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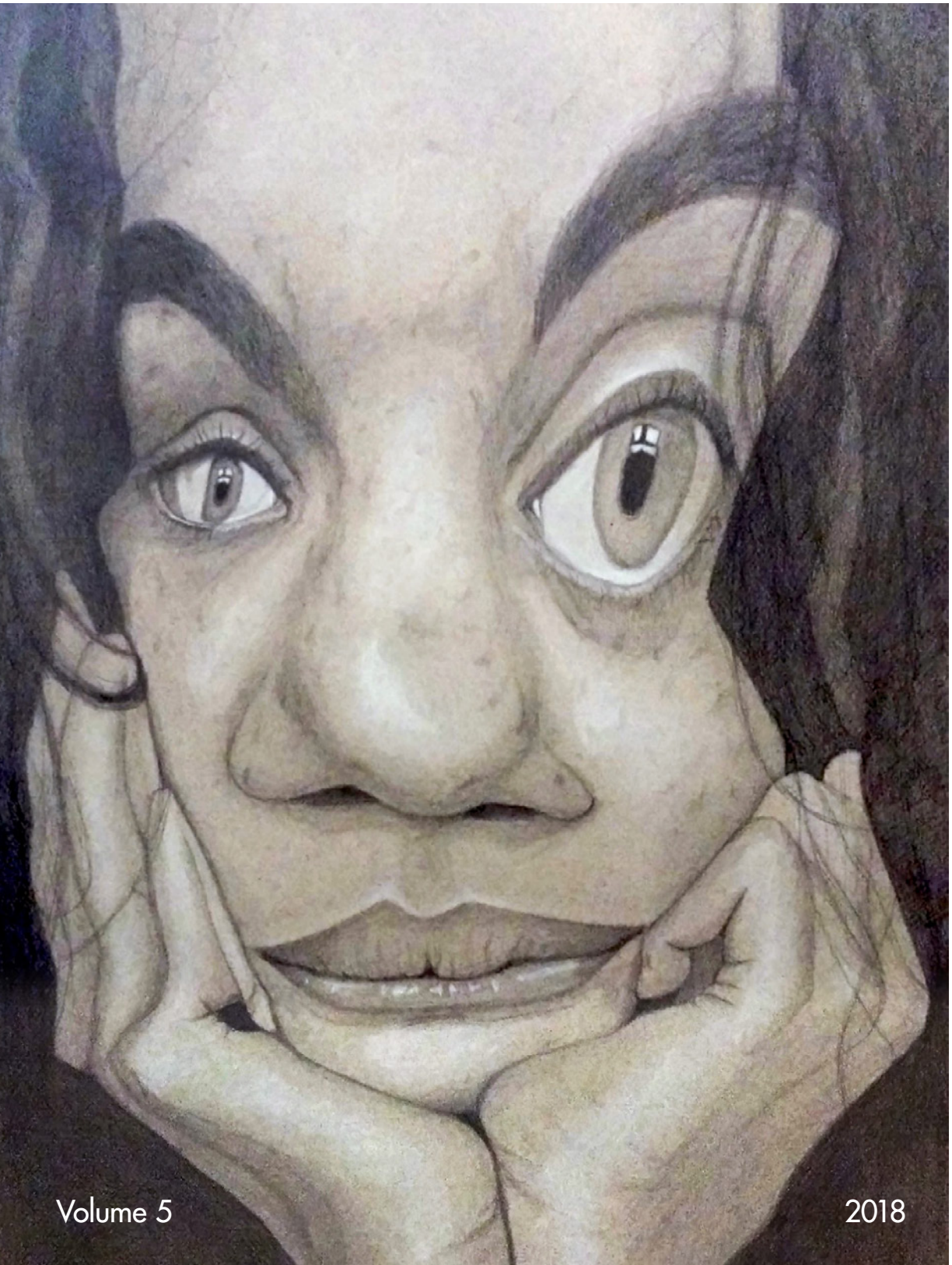

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monarchreview@methodist.edu
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Letter from the Editor

