of man. Iago is, without question, the villain of Othello and a thoroughly amoral person, but there is a widely held view that Iago personifies pure evil. Some argue that he is a demi-devil or daemon who is too powerful to defeat (See Hyman, Coleridge). Iago's manipulation of all the characters in Othello and his lack of contrition for the destruction that he creates has been a prime target for scholars to theorize about his motives.

Iago is often portrayed as an inhuman, supernatural being, bent on destroying the purity of Othello's nature but he is not The Devil or a demi-devil that Coleridge or Knott make him out to be. Iago is certainly racist, manipulative, malicious, and, above all else, flawed, but this flawed nature demonstrates Iago's humanity. He is not all-powerful or all-knowing; without Othello's hamartia and a good dose of luck, Iago would not have succeeded in seducing Othello's mind and making Othello his pawn. Iago is effective in his manipulation of Othello, but it is clear through Iago's choice of words and deeds that his power is limited and his plan is contingent on Othello's nature as well as fate itself. In four different scenes, Iago's rhetoric and actions towards Othello suggest that Iago is malicious and manipulative, but a mortal man of limited capacity.

Iago's manipulative behavior and rhetoric are evident from the start with his actions towards Roderigo but it isn't until Iago's first soliloquy in the end of Act I that the reader gets a glimpse into his mind. In his soliloquy, Iago breaks the fourth wall and speaks directly to the audience. Even though the audience is used as a confidant for many of Shakespeare's characters, Iago is not one of them. His personality is centered on word choice, both what he says and what he leaves to the imagination. Iago speaks candidly about his hatred for Othello, shows his racist nature, and his fear of being cuckolded:

Iago: I hate the Moor,
And it is thought abroad that 'twixt my sheets

'Has done my office. I know not if 't be true,
But I, for mere suspicion in that kind,
Will do as if for surety. He holds me well.

The better shall my purpose work on him. (1.3.429-34)

Here Iago states that his hatred for Othello stems from rumors about Othello and Emilia (Iago's wife) having an affair. He swears vengeance upon Othello even though he has no proof. Iago's reason is suspect; he does not love his wife, but he wants people to believe he is an "every man," someone honest and kind, not out to kill over his hurt pride. Iago himself says, "I am not what I am." (1.1.71) This line tells the audience not to trust what he says. With this in mind, it is easy to believe that Iago's reason for vengeance is an afterthought of convenience.

Iago's rhetoric is difficult to analyze as contrary to his nickname, he is in no way "honest." It isn't unusual for a character to lie to another character, but it is uncommon for him to lie to his audience in a moment of candidness. Dr. Robert Heilman sheds light on Iago's mind, "Wit is Iago's instrument to compensate for what he does not have. He perversely hates and yet lusts after what he does not have (Desdemona as a person, and as a symbol of love), and he undertakes to disparage it, minimize it, debunk it and destroy it" (Heilman 341-342). Thus Iago enjoys using his wit to dupe people, especially when they are unaware. He walks a tight line between lies and truth and withholds information from everyone including the audience. Iago's nature and proclivity for ambiguous sentences make understanding his true intent strenuous, and that abstruseness is what Shakespeare intended. Iago's character is intentionally difficult to understand, and it is because of this difficulty that the audience is not meant to understand Iago's character, which makes him all the more sinister.

It is apparent by the end of Act I that Iago hates Othello. What makes his restatement of his hatred in his soliloquy interesting is his approach to the topic. In other lines, he tries to convince Roderigo that he has been wronged as much as Roderigo, but when he speaks to the audience, he does show the restraint that others in the play have not, and while he does not tell the audience everything, he does paint a clear picture of his emotions towards Othello:

Iago: The Moor is of a free and open nature
That thinks men honest that but seem to be so,
And will as tenderly be led by th' nose
As asses are.

I have 't. It is engendered. Hell and night

Must bring this monstrous birth to the world's light. (1.3.442-47)

Iago uses the imagery of pack animals to disintegrate noble Othello's pure nature. Iago knows nothing of this kind of unadulterated trust, and seeks to destroy what he does not know and can never have. Iago's terminology for the rest of the rising action of the play is animalistic in nature, and when Othello has been captured by Iago's thrall, the terminology is transferred into Othello's speech patterns. The last sentence of Iago's soliloquy is particularly telling of Iago's need to disguise himself into a powerful being that could bring about terrible and wicked happenings. Iago will grow his persona, until he is confident enough in the disguise to convince Othello that he is a real demon sent from hell.

The theory that Iago is a devil is not new. The first scholar who proposed Iago as a demonic figure was Samuel Taylor Coleridge (Coleridge's *Criticism of Shakespeare*). He reasoned that Iago showed no motive, and it is because of that lack of motive that Iago is seen as a devil:

The last speech [of Act I], Iago's soliloquy, shows the motive-hunting of motiveless malignity - how awful! In itself fiendish; while yet he was allowed to bear the divine image, it is too fiendish for his own steady view. He is a being next to devil, only not quite devil - and this Shakespeare has attempted - executed - without disgust, without scandal! (Coleridge qtd. in Potter 49)

To state that Iago is like a devil for not showing appropriate motive for his actions is rash. Acting without sufficient motive could be psychopathic or sociopathic; both are psychological conditions that are rooted in a lack of empathy and an overactive Ego (Freud). It would be easy to say that Coleridge simply didn't see the possibility that Iago was mentally ill, but as psychology was in its formative years when Coleridge created his theory, he did not have the Freudian terminology to aid him.

Turning from science to chance, a major factor in Iago's success is luck. Without certain events taking place at the right time and without notice, Iago wouldn't prove to be successful. Bradley extolls Iago's intellect; he says "The skill of Iago was extraordinary, but so was his good fortune. Again and again a chance word from Desdemona, a chance meeting of Othello and Cassio, a question which starts to our lips and which anyone but Othello would have asked, would have destroyed Iago's plot and ended his life" (154-155). Iago is at the whim of good fortune for his plot to succeed; it is inconceivable for a demon or demi-devil to be made the pawn of chance.

The most salient event of good fortune occurs when Desdemona loses her handkerchief, and Emilia gives it to Iago without question. Iago would have taken considerably more time to convince Othello of Desdemona's infidelity without the "proof" of the handkerchief.

Iago: I will in Cassio's lodging lose this napkin
And let him find it. Trifles light as air
Are to the jealous confirmations strong
As proofs of holy writ. This may do something.(3.3.325-28)

Once the token is in Iago's possession, he assures the audience that his plan will work. He sees that bit of cotton and thread can cause pain in the wrong hands. Iago admits that the hand-kerchief is a small thing; something that at first would go unnoticed, but much like himself, the handkerchief is seemingly innocuous but will have great sway over Othello.

Iago changes his focus from the handkerchief to the effect it will have on Othello. His language is focused on the "poison" that is being dripped into Othello's mind and shows his favor for sadism. Iago wants Othello to suffer; that is clear, but there are no references to destroying Othello's soul. A demon or demi-devil would want to take the soul of a person along with making them suffer.

IAGO: Look where he [Othello] comes. Not poppy nor mandragora
Nor all the drowsy syrups of the world
Shall ever medicine thee to that sweet sleep
Which thus owedst yesterday. (3.3.379-82)

Iago's intentional use of physician and plant imagery conjures up notions of power. It is obvious that Iago knows that he is tormenting Othello and has no remorse. Iago is flirting with disaster; he is speaking his mind in his aside while his target walks to him. He shows his arrogance by risking discovery; he has internalized the idea that he is invincible and he is just as susceptible to his own rhetoric. This shows that he is capable of mistakes, and as supernatural beings are omnipotent, his belief in own strength illustrates his lack of supremacy.

Iago's aside is also important because of how Iago addresses Othello in his "inner" monologue. Nicholas Porter observes, "Here Iago makes full use of the privilege of his aside address, to describe Othello coming to him, and then to address him for the only time in the play with the contemptuous and/or intimate form of the second person pronoun" (Porter 83). Iago's use of the intimate pronoun in conjunction with

sadistic phrasing creates a chilling effect for the audience. There is no mistaking that Iago will do everything in his power to destroy Othello, and the fact that Iago has little motive to do so is a horrifying thought to the audience, which is why it is understandable that scholars consider Iago akin to the devil, for the idea that a normal man is capable of such sadism is repugnant to the ideals of man's virtue.

Scene I of Act IV is commonly referred to as "the Temptation Scene." Here, Iago's plot comes to fruition and Othello succumbs to jealousy and vows to kill Desdemona for her betrayal. Here Iago uses the imagery of a physician with repetition of the word "medicine." He reminds the audience that his method is poison with the use of the medicine at the very moment when Othello is at his most vulnerable.

Iago: Work on,
My medicine, (work!) Thus credulous fools are caught,
and many worth and chaste dames even thus,
All guiltless, meet reproach.-What ho! My lord!
My lord, I say. Othello! (4.1.53-58)

In The Temptation Scene, the audience sees Iago at his most sadistic, and at the height of his influence over Othello. At this moment, he seems invincible. He made Othello bend to his will, and Othello is consumed with rage and anguish. Ironically, here also is when Iago is at his low point in power. After this scene, it is a matter of keeping the metaphorical plates spinning for his plot to succeed that; Iago will have to rely on chance to make sure that none of his victims discovers his conspiracy.

Iago is one of Shakespeare's most loquacious characters, but in The Temptation Scene, Iago speaks as little as possible. He does this to entice Othello to make up his own reality about Desdemona's deeds. In her dissertation, Lucinda Birtciel Windsor conveys an excellent point:

Through scenes three and four Iago is conspicuous by his relative silence. He can afford to be silent, though, because he has thoroughly infected the other characters with his poison and can now sit back to wait for the climax of his self-manipulated play. (Windsor 62)

All of Iago's ploys are in play and he can wait for his pawns to play out their parts. Iago is brilliant in this action; even though he is skilled in finding his victims' weaknesses, he knows that their own mind will supply a far more crippling image than any other person would create.

At the end of the Temptation Scene Othello's speech takes on an animalistic

tone signaling his fall into jealousy. After minimal speech in the scene, Iago directly engages Othello to dissuade him from poisoning Desdemona. Iago purposes a more poetic method of retribution, which appeals to Othello's new found mania.

Othello: Get me some poison, Iago, this night. I'll not
expostulate with her lest her body and beauty
unprovide my mind again. This night, Iago.

Iago: Do it not with poison. Strangle her in her bed,
even the bed she hath contaminated.

Othello: Good, good. The justice of it pleases. Very good. (4.1.223-29)

Iago's suggestion of a more intimate killing method is a revealing moment for his character, as his need for his twisted idea of justice is apparent. He is taking a risk by advising Othello to make bodily contact to kill Desdemona, but at this point in the arch, Iago feels invincible and can't pass up the opportunity to twist the knife in Othello's back. It is also interesting to note that Iago steers Othello away from poison. Poison is Iago's method (though it is mental not physical), and any similarity between Othello and Iago would be horrific to Iago's sense of self. The theme of duality is seen again here; the opposition of the use of poison versus using brute force symbolizes the duality between the intellect and physical method of perceiving the world.

The Temptation Scene leaves the audience with a new understanding of Iago's ruthlessness. In James Harry Ernest Brock's comparative book *Iago and Some Shakespearean Villains* he succinctly states, "This baiting of the Moor [in the Temptation Scene], drawn by a master hand, portrays a scene of the most unexampled cruelty, done by Iago to minister to his perverted pleasure" (Brock 25). The effect that the Temptation Scene has on Othello is clear; he has succumbed to anguish, and become a pathetic shell of the noble man he was. The effect on Iago much subtler; he is secured in the role of vindictive villain, and the audience has lost interest in seeing his humanity. It is easy to understand why Iago is seen as a demon when he commits heinous acts of cruelty on good men.

The last scene of *Othello* finally reveals Iago's plot and indicts him for his crimes against Othello, Desdemona, Emilia, Roderigo, and Cassio. Othello is not in the "fall" he was in The Temptation Scene, but is not the level headed man he once was; he still feels Iago's sway over him, and mistakes that manipulation for supernatural power.