Dear Reader,

Has it ever occurred to you that someone had to invent the number zero? Once upon a time, humankind had no symbol to represent … nothing. In fact, once upon an even more distant time, we had no symbol for *any* number. We lacked the concept of a number that might exist apart from things themselves. I'm not even sure what that last statement means. I *think* it means that, in those days, we couldn't say "3 walnuts" or "3 wombats" because we lacked the abstract idea of a number—3, in this case—that could pertain to anything and everything that existed in discrete units. Hard to imagine, isn't it? But one mathematician here at Methodist was curious about our ancient ideas relating to mathematics and has written a paper on "figurate numbers," a system of ideas among the ancient Greeks. David Shane's paper is published in this fifth volume of the *Monarch Review*. I invite you to read it and be pleasantly baffled, as I have been. Read it a few times perhaps, and something new will seep into your mind, something you probably never imagined before.

This is scholarship. Study what others have thought and written, and reach an understanding, an idea you never had before. This volume of the *Monarch Review* presents Mr. Shane's scholarly paper and six others. Gender roles—the roles of men and women—clash at the heart of a literary analysis of Charlotte Perkins Gilman's short stories in Cheri Todd Molter's paper. The elasticity of the human mind threads through three very different papers: one by Sheryl Brock explores the nature of compassion and the ways it can be cultivated; a chemistry paper by Katayoon Dowlatshahi describes the action of the pharmaceutical antidepressant Effexor; and a report on some original psychology research, by Taylor Porter and David McNeil, investigates the nature of memories, lies, and false confessions. Race relations in this country are at the center of two other papers—Cheri Todd Molter's analysis of 17th century newspaper ads appealing for the capture of enslaved African Americans who have escaped their masters' control and Katayoon Dowlatshahi's sociological examination of 20th century affirmative action bans and the related decline in minority students' enrollment in colleges and universities.

Interestingly, two of the eleven artworks in this volume also take on race relations, the shocking *Caged Bird* and ominous *In Need of Change*. Other works range from the exuberantly abstract to the formally figurative. Whether worked in paint, digital design, collage, drawing, or print-making, these images have been

Letter from the Editor

brought to life by our six student artists: Karen Britton, Khalil Coleman, Heather Miller, Mary Sue Parker, Sierra Romero, and Tony Taylor, Jr.

Very soon, Acting President and Provost Delmas S. Crisp, Jr., will take his leave of Methodist University. He has been a steadfast friend of this journal from its inception. While many individuals, high and low, have meaningfully contributed to the *Monarch Review*, Dr. Crisp's support was simply vital. We couldn't have done it without you, Dr. Crisp. We're grateful for your many years of service and your dedication to academic opportunity and excellence.

And now, here is volume 5, for your pleasure and enlightenment.

Best regards,

Baylor Hicks
Managing Editor

The Charlotte Perkins Gilman Experience: An Analysis of the Literary Devices in Her Short Stories

Cheri Todd Molter

Faculty Sponsor: Dr. Michael Colonnese
Department of English and Writing

Authors have a variety of literary devices from which to choose, and their choices often undergird the structure of their pieces, both influencing the tone of the stories and provoking and intensifying the emotional response of their readers. The nineteenth-century writer Charlotte Perkins Gilman masterfully uses alliteration, consonance, assonance, symbolism, narrative techniques, structural techniques, and other literary and poetic devices in three of her short stories: "Through This," "The Yellow Wallpaper," and "Making a Change." Each story has a distinct plot and structure, but the specific devices that Gilman employs reinforce the overarching feminist theme and allow readers to experience that theme more completely as they read.

"Through This" is a powerful short story about women's endurance, self-sacrifice, and survival in a patriarchal world that restricts most female advancement beyond the domestic sphere. Gilman's title is effective for several reasons. First, it is a summation of the protagonist's belief that she can only be productive and successful "through" her service to her husband and children. Second, the title sets the tone for the piece since the woman struggles to get "through" her day. Lastly, the title connects with the reader's desire to get "through" the story because the literary techniques used by the author leave one breathless and anxious.