Othello: I look down towards his feet; but that's a fable-
If that thou be'st a devil, I cannot kill thee.

[Wounds Iago]

Lodovico: Wrench his sword from him.

Iago: I bleed, sir, but not killed. (5.2.336-39)

It is this moment that scholars cite as proof that Iago is not human. It is easy to come to this conclusion after the countless acts of violence and cruelty that Iago commits over the course of the play, but *Othello* is a play that highlights misconception and deceit; nothing is what it seems. Trusting Othello's judgment of his tormentor at this moment is unwise. Othello sees Iago as a devil, because Othello has been through a personal hell; that does make Iago a supernatural being; it makes him a sadistic, vengeful man. It does show the effect Iago's manipulation has had on Othello's psyche; Othello has been driven to such madness that he can no longer differentiate reality from fiction.

The context in which this is happening needs to be considered. The other characters have been affected by Iago in some way and react to him accordingly. Windsor comments, "Although the other characters realize their part in the tragedy, they continue to blame Iago for everything, calling him 'viper,' 'devil,' 'slave,' and 'demi-devil.' They try to justify their susceptibility to Iago's evil plots by implying that he is a servant of the devil --a superhuman being" (Windsor 68). Iago duped everyone with skill unparalleled, and he made them believe he was an honest, loyal, man. It is logical that when confronted with the truth about Iago's nature, the other characters react with extreme negativity to outweigh their previous good opinions of this despicable man, they are saving face by calling him a devil.

The problem with calling Iago a supernatural being of any kind is that it disregards Iago's complexity and his disguised evolution over the course of the play. Fred West brilliantly defends Iago's complexity in his article "Iago the Psychopath" when he argues that, "It is not sufficient to simply drape Iago in allegorical trappings and proclaim him Mister Evil or a Machiavelli or a Vice. Such a limited view of Iago is an injustice to the complexity of his character, since Shakespeare's studies in personality are acclaimed by psychologists for their accuracy and profundity" (West 27). Shakespeare was a master of complexity, and to call Iago something as simple as a "devil" degrades Iago as a character and the lessons that can be learned from studying him. Iago shows us that a man can do evil acts without being a demon, that because they are human, they are capable of evil; understanding that cruelty is possible without a supernatural element makes us examine humanity and its flaws.

Othello is an obviously a tragedy, but though the audience witnesses these horrific events happening to Othello and Desdemona, Bradley brings up an eloquent point about Iago's tragedy: "So, that, in fact, the tragedy of Othello is in a sense his [Iago's] tragedy too. It shows us not a violent man, like Richard, who spends his life in murder, but a thoroughly bad, cold man, who is at last tempted to let loose the forces within him, and is at once destroyed" (Bradley 187). The tragedy of Othello is that it is ubiquitous; no character is unaffected by the events of the play. Iago is a merciless man, and when he reached for what he wanted, he was destroyed by his own hand. He is not free from reproach or punishment for his actions, but his personal tragedy needs to be acknowledged.

Iago is not a symbol for the devil or a demon; he is a cruel man without scruples. He is a sadistic man, who enjoys making those around him suffer, and the more he can inflict the better. He is a complex character that has to be examined carefully to be understood. Iago is a stand-in for the "evil men" of the world; he is a warning of what a mortal man is capable of, and what horrors he is willing to commit in the name of little or no motive. Iago is the unhinged man, who is just as prevalent in modern times as in Elizabethan. Iago's warning is as relevant to the twenty-first century as it was to Shakespeare's first audience. Shakespeare does not dabble in metaphysics or religiously symbolic characters; he is known for his mastery of the human experience. Shakespeare is, as with many things, ahead of his time. He conceived of a character who is mortal, sadistic, an expert criminal, with a psychopathic personality long before the definition and terminology had been established.

Works Cited

- Bradley A..C. *Shakespearean Tragedy: Lectures on Hamlet, Othello, King Lear, Macbeth*. [In-tro: John Russell Brown] 3rd Ed. New York: St Martin's Press. 1957. Print.
- Brock, J.H.E. *Iago and Some Shakespearean Villains*. Cambridge: W. Heffer and Sons, Ltd. 1937. Print.
- Coleridge, Samuel T, and R A. Foakes. *Coleridge's Criticism of Shakespeare*. Detroit: Wayne State University Press, 1989. Print.
- Draper, John W. "Honest Iago" *PMLA* , Vol. 46, No. 3 (Sep., 1931), 724-737. Web.
- Freud, Sigmund, and Joan Riviere. *A General Introduction to Psychoanalysis*. Garden City, N.Y: Garden City Pub. Co, 1943. Print.
- Hawkes, Terence. "Iago's Use of Reason." *Studies in Philology* Vol. 58, No. 2, Part 1

- (Apr., 1961), 160-169. Web.
- Heilman, Robert B. "Wit and Witchcraft: An Approach to Othello." *Shakespeare: Modern Essays in Criticism*. Ed. Leonard Dean. New York: Oxford University Press. 1967. 329-345. Print.
- Hyman, Stanley Edgar. *Iago: Some Approaches to the Illusion of His Motivation*. New York: Atheneum and McClelland and Stewart Ltd. 1970. Print.
- Mccullen, Jr., Joseph T. "Iago's Use of Proverbs for Persuasion." *Studies in English Literature, 1500-1900*, Vol. 4, No. 2, Elizabethan and Jacobean Drama (Spring, 1964), 247-262. Web.
- Moisan, Thomas. "Repetition and Interrogation in Othello: What Needs this Iterance? or Can Anything be Made of This?" *Othello New Perspectives* Eds. Virginia Mason Vaughan and Kent Cartwright Cranbury NJ, London: Associated University Presses. 48-73. 1991. Print. Potter, Nicholas. *Othello: Character Studies*. New York, London: Continuum Books. 2008. Print.
- Porter, Joseph A. "Complement Extern: Iago's Speech Acts." *Othello New Perspectives* Eds. Virginia Mason Vaughan and Kent Cartwright Cranbury NJ, London: Associated University Presses. 74-88. 1991. Print.
- Shakespeare, William. *Othello*. Eds. Barbara A. Mowat and Paul Werstine. Washington D.C.: The Folger Shakespeare Library. 1993 [Rpt. of 1602 ed.] Print.
- Stoll, Elmer Edgar "Source and Motive In Macbeth and Othello." *Shakespeare: Modern Essays in Criticism*. Ed. Leonard Dean. New York: Oxford University Press. 1967. 317-328. Print.
- West, Fred. "Iago the Psychopath." *South Atlantic Bulletin*, Vol. 43, No. 2 (May, 1978), 27-35. Web.
- Windsor, Lucinda Birtciel Iago: "A Study in the Application of Rhetoric to the Problem of Appearance and Reality." MA Thesis. Texas Tech University. 1963. Print.

The Quest to the Empty Chapel and the Restorative Role as Reader in "The Waste Land"

Sarde Gumalo

In the final stages of Eliot's "The Waste Land," we arrive at a destination unlike any other in the Perilous Chapel at the center of section V, "What the Thunder Said." Jessie L. Weston's *From Ritual to Romance* describes that in Arthurian legend, a foundational source in writing the poem, the Chapel was filled with terror unimaginable to man: "Sometimes there is a Dead Body laid on the altar; sometimes a Black Hand extinguishes the tapers; there are strange and threatening voices, and the general impression is that this is an adventure in which supernatural, and evil, forces are engaged" (North 38-39). In Eliot's poem, the procession to the Chapel is distorted further and is in fact more nightmarish than described in the Grail legends. We hear the dire lamentations of a woman in loss of her child; we see the faces of innocent babes attached to the bodies of bats; there are tumbled graves and upside down towers all orchestrated to the sound of haunted music. In this spectral vision, Eliot synthesizes themes of fertility, spirituality, love, sexuality, and the fall of civilization, to form an ecliptic climax to the poem. Within this Chapel in the mountains, we find ourselves at the peak of Eliot's erratic pilgrimage, but upon entering find "nothing again nothing." This leaves us to question the true symbolism of the Chapel Perilous and what we are meant to discover in its hollow recesses.

Weston explains that several versions of the Grail quest exist featuring different heroes, but the Perilous Chapel is always included as a test of courage at the end of the knight's journey (North 38). Throughout the conflicting rumbling of the work, the Grail Quest remains as a paradigm. Journeying through the poem, several themes are posed as challenges to the reader. "The Waste Land" calls for connections across its different sections to be made, in order to mend disparity, and hermeneutics to fill in the spaces. Accepting these challenges and creating these connections is the only way to find meaning in the Perilous Chapel. For one theme, the degeneration of fertility is expressed in the first few lines of the nightmare sequence:

A woman drew her long black hair out tight
And fiddled whisper music on those strings
And bats with baby faces in the violet light

Whistled, and beat their wings (5.6.377-380)

This horrifying sight is the culmination of Eliot's response to the disruption of natural life. A woman's hair is used as a symbol of love and fertility, and holds allegorical significance throughout the work. In "The Burial of the Dead," we meet the Hyacinth girl whose hair is wet to signify her youth and potency, in comparison to Philomela and the neurotic woman from "The Game of Chess," whose hair is "spread out in fiery points" to embody the forceful barrenness of their relationships (2.1.109). Journeying through "The Waste Land," the reader encounters a string of feminine figures who struggle with empty love and disingenuous sexuality. Shortly after Philomela and the neurotic woman, we are introduced to a woman at the bar struggling with marriage, children, her appearance, and the effect of birth control on her body: "It's them pills I took, to bring it off, she said/ The chemist said it would be all right, but I've never been the same" (2.6.159-161). Lastly, approaching the Perilous Chapel, the woman drawing her hair out tight is mourning the corruption of her child's natural form through the image of the distorted babies. This somber mother is an accumulation of the mistaken idea of love and fertility developed amongst these women.

The problem of fertility begins with the Fisher King of the Grail Quest, who renders the land barren as a result of his impotence (Wilson, "The Poetry of Drouth"). Sir James G. Frazer's *The Golden Bough* describes the ancient influence of the sexes on vegetation and how, "the marriage of trees and plants could not be fertile without the real union of the human sexes" (North 30). The Fisher King's desolate kingdom becomes the setting of V. "What the Thunder Said" in reiteration of the arid desert. However, the absence of fruitful, natural elements is depicted from the beginning where we find "dull roots,, "dried tubers," and "dead land." The second stanza of the poem prophesies the final section through the imagery of the red rock: "And the dry stone no sound of water. Only/ There is shadow under this red rock,/ (Come in under the shadow of this red rock)" (1.2.24-26). Here Eliot calls forward to the Fisher King's desert, but rather than observing the rock as a dry, useless obstruction, within this prior context it is conveyed as a place of refuge (Brooks 208). In the fifth section, the pilgrim tirelessly aches and searches for water, but in the midst of this thirst one should note the persistent presence of the rock:

If there were water

And no rock

If there were rock

And also water And water
A spring
A pool among the rock (5.3.345-351)

It is a common perspective to focus on the water and its hopeful, quenching qualities, but with a turning of the eye one can find hope in the image of the rock. This second perspective is achieved by seeking understanding in different places. Because of the cross-reference between the first and fifth sections of the poem, one can logically attribute connotations to the rock as foundation, firmness, strength, and even God.

There are hopeful images of Divinity obscured throughout the poem; however, the idea of sacrament and spirituality is also closely scrutinized, to emphasize the contradictory nature of the work. Returning to the nightmare sequence, Brooks explains that, "The visit to the Perilous Chapel, according to Miss Weston, was an initiation - that is, a baptism. In the nightmare vision, the bats wear baby faces" (Brooks 203). This fearsome twist is a distorted juxtaposition of holy sacrament and the natural, wholesome birth of human life - two themes of which Eliot collapses simultaneously in this vision.

However, the Chapel sequence is not the first time Baptism appears in the work. Morden writes, "In 'The Waste Land' love is diminished--by adultery, betrayal, abortion, impotence or rape...No wonder then that throughout 'The Waste Land' there is also an undercurrent of motifs which promise absolution and cleansing of the spirit through immersion in water." She speaks of baptismal references found in the Phlebas sequence of "Death by Water," as well as allusions to Shakespeare's *The Tempest* ("A Quest for Meaning"). In this vein, the possibility of Baptism is portrayed several times but is often shadowed by fear, doubt, and death.