Gilman uses a variety of literary devices to enhance the reader's response to "Through This" and to reveal the tensions that exist because of the protagonist's love for her family, her attempts to fulfill societal expectations, and her desire to dream and make a difference in the world. Gilman writes,

> The **d**awn **c**olors **c**reep up my bedroom wall, **s**oftly, **s**lowly. **D**arkness, **d**im gray, **d**ull blue, soft lavender, clear **p**ink, **p**ale yellow, warm gold—sunlight. A new **d**ay. With the *great* sunrise *great* thoughts come. *I* rise **w**ith the **w**orld. *I* live. *I* can help. Here close at hand lie the *sweet home* duties *through* which my life shall t**o**uch the **o**thers! *Through* this **m**a**n** **m**a**d**e h**a**ppier **a**nd

> stronger by my living; *through* th**ese** ros**y** bab**ies** sl**ee**ping here in the growing light; *through* this **s**mall ***sweet,*** well-ordered *home*…*through* me, too, perhaps—**th**ere's **th**e baker. I must get up, or this bright purpose fades. ("Through This" 53, emphases added)

In this excerpt, some of the poetic devices—alliteration, consonance, assonance, and repetition—that Gilman employs to affect the tone of this story are highlighted. She certainly uses alliteration, the repetition of initial consonant sounds: "**c**olors" and "**c**reep," "**d**awn," "**d**arkness," "**d**im," "**d**ull," and "**d**ay," **"p**ink" and **"p**ale, and **"w**ith" and "**w**orld." Here the *d* sound is heavy; the words plod along, weighted down and burdened like the protagonist herself; however, the *p* and *w* sounds are lighter, more hopeful—an optimistic choice that enhances the feeling associated with sunrise. Similarly, repetition of consonant sounds in the words "**c**reep" and "up," "wall," "**s**oft**ly**," "**s**low**ly**," "**d**ull," "blue," and "**p**ale," and "lavender" and "gold" all provide evidence of the author's use of sound repetitions as a means of emphasizing what is most important to her protagonist. Gilman also uses assonance, the repetition of vowel sounds, in the phrases "**ma**n made h**a**ppier," "t**o**uch…**o**thers," and "th**ese** ros**y** bab**ies** sl**ee**ping." In addition, Gilman repeats the words "*great,*" "*sweet*," "*home*," and "*through*," a usage that helps to increase the tension that exists between the woman's loving dedication to her family and the socially-ascribed selflessness that devalues her as an individual and restricts her to living "through" her husband and children.

Furthermore, Gilman uses stream of consciousness narration, which is "a method of narration that describes in words the flow of thoughts in the mind of the character" ("Stream of Consciousness"). Gilman creates a nameless protagonist—a woman who represents all nineteenth-century housewives—and shares her character's hopeful, erratic, reasonable, and desperate thoughts from dawn to nightfall. Gilman writes,

> All is ready—healthful, dainty, delicious. The clean-aproned little ones smile milky-mouthed over their bowls of mush. John kisses me good-by so happily. Through this dear work, well done, I shall reach. I shall help—but I must get the dishes done and not dream. "Good morning! Soap, please, the same kind. Coffee, rice, two boxes of gelatin. That's all, I think."…There, I forgot the eggs! I can make these go, I guess. Now to soak the tapioca. Now the beets on, they take so long. I'll bake the potatoes—they don't go in yet. Now babykins must have her bath and nap. A clean hour and a half before dinner. I can get those little nightgowns cut and basted. How bright the sun is! (IT 53-4)

Gilman's stream of consciousness technique allows the reader to connect to her character in an intimate manner, exacerbates the protagonist's harried nature, and quickens the story's pace. In the excerpt above, the wife and mother makes and serves breakfast to her husband and children, her husband leaves for work, the protagonist speaks to a grocer,

returns home, prepares the baby's food, plans her husband's supper, bathes her baby girl, puts the infant down for a nap, and realizes that it is already midafternoon with only "an hour and a half before dinner" (TT 54). Everything this woman has done since she opened her eyes in the morning has been for the benefit of either her husband or her children, and she has had no time for personal reflection or for pursuing her own interests. By choosing the stream of consciousness technique, Gilman enables readers not only to see what a housewife's day entails but also to intimately connect with this woman through her thoughts. The protagonist's thoughts reveal her pride and love for her family (53), her desire to make a difference in and feel connected with the world (53), her frustration at never having enough time to finish chores or write letters to her friends (54-55), and her desperate hope that things will be easier once her children are grown (54). Furthermore, by structuring her protagonist's thoughts in simple, short sentences—like "That was a good dinner. I like to cook. …That pipe must be seen to before too long. I'll speak to John about it. Coal's pretty low, too" (54)—Gilman captures on the printed page what experienced Buddhists call "monkey mind," the bombardment of rapid, random thoughts that can sometimes overwhelm a person.