Additionally, the death of Christ is emphasized prior to the visit to the Perilous Chapel; however, Eliot shows no evidence of resurrection: "He who was living is now dead/ We who were living are now dying/ With a little patience" (North 16). This decline of faith and spirituality is capped by the mysterious emptiness of the Chapel, where it is void of all religious remnants, statues, and cloths. Past the mourning mother, Eliot describes, "voices singing out of empty cisterns and exhausted wells." This phrase recalls Jeremiah 2:13, in which the people "have forsaken the fountain of living waters, and hewed them out cisterns, broken cisterns, that can hold no water" (Jones 287). This illustrates a turn away from God and the hopelessness that remains.

To whom do these voices calling out belong but to each of the speakers encountered throughout the pilgrimage, yearning for that which is missing.

However, the image of the empty cisterns and exhausted wells is not one-dimensional, but has profound meaning in connection with the final lines of the nightmare procession: "And upside down in air were towers/ Toiling reminiscent bells, that kept the hours/ And voices singing out of empty cisterns and exhausted wells" (5.5.382-384). Apart from its theological implication, the image connotes a yearning for a desire previously discussed and echoed throughout the work: authentic love. The defunct towers and empty cisterns evoke the degenerative nature of sexuality and its separation from love as exemplified in the scene of the typist and the carbuncular man in "The Fire Sermon." Contemplating the meaning of the Perilous Chapel, Dilworth explains that, "Indifferent sex is the real Chapel Perilous of the modern Waste Land, an act devoid of meaning and--if we, unlike the typist and her young man, want meaning--profoundly disappointing" (Eliot's "The Waste Land"). He arrives at this conclusion through Eliot's deliberate placement of the word "perilously" in the scene: "Out of the window perilously spread/ Her drying combinations touched by the sun's last rays" (3.5.224-225).

This thought is reinforced by the mention of bells placed between the failing towers and cisterns. Bells are a recurring motif throughout "The Waste Land" and unveil significant undertones revealing Eliot's purpose. In this case, the bells hearken back to the Elizabeth and Leicester passage of "The Fire Sermon" where the "peal of bells" resound the idea of the Queen marrying Lord Robert Dudley (North 58). In the context of the nightmare sequence, the bells refer back to an instance of earnest love and another institution – marriage – that has been fractured by modern society. The "reminiscent" quality of the sound invokes feelings of nostalgia, but in a more powerful way it reminds the reader of something they have encountered before. Where have we previously heard the sound of bells?

The ringing belongs to the bells of Saint Mary Woolnoth first mentioned in section I, "The Burial of the Dead," in which the setting is not "The Waste Land" of the Fisher King, but rather the Unreal City engulfed in the brown fog of a winter dawn. This City reoccurs in several places throughout the poem and faces a disorderly ruin in the approach to the Perilous Chapel. However, in the first section, London is acknowledged as the Unreal City focusing on the financial center of King William Street. The dead sound of the bells described in this sequence emphasizes the empti-

ness of a civilization revolving around wealth and preoccupied with industrialization. Subsequently, in section II, “The Fire Sermon,” the Unreal City returns underneath the brown fog of a winter noon. Here the stage is immediately set between the typist and her visitor during the violet hour. In an analysis of the use of city in “The Waste Land”, Marianne Thormahlen describes, “In Eliot’s poetry, the metropolis is a huge, decaying receptacle which holds millions of people unable to reach across to one another” (North 237). The paradoxical isolation between people in the Modern City parallels the same problem of the desert in section V, “What the Thunder Said.” It is isolation that brings sterility of life, love, and of knowledge. By the time the Unreal City is described in the final section, it is now evening where the nightmare sequence occurs underneath the same violet light symbolizing the twilight of civilization. This context introduces another dimension to which the upside down towers refer: the collapsing of Western Civilization.

What is the city over the mountains
Cracks and reforms and bursts in the violet air
Falling towers
Jerusalem Athens Alexandria
Vienna London
Unreal (5.5.371-376)

In the Post-War period, Modernists such as Eliot experienced a disillusionment of Western society. The turmoil of World War I permeated art, literature, and philosophy. Eliot’s contemporary Herman Hesse wrote, “Mankind is now on the point of realizing this. Already half Europe, at all events half Eastern Europe, is on the road to Chaos. In a state of drunken illusion she is reeling into the abyss and, as she reels, she sings a drunken hymn such as Dmitri Karamazoff sang. The insulted citizen laughs that song to scorn, the saint and seer hear it with tears” (North 62).

In a similar way, Wilson finds, “And sometimes we feel that he is speaking not only for a personal distress, but for the starvation of a whole civilization—for people grinding at barren office-routine in the cells of gigantic cities, drying up their souls in eternal toil whose products never bring them profit, where their pleasures are so vulgar and so feeble that they are almost sadder than their pains. It is our whole world of strained nerves and shattered institutions...” (Wilson, “The Poetry of Drouth”).

In examining the symbolism of the Perilous Chapel, it is clear to see that similar to every line written in the poem, there is no single motif the Chapel is meant

to convey. Eliot has crafted his work to be a constant conversation within the lines through the use of these different allusions and the contexts that alter their meaning. In this case, the nadir of society in the approach to the Perilous Chapel can be found as a combination of the degeneration of land, an absence of love and acceptance of empty sensuality, the loss of faith and spirituality, and the downfall of civilizations centered on wealth and power. These are the true nightmares that Eliot warns the reader of, but the emptiness of the Chapel after moving past these fearful elements is what the author asks the reader to focus on.

The Empty Chapel reflects the hollow nature of being slave to the lures of the nightmare sequence; however, it also resembles an ultimate lack of understanding in the human experience. Proceeding on this pilgrimage through “The Waste Land” is a difficult, arduous endeavor, in which confusion and fragmentation are deliberate choices underneath the authority of the writer. Similar to Hieronimo in Thomas Kyd’s *The Spanish Tragedie*, the confusion is part of Eliot’s plot. On one hand, it is a commentary on another inadequate feature of modern society: the downfall of proper education, more specifically classical education or a simple familiarity with the texts primary to both Eastern and Western civilization. But beyond mere knowledge and openly challenging readers to dig through these classic texts, Eliot is describing the futility of being unable to understand life itself in tackling matters like the existence of God, the authenticity of love, the purpose of life, etc. Davidson explains it well in saying, “The human world is created in the desire to escape the absence defining our existence. The symbols, myths, art, and all of society attempt, in the endless elaboration of a relational linguistic world, to cover the absence” (“A Ceaseless Hermeneutic”). Lacan explains it as our “lack of wholeness or sufficiency even while we try to hide this lack” (Davidson). This “lack” is the true representation of the emptiness in the Perilous Chapel, and the nightmarish themes that Eliot explores throughout the land are what humans partake and undergo in order to fill this space.

Though it seems that this notion has come to complicate the work of “The Waste Land” even further, illumination can be found in looking back to the Grail legends. As described in Weston’s book, typically the Knight in the myth generally does not know the object of the quest or how to reach the goal, and is usually unaware of what he has done to bring fertility to the land (Davidson). Much like the first few readings of “The Waste Land”, it is relatively unclear what the goal is or if there are any central messages to take back in the midst of the confusion. Just as on a grander

scale, in moving through life, we are often like the Knight unsure of the end result or of our purpose. In the same way that the Knight must simply ask questions in order to relieve the barrenness of the land, it is our duty as humans to continually ask questions even when answers are unnecessary or are unable to be found. Conversely, it is this absence itself that comes to restore the land: "The confusing and inexplicable journey of the quester is the activity of being in the world –the body becomes the land. In the quest, the desire for presence is never fulfilled, but the land is restored nevertheless. The restorative magic remains an absence..." (Davidson). This is why the Chapel remained empty in the end, because it reveals the duality of our existence. The inherent emptiness that drives our thirst through the desert is also the source of yearning for all of the voices heard throughout time in "The Waste Land". And yet, it is emptiness that in turn gives us freedom to discover and take courage even when it seems that there is no sense of direction and all is lost. Any finite answer would set limits to our existence. Furthermore, the finale of the poem poses the question, "Shall I at least set my lands in order?" as the Fisher King sits along the shore watching the fragments and civilizations fall apart. In the same way that the external world around us goes astray and it seems that it is nothing but a "heap of broken images," Eliot is challenging us as readers to care for the world within and never stop progressing in the midst of chaos. Traversi writes, "To this end the speaker has "shored" certain fragments of tradition against his "ruin": fragments which have been present through the poem in the form of "broken," disconnected images and which he may now aspire to relate positively to his developed experience" ("The Waste Land: An Overview"). Also important to finding worth in the destruction is that in the Grail Legends, the Chapel Perilous is directly near the Grail Castle, where the right questions simply need to be asked in order to heal the Fisher King and restore the land: "So it may also be true that sex, even when meaningless as in this poem, is nevertheless somehow proximate to the kinds of love and meaning it traditionally symbolizes--near but requiring change of place, symbolizing personal metamorphosis" (Dilworth). In society's constant missteps and struggles to fill the innate void of humankind, we always find ourselves approximate to the right idea. It affords continual effort and questioning in order to finally find ourselves at a state of just fulfillment.

This culminates in the firm instructions of the Thunder to "Give, Sympathize, and Control." What needs to be given is, "the awful daring of a moment's surrender': acceptance of the risk involved in the commitment by which alone our lives

may become more than empty memories preserved in blank obituaries" (Traversi). We are called to continually give and put effort into every thought that needs to be wrestled with and to give oneself in all that is seen and heard. We are ordered to "sympathize," to mend the isolation expressed throughout "The Waste Land" and bring authentic life again between human beings. Finally to "control" is far more than controlling our human desires and urges but taking deliberate control of one's own thoughts and fate. Like the image of the Phoenician sailor, we are challenged to take control of the wheel and keep our eyes windward. Underneath the instructions of the Thunder, we discover what has been missing throughout the poem all along and what the true "emptiness" and "lack" of the pilgrimage is: a hero.

The reader is called to be a hero in the absence of a sole protagonist in the text. In the different voices and speakers that guide the reader throughout the pilgrimage, we find that none are "potential heroes or saviors for they have been overrun by corruption, moral decay, or their own mortality" (Hume, "Sound of Water Over a Rock"). Hume describes that the hero of this work is a reader who actively engages with the poem, though he or she is not physically a character on its printed pages. When addressed, "Who is the third who walks always beside you?" the figure can be interpreted as God or some other form of divine guide. But in the role of a reader, the hero also "appears to be invisible, or just not there, but is in fact present at all times" (Hume, "Sound of Water Over a Rock"). The interaction of reader to poem and the endless contexts embedded within the work create an infinite conversation and a boundless quest. It is the role of the reader to imagine and fill in the voids of the poem. In the case of the Fisher King's desert, though it is constantly repeated that there is no water among the rock, the water is actually brought into the land by the thoughts of the reader. It is heard in the water-dripping song of the hermit-thrush and thus brought into the desert (Hume, "Sound of Water Over a Rock"). It is hoped that with the reader in the role of the hero, "The Waste Land" will be imagined in a better state than when it was first encountered and that the hero will experience his or her own transformation: "It enables those who are not really engaged in learning, committed to seeking understanding, or those that feign knowledge to become spurious climbers, unworthy of the power entrusted to them" (Hume, "Sound of Water"). In approaching the discord of "The Waste Land" and –more importantly– the contemporary issues that the poem confronts, one may feel unworthy, incapable, and ineffective in the expanse of matters to be dealt with. Moreover, some may find that the poem does not relate at all and the call for active readers remains unanswered. In reality, the

process requires questions to be made fruitful and emptiness in order to be filled. The broken pilgrimage to the Perilous Chapel is rigorous, grueling, and awfully realistic; but the emptiness found within the Chapel does not deem a fruitless conquest, but a constant quest waiting to be fulfilled by the most noble of eyes.

Works Cited

- Brooks, Cleanth, Jr. "The Waste Land: An Analysis." Rev. of Poem. *Southern Review* 3 Summer 1937: 106-36. Print.
- Davidson, Harriet. "The Wasteland: A Ceaseless Hermeneutic." T. S. Eliot and *Hermeneutics: Absence and Interpretation in "The Waste Land."* Baton Rouge: Louisiana State University Press, 1985. 97-134. Rpt. in *Twentieth-Century Literary Criticism*. Ed. Lawrence J. Trudeau. Vol. 236. Detroit: Gale, 2010. Literature Resource Center. Web. 1 Dec. 2013.
- Dilworth, Thomas. "Eliot's The Waste Land." *The Explicator* 61.1 (2002): 43+. Literature Resource Center. Web. 11 Dec. 2013.
- Eliot, T. S., and Michael North. *The Waste Land: Authoritative Text, Contexts, Criticism*. New York: W.W. Norton, 2001. Print.
- "Hair." *Dictionary of Symbolism*. University of Michigan, 2001. Web. 14 Mar 2014.
- Hume, Amy. "Listening for the 'sound of Water over a rock': heroism and the role of the reader in The Waste Land." *Yeats Eliot Review* 23.3-4 (2006): 2+. Literature Resource Center. Web. 1 Dec. 2013.
- "Hypertext. Exploring the Waste Land." N.p., n.d. Web. 18 Dec. 2013.
- Leavis, F. R. "T. S. Eliot." *New Bearings in English Poetry: A Study of the Contemporary Situation* (1932). AMS Press, Inc., 1978. 75-132. Rpt. In *Contemporary Literary Criticism* Select. Detroit: Gale, 2008. Literature Resource Center. Web. 16 Dec. 2013.
- Morden, Barbara. "The Waste Land: a Quest for Meaning." *The English Review* 21.2 (2010): 35+. Literature Resource Center. Web. 2 Dec. 2013.
- Traversi, Derek A. "The Waste Land: Overview." *Reference Guide to American Literature*. Ed. Jim Kamp. 3rd ed. Detroit: St. James Press, 1994. Literature Resource Center. Web. 1 Dec. 2013.
- Wilson, Edmund, Jr. "The Poetry of Drouth." *Critical Essays on T. S. Eliot's The Waste Land*. Ed. Lois A. Cuddy and David H. Hirsch. Boston: G. K. Hall & Co., 1991. 27-31. Rpt. in *Twentieth-Century Literary Criticism*. Ed. Lawrence J. Trudeau. Vol. 236. Detroit: Gale, 2010. Literature Resource Center. Web. 10 Dec. 2013.

Is Stress a Trigger for Schizophrenia?

Jan Siess

Schizophrenia is usually referred to as the equivalent medical diagnosis of cancer. This disorder makes it hard for people to interact normally in social environments, react normally to certain situations, and tell the difference between what is real and what is not. An accurate diagnosis of schizophrenia is difficult to make, and the cause remains mostly unknown. The suffering experienced by the patients affects those patients' families as well. The signs and symptoms of schizophrenia are diverse, encompassing almost every aspect of cognition and behavior: perception, inferential thinking, speech and language, motor behavior, attention, volition, emotion, and executive functions, according to Andreasen and Carpenter (1993). Curiously, not all patients manifest the same signs and symptoms in all of the above areas, and symptoms may include not only apathy, emotional remoteness, and mental impoverishment, but also florid delusions, hallucinations, and disordered thought.

The history of research into Schizophrenia begins with a comprehensive definition formulated by the German psychiatrist Emil Kraepelin. Kraepelin identified a syndrome that begins early in life, or "praecox," which provides persistent impairment of behavioral and cognitive function, or "dementia," which Kraepelin termed "praecox dementia." Kraepelin's work was complemented by the work of a Swiss psychiatrist, Eugen Bleuler, who studied the disorder from a different perspective. Bleuler focused on the defining symptoms that were present in almost all of the patients and renamed the disorder "schizophrenia," in order to emphasize the typical occurrence of separating associations. Bleuler's observations maintain a historic place within psychiatry and psychology and remain true. There are many reasons, some based on speculation and others experimentally proven, that contribute to the formation of this debilitating disorder. It has been frequently hypothesized that environmental stresses such as life events (Bebbington, 1996), childhood trauma (Bebbington, 2004; Janssen, 2004; Varese, 2012), or bullying (Lataster, 2006), play a role in the development of a psychotic disorder. The following research studies seek to support and demonstrate the accuracy of these findings.

In 2013, Tineke Lataster's primary aim was to investigate whether the positive and negative symptoms associated with psychotic disorders show a correlation between everyday stressful events and stress reactivity. Essentially, based on the

type of stress encountered in everyday life, and how a person would react to them, what would be the symptoms expressed in patients with psychotic disorders? It has been hypothesized that high levels of positive symptoms would be specifically associated with this reactivity to stress in daily life. However, what constitutes positive and negative symptoms of psychosis, or schizophrenia for that matter? Positive symptoms are typically comprised of delusions and hallucinations. Negative symptoms are comprised of problems with emotional expression and experience. Positive symptoms typically fluctuate over time periods of hours and even minutes, whereas negative symptoms are thought to be fairly stable over time (Lataster, et al., 2013). The sample consisted of 77 patients with a diagnosis of non-affective psychotic disorder. To assess current psychiatric conditions, the Positive and Negative Syndrome Scale was used (PANSS; Kay, 1987). The ESM was another method used to measure the emotional reaction to stress and the flow of daily life, which is called "stress reactivity." To simplify, all subjects were assessed with PANNS (Kay, 1987) at the end of the ESM week, an assessment period of the last two previous weeks that overlapped with another ESM week, and so on. It was found that higher levels of positive symptoms and lower levels of negative symptoms significantly moderate the association between unpleasant events and negative effects. Also, the effect of lifetime and current symptoms on the stress negative affect association was significantly larger for those patients with predominantly positive symptoms. In addition, it was also found that patients with high levels of negative symptoms have a lower risk for posttraumatic stress disorder (Strauss, et al., 2011). The results of this study have shown that the positive symptoms of psychosis in relation to stressful events and negative affect in the patient's everyday life were directly related. All of these results prove that stress reactivity is a core risk factor leading to a psychotic syndrome with high levels of positive symptoms.

The previous study was focused primarily upon empirical evidence, meaning that many of the results were concerned with verifiable observations or experience based solely upon observations. However, in an article published in 2008, Ruud Van Winkel takes the same approach towards proving that certain stresses, such as psychosocial stress, may indeed increase the risk for psychosis. While these may seem the same, he explains a more scientific approach, specifically within neurobiological mechanisms, in an attempt to prove evidence for gene-stress interaction. In his article Van Winkel (2008) presents evidence, similar to that in Lataster's article, suggesting that psychosocial stress may increase the risk for psychosis, especially in accounts of cumulative exposure.

A factor considered in an attempt to understand stress reactivity pathways is “sensitization,” which might represent an underlying mechanism (Collip, 2008). Sensitization refers to the process whereby repeated exposure to a certain event increases the behavioral and biological response to later exposure to a similar event, even if the later exposure is not as severe. Essentially, the more you are exposed to something, the more you will be able to respond to the same type of stimulus. There are two things currently being explored within this hypothesis: (1) the hypothalamus-pituitary-adrenal axis, because it brings about the primary adaptive response to the perceived psychological or physiological stress, and (2) the dopamine system, which is considered to be important in the development of psychosis (Myin-Germeys, 2003).

Work done by Walker and Diforio in 1997 proposes a “neural diathesis-stress model,” suggesting that the HPA axis may trigger a cascade of events resulting in neural circuit dysfunction, including alterations in dopamine signaling. This model is based on evidence regarding effects induced by HPA axis hormones, especially cortisol, on brain and behavior. The authors of the above studies conclude that several lines of evidence suggest a link between HPA activity and psychosis (Walker, Diforio, 1997; Walker, 2008). Interestingly enough, the evidence that proves this is related to four main points: (1) Illnesses such as Cushing’s syndrome that contributes to increased cortisol levels, which are subsequently treated by corticosteroids, have been observed to induce psychotic symptoms. (2) Patients with schizophrenia and other psychotic disorders exhibit HPA dysregulation, evidenced by increased baseline cortisol and adrenocorticotrophic hormone levels (Ryan, 2004; Walsh, 2005; Muck-Seler, 2004), increased cortisol response to pharmacological challenge (Walker, Diforio, 1997; Elman, 1998), and possibly also abnormalities in glucocorticoid receptors (Perlman, et al., 2004; Xing, et al., 2004; Webster, et al., 2002). (3) There may be a relationship between activation of the HPA axis and activation of dopaminergic circuits that have been depicted in psychosis. While the exact mechanism is still being researched, there is evidence that suggests that glucocorticoid secretion increased dopamine activity in certain brain regions (Czyrak, 2003; Dallman, 2004; Moghaddam, 2002), particularly within the mesolimbic system (Marinelli, 2006). (4) Factors that have been observed in the causation of schizophrenia, especially those present prenatally, can also contribute to HPA dysregulation. Factors that contribute to this include prenatal exposure to maternal stress or glucocorticoid administration (Kofman, 2002), drugs of abuse, and various forms of pre- and perinatal complications (Boog, 2004).

Accumulating evidence suggests that psychosocial stress may be associated

with an increased risk for developing psychosis. The evidence suggests that the association is particularly evident in cases of cumulative exposure, an idea that is compatible with the concept of “behavioral sensitization.” Behavioral sensitization may involve dysregulation of the HPA axis as well. While gene-environment interaction may be an important variable in explaining between subject differences in the risk of developing psychosis following exposure to psychosocial stress, the evidence seems to be scarce, and the results have proven to be inconsistent.

Continuing the research done by Ruud Van Winkel (2008), especially with regards to the HPA axis, the study by Collip, Nicolson, Lardinois, Lataster, van Os, and Myin-Germeys (2001) investigated whether HPA axis functioning is altered in individuals at above average genetic risk for a psychotic disorder, and was accomplished by examining diurnal cortisol profiles, cortisol reactivity to daily stressors, and the association between HPA axis activity and previous psychotic experiences. Results of experimental studies suggest that increased psychotic reactivity to stress may reflect increased dopamine reactivity (Myin-Germeys, 2005b; Soliman, 2008). In addition, several lines of evidence indicate that dysregulation of the hypothalamic-pituitary-adrenocortical (HPA) axis may play a role in the relationship between stress and psychotic experiences (Van Winkel, 2008; Walker, 2008). One of the major obstacles to research in this area is that patients with a psychotic disorder usually receive antipsychotic medication, which can affect cortisol levels and brain structures (Meltzer, et al., 1989; Wik, 1995; Pariante, 2008). Studies have been conducted in persons who are probably experiencing psychosis but have not developed a psychotic disorder. Schizotypal adolescents, for example, were found to have higher cortisol levels than controls (Mittal, 2007) and heightened cortisol secretion in another sample of schizotypal adolescents was associated with schizotypal symptomatology at two-year follow-up (Walker, 2001). The potential predictive value of HPA axis abnormalities is further supported by findings in a sample of young people at ultrahigh risk of psychotic disorder. Months before onset, those who later develop a psychotic disorder had larger pituitary volumes than those who did not develop a disorder (Garner, 2005).