Charlotte Perkins Gilman, c. 1900. Photograph probably by C.F. Lummis. Restoration by Adam Cuerden. United States Library of Congress's Prints and Photographs. Public domain.

If Gilman's "Through This" reads like a spinning top that is about to veer off its path and flip over, then "The Yellow Wallpaper" captures the moments that occur after the top swerves away from its centralized rotation and, finally, collapses. The stakes are higher for the protagonist in this story, so Gilman's writing choices reflect that shifting theme and tone. In "The Yellow Wallpaper," Gilman tells the story through a series of journal entries—the forbidden written communication of the protagonist herself. This technique promotes a closer connection between the protagonist and the readers: She shares her innermost thoughts and feelings, and readers become her trusted confidants. Gilman writes,

> Personally, I believe that congenial work, with excitement and change, would do me good. But what is one to do? I did write for a while in spite of [my husband and brother]; but it *does* exhaust me a good deal—having to be so sly about it, or else meet with heavy opposition. …There comes John, and I must

> put this away—he hates to have me write a word. ("The Yellow Wallpaper" 30, 32, emphasis original)

Here Gilman's narrative perspective enhances the credibility of the narrator—the protagonist—since the reader knows precisely what she is thinking. The protagonist comes across as a sensible woman who unfortunately suffers from depression in a patriarchal society that belittles and oppresses women, and her husband—a product of this society—attempts to restrict her movement, to silence her voice, and to trap her until she is able to once again assume her role as the traditionally subordinate, "happy housewife." Moreover, Gilman's journal entry approach also intensifies the reader's response to the gradual decline of the protagonist's mental state. As the protagonist's condition worsens, her "entries" become more erratic, and the reader experiences her desperate isolation and sense of entrapment when she writes about the yellow wallpaper. Later in the story, Gilman switches to the second person to intensify the reader's experience of the protagonist's critical analysis of the wallpaper. She writes,

> [John] thought I was asleep first, but I wasn't, and lay there for hours trying to decide whether that front pattern and the back pattern really did move together or separately. …[T]he pattern is torturing. You think you have mastered it, but just as you get well underway in following, it turns a back-somersault and there you are. *It slaps you in the face, knocks you down, and tramples upon you. It is like a bad dream.* The outside pattern is a florid arabesque, reminding one of a fungus. If you can imagine a toadstool in joints, an interminable string of toadstools, budding and sprouting in endless convolutions—why, that is something like it. (TYW 41-42, emphasis added)

Because the wallpaper is a symbol for this woman's entrapped status in a society that will not aid her recovery, Gilman's shift to the *you* pronoun enables her readers to feel as battered, bruised, and helpless as this new mother whose physical, mental, and emotional needs are disregarded due to ignorance and discrimination. Gilman uses toadstools as symbols also. Toadstools are fungi that grow around dead, decomposing organisms, so their inclusion is another inventive association that conveys the relationship between the wallpaper and the oppressive—even parasitic—society in which the protagonist, her husband John, and their son live. Furthermore, despite the fact that readers are informed by the journal's confessions, Gilman manages to convey that the protagonist is envisioning herself when she sees the "faint figure" who "shake[s] the pattern…as if she want[s] to get" (40). Gilman writes,

> There is one marked peculiarity about this paper…and that is that it changes as the light changes. …At night in…twilight, candle light…and worst of all by moonlight, it becomes bars! …The woman behind it is as plain as can be. I didn't realize for a long time what the thing was that showed behind…but now I am quite sure it is a woman. By daylight she is subdued,

> quiet. I fancy it is the pattern that keeps her so still. It is so puzzling. It keeps me quiet by the hour. (TYW 42)

Even an unsophisticated reader can see that the protagonist is visualizing her own complicated, oppressed situation within an ugly, complex patriarchal pattern of rules, norms, and traditions that dehumanize women. The narrator *is* the woman stuck in the disgustingly unattractive wallpaper pattern. At the story's conclusion, she has locked her husband out of her room and is on the floor creeping along with her shoulder in "the long smooch around the wall' (TYW 49). However, according to Marianne DeKoven, "[i]t is impossible to think of that creeping woman as any embodiment of liberation, even though she has ripped away 'bars' and even though her creeping circuit takes her over, again and again, her husband's fallen body. She has defeated him and his world of anti-female laws at far too great a cost to herself" (219).