Healthy siblings of individuals with a psychotic disorder are another important research population: they not only share genetic vulnerability for psychosis with their affected siblings, but also have many similar sociodemographic, parental, and developmental characteristics. Studies have reported structural HPA axis abnormalities, such as increased pituitary (Mondelli, 2008) and hypothalamic volumes (Goldstein, et al., 2007) in the relatives of patients with schizophrenia. In order to

assess cortisol in a sample of siblings of patients with a psychotic disorder and matched controls, the Experience Sampling Method (ESM) was employed. The sample consisted of 71 healthy siblings (68 full siblings and 3 half-siblings) of patients diagnosed with a nonaffective psychotic disorder and 66 control subjects. Subjects received the digital wristwatch that signaled a beep randomly throughout the day. After each “beep,” subjects completed ESM self-assessment forms. After these ESM beeps, subjects collected a saliva sample with a cotton swab, replaced the swab in the salivette tube, and recorded the exact collection time. Altogether, the final sample included 123 participants (60 siblings and 63 controls). With the exception of moderate differences in ESM compliance and age, the two groups did not differ significantly from each other on any of the display variables. Siblings had significantly higher cortisol levels over the ESM sampling moments than controls. The current findings indicated that siblings of individuals with psychotic disorders had higher mean cortisol levels throughout the day and greater cortisol reactivity to daily stressors than the comparison group with no family history of psychosis. In the sibling, but not the control, group the rated intensities of momentary psychotic experiences and negative emotions were associated with transient increases in cortisol secretion. Those findings suggest that alterations in HPA axis activity previously reported in patients with an established psychotic disorder, unmedicated first episode patients, and ultra-high risk samples may also be present to some degree in healthy first-degree relatives. The higher diurnal cortisol observed in the sibling group is consistent with reports of elevated HPA activity in patients with schizophrenia (Muck-Seler, 2004), first episode psychosis (Ryan, 2004; Mondelli, 2010) and individuals at high risk for a psychotic disorder (Mittal, 2007; Walker, 2010). Together, those findings may support the notion that altered activity of the HPA axis may be a marker of underlying vulnerability for the psychotic disorder. However, in contrast with the previous studies, the siblings do not differ from controls and their emotional reactivity to daily life stress. Another important finding is that momentary increases in psychotic symptomology were accompanied by increases in cortisol. While the current results suggest that increased HPA axis activity may indeed reflect the underlying vulnerability to psychosis, the biological processes involved, however, remain to be uncovered.

Along with HPA axis hyperactivity, this next article by Habets in 2012 explored whether pituitary volume and genetic risk may play a role for psychotic disorder as a result of stress. The hypothesis was that patients and, to a lesser degree, siblings would exhibit an increase in emotional stress reactivity compared to controls,

which in turn would yield a higher pituitary volume. Different volumes of the pituitary gland have been paired with increased vulnerability for the psychotic disorder (Garner, et al., 2005). Patients who have experienced the first episode of psychosis exhibit an increase in pituitary volume, as compared to that of controls (Pariente, 2005; Takahashi, 2009), as well as individuals with early prodromal signs (referring to early symptoms, or set of symptoms, that indicate the onset of a disease before actual symptoms are apparent) and subsequent transition to psychotic disorder, in comparison to those who did not make the transition (Garner, 2005). The pituitary gland is a crucial organ involved in the hypothalamus-pituitary-adrenal (HPA) axis in regards to stress response. It has even been shown that exposure to stress activates the HPA axis through the release of corticotropin releasing hormone (CTH) in the hypothalamus, which in turn leads to a secretion of adrenocorticotrophic hormone (ACTH), which then stimulates the release of cortisol in the adrenal cortex. Patients with a first episode of psychosis have been shown to have increased cortisol levels (Ryan, 2004) as well as the patient's siblings (Collip, 2011). Also, there is evidence that suggests that patients with a psychotic disorder are more sensitive to daily life stressors, resulting in an increase of stress related negative emotions (Myin-Germeys, 2001), as well as psychotic experiences (Myin-Germeys, 2005a).

It has also been found that a genetic risk for the psychotic disorder may be associated with increasing cortisol reactivity (Collip, 2011), although there is other evidence that could refute this. The sample consisted of 20 patients with a psychotic disorder, 37 siblings of patients with a psychotic disorder and 32 controls. The positive and negative syndrome scale (PANSS; Kay 1987) was used to measure psychotic symptoms over the past two weeks. Also, the ESM was employed. Subjects received the digital wristwatch that admitted a signal randomly throughout the day, at unpredictable moments. After each "beep," ESM self-assessment forms were to be filled out. In addition to the ESM measured, two different stress measures were computed: event stress and social stress (Myin-Germeys, 2001). After each ESM beep, siblings and controls collected a saliva sample with a cotton swab from a salivette tube, and were directed to place the swab back in the salivette tube along with a record of the time when this was done. Interestingly enough, there was no mean difference in pituitary volume among the groups that were being measured. However, patients with a psychotic disorder showed higher levels of emotional stress reactivity than siblings and controls. As a result, increased emotional stress reactivity was shown to be related to higher pituitary volume, but it was more pronounced in the patient group. Each unit increase in stress reactivity was associated

with an increase in pituitary volume of 0.2 S.D. in patients. Mean cortisol levels were higher in siblings than controls, and those findings were consistent with the previous study by Collip, Nicolson, Lardinoi, Lataster, van Os, and Myin-Germeys (2011). Cortisol fluctuations in response to daily life stress did not show a significant difference between siblings and controls, which in fact goes against the 2011 study by Collip above. While some evidence has been found that cortisol reactivity was not mediated by group status or pituitary volume, larger studies are needed before any clear conclusions can be drawn.

While the previous articles focused on external stressors and their subsequent effect on the HPA axis, Igor Elman (1998) studied the effects of metabolic stress on HPA axis activation in a brief experiment that will ultimately provide a different perspective on the entire topic. There are only a few experiments that have provided laboratory-induced stress to determine if there is a neurobiological relationship to stress response, and the results that were obtained are inconsistent (Albus, 1982; Breier, 1988). There is one method to induce acute stress, and it is through the administration of a pharmacological dose of 2-deoxy-D-glucose (2-DG). 2-DG is similar in structure to glucose, but possesses a slight difference from that of glucose. As such, its primary function blocks glycolysis by inhibition of glucose-6-phosphate dehydrogenase, which in turn prevents neuronal glucose utilization and results in a clinical state similar to hypoglycemia (Horton, et al., 1973). The advantage of activation of stress-related neurochemical and neuroendocrine systems, including the HPA axis (Breier, 1989), which may provide unique information about mechanisms of hormonal synthesis, release, and clearance. The sample consisted of 13 patients with schizophrenia and 11 healthy control subjects. Patients with schizophrenia and 11 healthy comparison subjects were administered the pharmacological dose of 2-DG (40 mg/kg). Subsequently, the subject's arterial plasma was then examined for levels of adrenocorticotrophic hormone (ACTH) and cortisol. Patients with schizophrenia and the control subjects demonstrated sharp increases in plasma ACTH levels. However, patients demonstrated significantly higher 2-DG-induced ACTH levels than control subjects. Also, an analysis of cortisol levels revealed that they were similar to patients in the control. All the patients exhibited significantly greater 2-DG-induced plasma ACTH levels. Cortisol levels had pretty much stayed the same in comparison to the control subjects. This research requires further investigation, due mostly to the fact that there were a small number of subjects in the study. In addition, the study examined only acute stress response. The results may have been different if a study of longer duration had been done.

Delving deeper into the topic of the involvement of stress as a trigger for schizophrenia, an article by Peerbooms, Rutten, Collip, Lardinois, Lataster, Thewissen, Mafé Rad, Drukker, Kenis, van Os, Myin-Germeys, and Van Winkel (2012), provides even more insight than the HPA axis. In this experiment, there was evidence that the effects of Catechol-O-Methyl Transferase (COMT) and Methyl-ene-tetrahydrofolate reductase (MTHFR) play a role in the psychotic response to environmental stressors. Both COMT and MTHFR are enzymes that are encoded by genes bearing the same name. Mutations in both of these genes, or even in one for that matter, bear catastrophic health defects. Specifically, the (COMT) VA1158Met polymorphism is the suspected culprit in the development of schizophrenia. Evidence suggests that COMT VA1158Met is involved with essentially “making decisions” in important intermediate phenotypes in relation to psychosis. To prove these trade-off effects, the experiment was done with mice in which the experimenters overexpressed the human Va1/Va1 genotype. As a result, they displayed worse cognition, but were resilient to stress and pain. However, a knockout of COMT was associated with the complete opposite effect: better cognitive function, less resilience to stress and pain (Papaleo, et al., 2008). In addition, there were two studies that were done that found that the Met/Met genotype was tied to increased reactivity to stress in patients with the psychotic disorder (Collip, 2011; Van Winkel, 2008).

In addition to this, researchers suggest that the difference in phenotype associated with COMT Va1158Met provides a plausible explanation for genes that either add, or modify the function of COMT (Nicodemus, et al., 2007).

So what could possibly result from the modification of COMT? It has been suggested that functional interactions between COMT and MTHFR may be held liable for psychosis. It has also been suggested that the presence of both MTHFR and the allele 67TT with COMT Met/Met carriers was associated with an increased risk of schizophrenia (Muntjewerff, et al., 2008). In the current study, the sample comprised 316 participants consisting of 171 patients and 145 controls. Of those 316, 216 agreed to provide DNA which was extracted from blood and buccal cell samples. In addition, the experience sampling method (ESM) was employed. Participants received a preprogrammed digital wristwatch and an assessment form that they would have to fill out when the watch emitted a beep. Once all the data had been collected, it was found that the COMT Va1158Met and stress interaction was conditional on the MTHFR C677T genotype, but only in patients. Interestingly enough, patients with MTHFR and the allele C677T and COMT

Met/Met displayed the largest increase in psychotic symptoms in response to stress. However, it is important to note that the previous research identified this interaction between MTHFR and COMT as present in healthy controls as well (Roffman, 2008), but the experiment found no evidence of this. Like most of the research done in this area, the results that were found require more experimentation in an attempt to replicate the entire results.

Finally, Morrens explored the relationship between cognitive dysfunction and stress in 2007. The results obtained through his experiment were consistent with what was previously obtained by others. The various symptoms associated with schizophrenia have been hypothesized as the expression of different and possibly independent causal pathways related to psychosis (Verdoux, 2002; Weiser, 2005). There appears to be a genetic connection between both cognitive dysfunctions (Green, 1998; Sharma, et al., 2000) and abnormal sensitivity to stress (Myin-Germeys, 2001; Krabbendam, 2001; Sharma, 2000). In addition, it has been noted that abnormal sensitivity to stress in daily life has been reported by patients in remission, as well as in first-degree relatives of patients with psychosis (Myin-Germeys, 2001). The purpose of Morrens' study was to replicate the findings that were previously reported, but in a new set of patients with psychosis. The sample consisted of 35 in or out-patients with psychotic illness. Additionally, the ESM was used, and patients were given digital wristwatches that would randomly beep throughout the day. Each patient had to fill out a self-assessment form after hearing a beep. The neuropsychological assessment focused on the following: processing speed, selective attention, and executive functioning. To measure processing speed, simple test conditions of the Trail Making Test were employed (Lezak, 2004; Spreen, 1998) in addition to the Stroop Color Word Test (Lezak, 2004; Stroop, 1935). Selective attention was observed by using the same tests. Executive function was measured using the raw score on the zoo map subtest of the behavioral assessment of the Dysexecutive Syndrome (Wilson, 1996). Interestingly enough, the group with the best performance on the neuropsychological test showed a stronger reaction to stress, with larger decreases in positive affect, and larger increases in negative affect, when compared to the group with the worst performance. The previous hypothesis that had been proposed, that sensitivity to stress does not lie on the same pathway between cognitive impairment and psychosis, in fact constitutes an independent, and even a somewhat competing pathway leading to psychosis. These pathways may contribute to the mechanisms underlying the broad range of symptoms in schizophrenia, and these have been broken down by several different authors (Carpenter

1988; Crow, 1980; Murray 1992; Van Os 1998). The condition may be reduced to two main parts: a more chronic condition characterized by high levels of negative symptoms in Europe cognitive impairment, and an episodic, reactive form with higher levels of positive symptoms.

The combined results indicate that stress factors, as well as genetic phenomena, play a significant role in the onset of schizophrenia, and the development of a psychotic disorder (Morrens, Manuel, 2007; Lataster, 2013; Lataster, 2010; Winkel, Van, 2008; Collip, 2011; Habets, 2012; Elman, 1998; Peerbooms, 2012). The specific kind of stress can bring out both positive or negative symptoms in schizophrenia, as well as various other symptoms associated with psychosis. From the eight studies reviewed, it can be assumed that various forms of stress will act as a trigger for schizophrenia, or psychotic disorders, and that stress involves biochemical, genetic, and certain environmental risk factors that aid in its explanation. However, more studies need to be done in these subject fields. A common theme in each of these articles is that more studies need to be done in order to replicate the results that were obtained in the original studies. Doing so might pinpoint a specific mechanism and provide a reasonable explanation for the onset of this disorder, as well as possibly lead to different treatment methods that would ultimately help many affected by this truly incapacitating disorder, known as schizophrenia.

Works Cited

- Andreasen, N., and Carpenter, W. (1993). Diagnosis and Classification of Schizophrenia. *Schizophrenia Bulletin* 19.2: 199-214. PsycARTICLES. Web. 13 Feb. 2014.
- Albus, M., Engel, R., Muller, F., Zander Kjm, and Ackenheil, M. (1982): Experimental stress situations and the state of autonomic arousal in schizophrenic and depressive patients. In *Pharmacopsychiatry*, 17: 129- 135.
- Bebbington, P., Bhugra, D., Brugha, T., Singleton, N., Farrell, M., Jenkins, R., Lewis, G., and Meltzer, H. (2004). Psychosis, victimisation and childhood disadvantage: evidence from the second British National Survey of Psychiatric Morbidity. *British Journal of Psychiatry* 185, 220-226.
- Boog, G. (2004). Obstetrical complications and subsequent schizophrenia in adolescent and young adult offsprings: is there a relationship? *Eur Journal Obstet Gynecol Reprod Biol.*; 114:130-136.
- Breier, A. (1989). Experimental approaches to human stress research: assessment of

- neurobiological mechanisms of stress in volunteers and psychiatric patients. *Biol Psychiatry*, 26: 438–462.
- Breier, A., Wolkowitz, O., Doran, A., Bellar, S., and Pickar, D. (1988). Neurobiological effects of lumbar puncture stress in psychiatric patients and healthy volunteers. *Psychiatry Res*, 25: 187–194.
- Carpenter, W., Heinrichs, D., and Wagman, A. (1988). Deficit and nondeficit forms of schizophrenia: the concept. *American Journal of Psychiatry*, 145:578–583.
- Collip D., Myin-Germeys, I., and Van Os, J. (2008). Does the concept of “sensitization” provide a plausible mechanism for the putative link between the environment and schizophrenia? *Schizophrenia Bulletin*, 34:220–225.
- Collip, D., Nicolson, N., Lardinois, M., Lataster, T., van Os, J., and Myin-Germeys, I. (2011). Daily cortisol, stress reactivity and psychotic experiences in individuals at above average genetic risk for psychosis. *Psychological Medicine*, 41, 2305–2315.
- Crow, T. (1980). Molecular pathology of schizophrenia: more than one disease process? *Br Med J*, 280:66–68.
- Czyrak, A., Mackowiak, M., Chocyk, A., Fijal, K., and Wedzony, K. (2003). Role of glucocorticoids in the regulation of dopaminergic neurotransmission. *Pol J Pharmacol*, 55:667–674.
- Dallman, M., Akana, S., Strack, A. et al. (2004). Chronic Stress-induced Effects of Corticosterone On Brain: Direct And Indirect. *Ann NY Acad Sci*, 1018:141–150.
- Elman, I., Adler, C., Malhotra, A., Bir, C., Pickar, D., and Breier, A. (1998). Effect of Acute Metabolic Stress on Pituitary-Adrenal Axis Activation In Patients With Schizophrenia. *Am J Psychiatry*, 155:979–981.
- Garner, B., Pariante, C., Wood, S., Velakoulis, D., Phillips, L., Soulsby, B., Brewer, W., Smith, D., Dazzan, P., Berger, G., Yung, A., van den Buuse, M., Murray, R., McGorry, P., and Pantelis C. (2005). Pituitary volume predicts future transition to psychosis in individuals at ultra-high risk of developing psychosis. *Biological Psychiatry* 58, 417–423.
- Goldstein, J., Seidman, L., Makris, N., Ahern, T., O'Brien, L., Caviness Jr., V., Kennedy, D., Faraone, S., and Tsuang, M. (2007). Hypothalamic abnormalities in schizophrenia: sex effects and genetic vulnerability. *Biological Psychiatry* 61, 935–945.
- Green, M. (1998). *Schizophrenia From a Neurocognitive Perspective: Probing the Impenetrable Darkness*. Allyn & Bacon, Boston.
- Habets, P., Collip, D., Myin-Germeys I., Gronenschild, E., van Bronswijk, S., Hofman, P., Lataster, T., Lardinois, M., Nicolson, N., Van Os, J., and Marcelis, M. for G.R.O.U.P. (2012). Pituitary volume, stress reactivity and genetic risk for psychotic disorder. *Psychological Medicine*, 42.7 1523–33.
- Horton, R., Meldrum, B., and Bachelard, H. (1973). Enzymic and cerebral metabolic effects of 2-deoxy-D-glucose. *J Neurochem*, 21: 507 – 520.

- Jacobs, N., Rijdsdijk, F., Derom, C. et al. (2006). "Genes making one feel blue in the flow of daily life: a momentary assessment study of gene-stress interaction." *Psychosom Med*, 68:201– 206.
- Janssen I, Krabbendam, L., Bak, M., Hanssen, M., Vollebergh, W., de Graaf, R., and van Os, J. (2004). Childhood abuse as a risk factor for psychotic experiences." *Acta Psychiatrica Scandinavica*, 109, 38–45.
- Kay, S., Fiszbein, A., and Opler, L. (1987). The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophrenia Bulletin*, 13, 261–276.
- Kofman, O. (2002). The role of prenatal stress in the etiology of developmental behavioural disorders. *Neurosci Biobehav Rev.*, 2002; 26:457–470.
- Krabbendam, L., Marcelis, M., Delespaul, P., Jolles, J., and van Os, J. (2001). "Single or multiple familial cognitive risk factors in schizophrenia?" *Am J Med Genet* 105:183–188.
- Lataster, T., Valmaggia, L., Lardinois, M., van Os, J., and Myin-Germeys, I. (2013). Increased Stress Reactivity: A Mechanism Specifically Associated with the Positive Symptoms of Psychotic Disorder. *Psychological Medicine*, 43.7: 1389–400.
- Lataster, T., van Os, J., Drukker, M., Henquet, C., Feron, F., Gunther, N., and Myin-Germeys, I. (2006). Childhood victimization and developmental expression of non-clinical delusional ideation and hallucinatory experiences: victimisation and non-clinical psychotic experiences. *Social Psychiatry and Psychiatric Epidemiology* 41, 423–428.
- Lezak, M., Howieson, D., and Loring, D. (2004). *Neuropsychological Assessment*. University Press, Oxford.
- Marinelli, M., Rudick, C., Hu, X., and White, F. (2006). Excitability of dopamine neurons: modulation and physiological consequences. *CNS Neurol Disord Drug Targets*, 5:79–97.
- Meltzer HY, Koenig JI, Nash JF, Gudelsky GA (1989). Melperone and clozapine: neuroendocrine effects of atypical neuroleptic drugs. *Acta Psychiatrica Scandinavica* (Suppl.) 352, 24–29.
- Mittal, V., Dhruv, S., Tessner, K., Walder, D., and Walker, E. (2007). "The relations among putative biorisk markers in schizotypal adolescents: minor physical anomalies, movement abnormalities, and salivary cortisol. *Biological Psychiatry* 61, 1179–1186.
- Moghaddam, B. (2002). Stress activation of glutamate neurotransmission in the prefrontal cortex: implications for dopamine-associated psychiatric disorders. *Biol Psychiatry*: 51:775–787.
- Mondelli, V., Dazzan, P., Gabilondo, A., Tournikioti, K., Walshe, M., Marshall, N., Schulze, K., Murray, R., McDonald, C., and Pariante, C. (2008). Pituitary volume in unaffected relatives of patients with schizophrenia and bipolar disorder. *Psychoneuroendocrinology* ,33, 1004–1012.
- Mondelli, V., Dazzan, P., Hepgul, N., di Forti, M., Aas, M., d'Albenzio, A., di Nicola, M., Fisher, H., Handley, R., Marques, T., Morgan, C., Navari, S., Taylor, H., Papadopoulos,

- A., Aitchison, K., Murray, R., and Pariante, C. (2010). Abnormal cortisol levels during the day and cortisol awakening response in first-episode psychosis: the role of stress and of antipsychotic treatment. *Schizophrenia Research* 116, 234–242.
- Morrens, M., Krabbendam, L., Bak, M., Delespaul, P., Mengelers, R., Sabbe, B., Hulstijn, W., Van Os, J., and Myin-Germeys, I. (2007). The Relationship between Cognitive Dysfunction and Stress Sensitivity in Schizophrenia. *Social psychiatry and psychiatric epidemiology*, 42.4: 284–7.
- Myin-Germeys, I., Delespaul, P., and van Os, J. (2005a). “Behavioural sensitization to daily life stress in psychosis. *Psychological Medicine*, 35, 733–741.
- Myin-Germeys, I., Krabbendam, L., Delespaul, P., and van Os, J. (2003). Do life events have their effect on psychosis by influencing the emotional reactivity to daily life stress.” *Psychol Med.*, 33:327–333.
- Myin-Germeys, I., Marcelis, M., Krabbendam, L., Delespaul, P., and van Os, J. (2005b). Subtle fluctuations in psychotic phenomena as functional states of abnormal dopamine reactivity in individuals at risk. *Biological Psychiatry* 58,105–110.
- Myin-Germeys, I., van Os, J., Schwartz, J., Stone, A., and Delespaul, P. (2001). Emotional reactivity to daily life stress in psychosis. *Archives of General Psychiatry* 58, 1137–1144.
- Muck-Seler, D., Pivac, N., Mustapic, M., Crncevic, Z., Jakovljevic, M., and Sagud, M. (2004). Platelet serotonin and plasma prolactin and cortisol in healthy, depressed and schizophrenic women. *Psychiatry Research*, 127, 217–226.
- Muntjewerff, J., Gellekink, H., Den Heijer, M. et al. (2008). Polymorphisms in catechol-O-methyltransferase and methylenetetrahydrofolate reductase in relation to the risk of schizophrenia. *Eur Neuropsychopharmacol*, 2008;18:99–106.
- Murray, R., O’Callaghan, E., Castle, D., and Lewis, S. (1992). A neurodevelopmental approach to the classification of schizophrenia. *Schizophr Bull*, 18:319–332.
- Nicodemus, K., Kolachana, B., Vakkalanka, R. et al. (2007). Evidence for statistical epistasis between catechol-O-methyltransferase (COMT) and polymorphisms in RGS4, G72 (DAOA), GRM3, and DISC1: influence on risk of schizophrenia. *Hum Genet*, 120:889–906.
- Pariante, C., Dazzan, P., Danese, A., Morgan, K., Brudaglio, F., Morgan, C., Fearon, P., Orr, K., Hutchinson, G., Pantelis, C., Velakoulis, D., Jones, P., Leff, J., and Murray, R. (2005). Increased pituitary volume in an antipsychotic-free and antipsychotic-treated patients of the Æsop first-onset psychosis study. *Neuropsychopharmacology*, 30, 1923–1931.
- Peerbooms, O., Rutten, B., Collip, D., Lardinois, M., Lataster, T., Thewissen, V., Mafé Rad, S., Drukker, M., Kenis, G., Van Os, J., Myin-Germeys, I., and van Winkel, R. (2012). Evidence that Interactive Effects of COMT and MTHFR Moderate Psychotic Response to Environmental Stress. *Acta Psychiatrica Scandinavica* 125.3: 247–56.
- Perlman, W., Webster, M., Kleinman, J., and Weickert, C. (2004). Reduced glucocorticoid and estrogen receptor alpha messenger ribonucleic acid levels in

- the amygdala of patients with major mental illness. *Biol Psychiatry*. 2004; 56:844–852.
- Roffman, J., Gollub, R., Calhoun, V. et al. (2008). MTHFR 677C→T genotype disrupts prefrontal function in schizophrenia through an interaction with COMT Val158Met. *Proc Natl Acad Sci U S A*; 105:17573–17578.
- Ryan, M., Sharifi, N., Condren, R., and Thakore, J. (2004). Evidence of basal pituitary adrenal overactivity in first episode, drug naive patients with schizophrenia. *Psychoneuroendocrinology* 29, 1065–1070.
- Sharma, T., and Harvey, P. (2000). *Cognition in Schizophrenia: Impairments, Importance and Treatment Strategies*. University Press, Oxford.
- Soliman, A., O'Driscoll, G., Pruessner, J., Holahan, A., Boileau, I., Gagnon, D., and Dagher, A. (2008). Stress-induced dopamine release in humans at risk of psychosis: a [11C]raclopride PET study. *Neuropsychopharmacology*, 33, 2033–2041.
- Spreen, O., and Strauss, E. (1998). *A Compendium of Neuropsychological Tests. Administration, Norms and Commentary*. University Press, Oxford.
- Strauss, G., Duke, L., Ross, S., and Allen, D. (2011). Posttraumatic stress disorder and negative symptoms of schizophrenia. *Schizophrenia Bulletin* 37, 603–610.
- Stroop, J. (1935). Studies of interference in serial verbal reactions. *J Exp Psychology* 18:643–662.
- Takahashi, T., Suzuki, M., Velakoulis, D., Lorenzetti, V., Soulsby, B., Zhou, S., Nakamura, K., Seto, H., Kurachi, M., and Pantelis, C. (2009). Increased pituitary volume in schizophrenia spectrum disorders. *Schizophrenia Research*, 108, 114–121.
- Van Os, J., Jones, P., Sham, P., Bebbington, P., and Murray, R. (1998). Risk factors for onset and persistence of psychosis. *Soc Psychiatry Psychiatr Epidemiol*, 33:596–605
- Van Winkel, R., Henquet, C., Rosa, A. et al. (2008). Evidence that the COMT(Val158Met) polymorphism moderates sensitivity to stress in psychosis: an experience-sampling study. *Am J Med Genet B Neuropsychiatr Genet*, 147B:10–17.
- Van Winkel, R., Stefanis, N., and Myin-Germeys, I. (2008). Psychosocial stress and psychosis. A review of the neurobiological mechanisms and the evidence for gene-stress interaction. *Schizophrenia Bulletin*, 34, 1095–1105.
- Varese, F., Smeets, F., Drukker, M., Lieveise, R., Lataster, T., Viechtbauer, W., Read, J., van Os, J., and Bentall, R. (2012). Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective- and cross-sectional cohort studies. *Schizophrenia Bulletin* 38, 661–671.
- Verdoux, H., and van Os, J. (2002). Psychotic symptoms in non-clinical populations and the continuum of psychosis. *Schizophr Res*, 54:59–65.
- Walker, E., Mittal, V., and Tessner, K. (2008). Stress and the hypothalamic pituitary adrenal axis in the developmental course of schizophrenia. *Annual Review of Clinical Psychology*, 4, 189–216.
- Walker, E., and Diforio, D. (1997). Schizophrenia: a neural diathesis-stress model. *Psychol Rev*. 1997; 104:667–685.
- Walker, E., Walder, D., and Reynolds, F. (2001). Developmental changes in cortisol secretion in normal and at-risk youth. *Development and Psychopathology* 13, 721–732.

- Walsh, P., Spelman, L., Sharifi, N., and Thakore, J. (2005). Male patients with paranoid schizophrenia have greater ACTH and cortisol secretion in response to meto clopramide-induced AVP release. *Psychoneuroendocrinology*. 2005; 30:431–437.
- Webster, M., Knable, M., O'Grady, J., Orthmann, J., and Weickert, C. (2002). Regional specificity of brain glucocorticoid receptor mRNA alterations in subjects with schizophrenia and mood disorders. *Mol Psychiatry*. 7:924, 985–994.
- Weiser, M., van Os, J., Davidson, M. (2005). Time for a shift in focus in schizophrenia: from narrow phenotypes to broad endophenotypes. *Br J Psychiatry* 187:203–205.
- Wichers, M., Myin-Germeys, I., Jacobs, N. et al. (2007). Genetic risk of depression and stress-induced negative affect in daily life. *Br J Psychiatry*, 191:218–223.
- Wilson, B., Alderman, N., Burgess, P., Emslie, H., and Evans, J. (1996). Behavioural Assessment of the Dysexecutive Syndrome (BADS). Thames Valley Test Company, Bury St Edmunds Wik, G. (1995). Effects of neuroleptic treatment on cortisol and 3-methoxy-4-hydroxyphenylethyl glycol levels in blood. *Journal of Endocrinology* 144, 425–429.
- Xing, G., Russell, S., Webster, M., and Post, R. (2004). Decreased expression of mineralocorticoid receptor mRNA in the prefrontal cortex in schizophrenia and bipolar disorder." *Int J Neuropsychopharmacol*, 7:143–153.

A Series Representation Formula for $a^p - b^p$

Pavel Sokolov

Introduction

The objective of this work is to write $a^p - b^p$ as a sum of a finite number of terms using concepts from the calculus. For example, if $a = 4$, $b = 5$, and $p = 3$, then

$4^3 - 5^3 = -75 + 15 + (-1) = -61$, where $-75 = \frac{(4-5)(3*5^2)}{1!}$, $15 = \frac{(4-5)^2(3*2*5^1)}{2!}$, and $-1 = \frac{(4-5)^3(3*2*1*5^0)}{3!}$. Using a calculator type in $4^3 - 5^3$. The answer is the same, isn't it?

Important Terms

There are some mathematical terms essential to this work. Their usage and notation are discussed in this section.

Set Notation: The notation for the set of all real numbers is R and the notation for the set of all positive integers is Z^+ . The sign " \in " means "belongs to." For example, $n \in R$ should be read in English as "the number n belongs to the set of all real numbers," or, in other words, "the number n is a real number."

Derivatives: The symbol that denotes the derivative of the function f of n , written $f(n)$, is $\frac{df}{dn}$. The derivative of any function of type $f(n) = n^p$ is the rate of change of the function where n is any real number and p is any positive integer. When taking a derivative of such a function, we multiply our function by the power of n and then reduce the power of n by 1. That is $\frac{df}{dn} = pn^{p-1}$.

The derivative of the derivative is the second order derivative symbolized by $\frac{d^2f}{dn^2}$.

When taking the second derivative of a function of the type $f(n) = n^p$, we are doing the same as taking a derivative of the first order derivative of the function, $\frac{df}{dn} = \frac{d}{dn}(n^p) = pn^{p-1}$. We keep the p multiplier and multiply the function obtained after taking the first derivative by its new power $p - 1$. We

also reduce the power of n by 1. So we have $\frac{d^2 f}{dn^2} = \frac{d}{dn} \left(\frac{df}{dn} \right) = p(p-1)n^{p-2}$. The third order derivative of the function $f(n) = n^p$ is the derivative of the second derivative of that function $\frac{d^3 f}{dn^3} = \frac{d}{dn} \left(\frac{d^2 f}{dn^2} \right) = p(p-1)(p-2)n^{p-3}$. Generally, the r th order derivative of the function $f(n)$ would be symbolized by $\frac{d^r f}{dn^r}$, where r is a positive integer.

There is an alternative way to denote derivatives as well. $f'(n)$, $f''(n)$, $f^{(3)}(n)$, and $f^{(r)}(n)$ are the first, second, third, and r th order derivatives of the function $f(n)$, respectively.

Permutations and Combinations: A factorial of a positive integer p is denoted by $p!$ $p! = p(p-1)(p-2) \dots 1$. So, the factorial of a number is a product of that number and all the numbers that are less than that number by an integer down to 1. For example, $5! = 5 * 4 * 3 * 2 * 1 = 120$. Zero factorial is defined to be one ($0! = 1$). In mathematics a permutation of p items taken r at a time (or given p , choose r) is the number of distinct arrangements of these items allowing repetitions, and a combination of p items taken r at a time is the number of distinct arrangements of these items without repetitions. The permutation of p items taken r at a time is denoted by $P(p, r)$, and the combination of p items taken r at a time is denoted by $C(p, r)$. The formulas for computing permutations and combinations are $P(p, r) = \frac{p!}{(p-r)!}$ and $C(p, r) = \frac{p!}{r!(p-r)!}$ respectively. Note that in both, permutations and combinations p is always greater than or equal to r . Also, notice that $C(p, r) = \frac{P(p, r)}{r!}$.

Mathematical Induction: Mathematical Induction is a technique of proof used to verify a statement about some natural number q by showing first that the statement is true when $q = 1$. Then, if the statement is true for the number q , it follows that the statement is true for the number $q + 1$. This being the case one can conclude that the statement is true for all natural numbers.

Part I: The Permutation Definition of the Derivative of the Function

$$f(n) = n^p$$

Define the function of n , $h(n) = (n+1)^p - n^p$, $n \in \mathbb{R}$ and $p \in \mathbb{Z}^+$.
For $p = 1$:

$$(n+1)^1 - n^1 = n+1-n = 1.$$

For example, $4^1 - 3^1 = 1$.

For $p = 2$:

$$(n+1)^2 - n^2 = n^2 + 2n + 1 - n^2 = 2n + 1.$$

For example, $6^2 - 5^2 = 2*5 + 1 = 11$.

For $p = 3$:

$$\begin{aligned}(n+1)^3 - n^3 &= (n+1-n)((n+1)^2 + n(n+1) + n^2) \\ &= n^2 + 2n + 1 + n^2 + n + n^2 = 3n^2 + 3n + 1.\end{aligned}$$

For example, $5^3 - 4^3 = 3*4^2 + 3*4 + 1 = 61$.

For $p = 4$:

$$\begin{aligned}(n+1)^4 - n^4 &= (n^2 + 2n + 1)(n^2 + 2n + 1) - n^4 \\ &= n^4 + 4n^3 + 6n^2 + 4n + 1 - n^4 = 4n^3 + 6n^2 + 4n + 1.\end{aligned}$$

For example, $3^4 - 2^4 = 4*2^3 + 6*2^2 + 4*2 + 1 = 32 + 24 + 8 + 1 = 65$.

Given the above results, it seems that there should be a formula for simplifying the expression $(n+1)^p - n^p$, $n \in \mathbb{R}$ and $p \in \mathbb{Z}^+$.

Suppose we have an infinitely differentiable function of n , $f(n) = n^p$, $n \in \mathbb{R}$, $p \in \mathbb{Z}^+$. If we differentiate the function with respect to n several times, then we get the following:

$$\begin{aligned}f'(n) &= pn^{p-1}, f''(n) = p(p-1)n^{p-2}, \quad f'''(n) = p(p-1)(p-2)n^{p-3} \\ &\dots, f^{(r)}(n) = p(p-1)(p-2) \dots (p-r+1)n^{p-r}.\end{aligned}$$

For example, if $f(n) = n^4$, then

$$\begin{aligned}f'(n) &= 4n^3, & f''(n) &= 4 * 3n^2, & f'''(n) &= 4 * 3 * 2n, \\ f^{(4)}(n) &= 4 * 3 * 2 * 1 = 4! & \text{or} & & f'(n) &= \frac{4!}{(4-1)!}n^{4-1}, \\ f''(n) &= \frac{4!}{(4-2)!}n^{4-2}, f'''(n) = \frac{4!}{(4-3)!}n^{4-3}, & f^{(4)}(n) &= \frac{4!}{(4-4)!}n^{4-4}\end{aligned}$$

The above pattern suggests that the r^{th} derivative of the function $f(n) = n^p$, $n \in \mathbb{R}$ and $p \in \mathbb{Z}^+$, can be expressed as:

$$f^{(r)}(n) = \frac{p!}{(p-r)!}n^{p-r} = P(p, r)n^{p-r}, \text{ where } P(p, r) \text{ is the permutation}$$

of p items taken r at a time.

Theorem 1:

If $f^{(r)}(n) = P(p, r)n^{p-r}$, where $P(p, r)$ is the permutation of p items taken r at a time,

$f(n) = n^p$, $n \in \mathbb{R}$, $p \in \mathbb{Z}^+$, then

Proof: Using mathematical induction, if $p = 1$ so that $r = 1$, then $f(n) = n$. Thus, $f'(n) = 1$ and $P(1, 1)n^{1-1} = P(1, 1) = \frac{1!}{0!} = 1$. So that $f'(n) = P(1, 1)n^{1-1}$.

If we assume that

$P(k): f^k(n) = P(p, k)n^{p-k}$, where $P(p, k)$ is the permutation of p items taken r at a time,

$f(n) = n^k$, $n \in \mathbb{R}$, $k \in \mathbb{Z}^+$ is true, then

$$f^{k+1}(n) = \frac{d}{dn} (f^k(n)) = (p - k)P(p, k)n^{p-k-1}$$

$$\text{Now, } P(p, k + 1) = \frac{p!}{(p-k-1)!} \text{ and } P(p, k) = \frac{p!}{(p-k)!} = \frac{p!}{(p-k)(p-k-1)!}$$

$$\text{so that } (p - k)P(p, k) = \frac{p!}{(p-k-1)!} = P(p, k + 1)$$

$$P(p, k) = \frac{P(p, k + 1)}{p - k}$$

Therefore, $f^{k+1}(n) = P(p, k + 1)n^{p-k-1}$.

Thus, Theorem 1 is true for all natural numbers r .

$$\text{If, in Theorem 1, } r = p, \quad f^{(p)}(n) = P(p, p)n^{p-p} = \frac{p!}{(p-p)!} = p!$$

Part II: A Series Representation for $(n + 1)^p - n^p$

We return to the original problem of finding a representation of $(n + 1)^p - n^p$. If we have a function $f(n) = n^p$ and $p = 1$, then $(n) = n$, $f'(n) = 1$, and

$$(n + 1)^1 - n^1 = 1 = \frac{f'(n)}{1!}$$

Suppose $p = 2$. Then

$$\begin{aligned} f(n) &= n^2, & f'(n) &= 2n, & f''(n) &= 2, \\ h(n) &= (n + 1)^2 - n^2 = 2n + 1 = \frac{f'(n)}{1!} + \frac{f''(n)}{2!} \end{aligned}$$

For $p = 3$:

$$\begin{aligned} f(n) &= n^3, & f'(n) &= 3n^2, & f''(n) &= 6n, \\ f'''(n) &= 6 & \text{and} & & h(n) &= (n + 1)^3 - n^3 \\ &= 3n^2 + 3n + 1 = \frac{f'(n)}{1!} + \frac{f''(n)}{2!} + \frac{f'''(n)}{3!} \end{aligned}$$

When $p = 4$:

$$\begin{aligned} f(n) &= n^4, & f'(n) &= 4n^3, & f''(n) &= 12n^2, \\ f'''(n) &= 24n, & f^{(4)}(n) &= 24, & \text{and} & \end{aligned}$$

$$h(n) = (n+1)^4 - n^4 = 4n^3 + 6n^2 + 4n + 1$$

$$= \frac{f'(n)}{1!} + \frac{f''(n)}{2!} + \frac{f'''(n)}{3!} + \frac{f^{(4)}(n)}{4!}$$

It seems like there is a general rule for finding the values of functions of type $h(n) = (n+1)^p - n^p$, $n \in \mathbb{R}$ and $p \in \mathbb{Z}^+$ for every n and p . That is:

$$h(n) = (n+1)^p - n^p$$

$$= \frac{f'(n)}{1!} + \frac{f''(n)}{2!} + \frac{f'''(n)}{3!} + \dots + \frac{f^{(r)}(n)}{r!} + \dots + \frac{f^{(p)}(n)}{p!}$$

where $f(n) = n^p$, $n \in \mathbb{R}$, and $p \in \mathbb{Z}^+$.

We can write

$$(n+1)^p - n^p$$

$$= \frac{f'(n)}{1!} + \frac{f''(n)}{2!} + \frac{f'''(n)}{3!} + \dots + \frac{f^{(r)}(n)}{r!} + \dots + \frac{f^{(p)}(n)}{p!} \quad \text{as} \quad \sum_{i=1}^p \frac{f^{(i)}(n)}{i!},$$

where $f(n) = n^p$, $n \in \mathbb{R}$, and $p \in \mathbb{Z}^+$.

Theorem 2:

$$(n+1)^p - n^p = \sum_{i=1}^p \frac{f^{(i)}(n)}{i!}$$

where $f(n) = n^p$, $n \in \mathbb{R}$, $p \in \mathbb{Z}^+$.

Proof:

By the Binomial Theorem:

$$(a+b)^p$$

$$= C(p,0)a^p b^0 + C(p,1)a^{p-1}b^1 + C(p,2)a^{p-2}b^2 + \dots$$

$$+ C(p,r)a^{p-r}b^r + \dots + C(p,p)a^0 b^p.$$

Let $a = n$ and $b = 1$. Then

$$(n+1)^p$$

$$= C(p,0)n^{p-0} + C(p,1)n^{p-1} + C(p,2)n^{p-2} + \dots + C(p,r)n^{p-r} + \dots$$

$$+ C(p,p)n^{p-p}$$

$$C(p,0)n^{p-0} = n^p \text{ since } \frac{p!}{0!(p-0)!} n^{p-0} = n^p$$

We have seen that $C(p,r) = \frac{P(p,r)}{r!}$,

By Theorem 1

$$C(p,r)n^{p-r} = \frac{f^{(r)}(n)}{r!}$$

where $f(n) = n^p$, $n \in \mathbb{R}$, $p \in \mathbb{Z}^+$.

Therefore,

$$\begin{aligned}(n+1)^p - n^p &= C(p, 1)n^{p-1} + C(p, 2)n^{p-2} + \dots + C(p, r)n^{p-r} + \dots + C(p, p)n^{p-p} \\ &= \frac{f'(n)}{1!} + \frac{f''(n)}{2!} + \frac{f'''(n)}{3!} + \dots + \frac{f^{(r)}(n)}{r!} + \dots + \frac{f^{(p)}(n)}{p!} \\ (n+1)^p - n^p &= \sum_{i=1}^p \frac{f^{(i)}(n)}{i!}\end{aligned}$$

where $f(n) = n^p$, $n \in \mathbb{R}$, $p \in \mathbb{Z}^+$.

Part III: A Series Representation for $a^p - b^p$.

Let's think of a formula for the expression $a^p - b^p$. This expression is similar to the Theorem 2. The difference of $n+1$ and n is 1. Let's consider other examples:

$$\begin{aligned}(n+2) - n &= 2, (n+3) - n = 3, \dots, (n+r) - n = r, \dots, \\ (n+n) - n &= n.\end{aligned}$$

We claim that:

$$\begin{aligned}a^p - b^p &= \frac{(a-b)^1 f'(b)}{1!} + \frac{(a-b)^2 f''(b)}{2!} + \dots + \frac{(a-b)^r f^{(r)}(b)}{r!} + \dots \\ &\quad + \frac{(a-b)^p f^{(p)}(b)}{p!} = \sum_{i=1}^p \frac{(a-b)^i f^{(i)}(b)}{i!}\end{aligned}$$

where $f(n) = n^p$; $a, b, n \in \mathbb{R}$; $p \in \mathbb{Z}^+$.

Theorem 3:

$$a^p - b^p = \sum_{i=1}^p \frac{(a-b)^i f^{(i)}(b)}{i!}$$

where $f(n) = n^p$; $a, b, n \in \mathbb{R}$; $p \in \mathbb{Z}^+$.

Proof:

Suppose the difference of the numbers a and b is some number c .

$$a - b = c; \quad a = b + c; \quad a^p - b^p = (b + c)^p - b^p, \quad \text{where } a, b, c \in \mathbb{R}, p \in \mathbb{Z}^+.$$

By the Binomial Theorem:

$$\begin{aligned}
(b+c)^p &= C(p,0)b^{p-0}c^0 + C(p,1)b^{p-1}c^1 + C(p,2)b^{p-2}c^2 + \dots \\
&+ C(p,r)b^{p-r}c^r + \dots + C(p,p)b^{p-p}c^p \\
&= b^p + C(p,1)b^{p-1}c^1 + C(p,2)b^{p-2}c^2 + \dots \\
&+ C(p,r)b^{p-r}c^r + \dots + C(p,p)b^{p-p}c^p.
\end{aligned}$$

$$\begin{aligned}
(b+c)^p - b^p &= \\
&C(p,1)b^{p-1}c^1 + C(p,2)b^{p-2}c^2 + \dots + C(p,r)b^{p-r}c^r + \dots + \\
&C(p,p)b^{p-p}c^p.
\end{aligned}$$

Since $f^{(r)}(n) = P(p,r)n^{p-r}$, and $C(p,r) = \frac{P(p,r)}{r!}$, where $f(n) = n^p$, $n \in \mathbb{R}$, $p \in \mathbb{Z}^+$,

$$\begin{aligned}
(b+c)^p - b^p &= \\
&= \frac{c^1 f'(b)}{1!} + \frac{c^2 f''(b)}{2!} + \dots + \frac{c^r f^{(r)}(b)}{r!} + \dots + \frac{c^p f^{(p)}(b)}{p!}
\end{aligned}$$

Now we can see that:

$$a^p - b^p = \sum_{i=1}^p \frac{c^i f^{(i)}(b)}{i!}$$

where $f(n) = n^p$.

Finally:

$$a^p - b^p = \sum_{i=1}^p \frac{(a-b)^i f^{(i)}(b)}{i!}$$

where $f(n) = n^p$; $a, b, n \in \mathbb{R}$, $p \in \mathbb{Z}^+$.

Part IV: A Formula for the expression $a^p + b^p$.

The formula for $a^p + b^p$ follow directly from Theorem 3.

Corollary 1:

$$a^p + b^p = 2b^p + \sum_{i=1}^p \frac{(a-b)^i f^{(i)}(b)}{i!}$$

where $f(n) = n^p$; $a, b, n \in \mathbb{R}$, $p \in \mathbb{Z}^+$.

Conclusion:

The formula for the expression $a^p - b^p$ was derived from the formula for the expression $(n+1)^p - n^p$. It appeared that the series representation for the expression $a^p - b^p$ should be similar to the series representation for the expression $(n+1)^p - n^p$.

Finally, I would like to thank the Mathematics Department Chair, Dr. R. Forsstrom for teaching me the essentials used in this work: set notation, iteration, combinations, permutations, Binomial Theorem, and proof techniques. I would also like to thank my faculty advisor, Dr. Ruth Feigenbaum for guiding me in my research.

Erratum

Bergen Scholarly Journal Vol. II. 2015

Pavel Sokolov

Page 60, lines 31-33 IS: “If $f^{(r)}(n) = P(p, r)n^{p-r}$, where $P(p, r)$ is the permutation of p items taken r at a time, $f(n) = n^p, n \in R, p \in Z^+$, then.”

IT SHOULD BE: “ $f^{(r)}(n) = P(p, r)n^{p-r}$, where $P(p, r)$

is the permutation of p items taken r at a time, $f(n) = n^p, n \in R$, and $p \in Z^+$.”

Page 61, line 5 IS: “ $P(k): f^k(n) = P(p, k)n^{p-k}$.”

IT SHOULD BE: “ $P(k): f^{(k)}(n) = P(p, k)n^{p-k}$.”

Page 61, line 7 IS: “ $f^{k+1}(n) = \frac{d}{dn} \left(f^k(n) \right) = (p - k)P(p, k)n^{p-k-1}$.”

IT SHOULD BE: “ $f^{(k+1)}(n) = \frac{d}{dn} \left(f^{(k)}(n) \right) = (p - k)P(p, k)n^{p-k-1}$.”

Page 61, line 11 IS: “ $f^{k+1}(n) = P(n, k + 1)n^{p-k-1}$.”

IT SHOULD BE “ $f^{(k+1)}(n) = P(n, k + 1)n^{p-k-1}$.”

Page 63, lines 9-10 IS: “This expression is similar to the Theorem 2.”

IT SHOULD BE: “This expression is similar to that presented in Theorem 2.”

Cover Art Fernand Leger,
Woman with a Book, 1923, The Museum of Modern Art



400 Paramus Road, Paramus, New Jersey 07652
201-447-7200 | www.bergen.edu