Gilman's short story "Making a Change" has a happier outcome for its female protagonist than have the aforementioned stories. Nevertheless, in this text, as in the others, Gilman is still grappling with the late nineteenth-century social expectations for mothers. Gilman chooses to write "Making a Change" from the third person omniscient point of view, which offers a broader look at how each of the main characters—Julia and Frank Gordins and "Mrs. Gordins, senior" (Gilman's name for Frank's mother)—interact with one another and behave within the restrictive gender-based norms of their society. Although the reader is allowed less direct access to the inner thoughts of Julia, the reader still understands how dejected and depressed Julia feels because of the language Gilman uses:

> Upon her tired ears, her sensitive mother's heart, the grating wail from the next room fell like a lash. Her ears were hypersensitive, always. She had been an ardent musician before her marriage, and had taught quite successfully on both piano and violin…But if her ears were sensitive, so was her conscience. …The child was her child, it was her duty to take care of it, and take care of it she would. ("Making a Change" 57-58)

Julia feels that it is her "duty" to take care of the wailing child—a child whose cries hurt her ears, which were once so instrumental in her career as a musician. Obviously, Julia would rather be working as a musician again, but in her new role as a mother, society does not approve of her continued employment outside her home. Gilman uses the metaphor of a machine to describe Julia's manner of movement and speech, calling it "mechanical" three times, thus stressing her disengaged, emotionless state of mind and her dehumanized, almost lifeless state (MAC 57, 58, 60). According to Julianne Fleener, Gilman believed that "[f]emale exclusion, women denied the opportunity to work, or their imprisonment behind four walls, led to madness" (143). This belief is evident in all three Gilman pieces, but after Julia attempts suicide she is saved by her mother-in-law, who introduces a creative new idea that will improve the lives of both women: Mrs. Gordins, senior, offers to watch her grandson Albert so Julia can once again work as a musician and teacher.

Gilman's use of dialogue is particularly important in this story because it suggests that productive communication between the characters is possible. The progressive changes that occur in their family's social dynamic require respectful discourse and thoughtful responses, and Gilman's realistic verbal exchanges facilitate the familial improvements that occur. This use of dialogue is different from the one-sided conversations with the grocer in "Through This" or the ineffective discourse between the protagonist and John in "The Yellow Wallpaper." In fact, in "Making a Change," the dialogue dictates what is happening in the story. The communication at the beginning of the story is just as ineffective as any that can be found in "The Yellow Wallpaper." However, after Julia's suicide attempt, the story takes a marked turn. Instead of Julia's dying or being saved only to further descend into depression, the dialogue between the two women changes and their improved communication allows Julia to begin recovering. Not only does Julia's mother-in-law save Julia's physical life, but she also seems to revive the person Julia truly is, simply by communicating effectively. Because of the culturally based gender norms, both Julia and her mother-in-law fear Frank's reaction to his discovery that Julia is working outside the home and that her mother-in-law is also earning income through babysitting. At this pivotal point, their effective communication wins over Frank as well: Frank listens to his mother and his wife explain the changes that have occurred at home, and afterward simply replies, "If it makes all of you as happy as that…I guess I can stand it" (MAC 65). Frank's colleagues could judge him harshly; nonetheless, for the sake of his marriage and family, Frank risks taking a progressive stance by listening to the arguments of women and, in so doing, resists being manipulated by the patriarchal norms of the time. However, he would not be able to take such a position if he were not first willing to engage in effective dialogue with his wife and mother, who encourage his progressive stance.

In all three of these stories, the names of Gilman's characters are significant symbols. In "Through This" and "The Yellow Wallpaper," the female protagonists remain nameless, and their anonymity enables them to effectively represent all women in stories that comment on women's societally hindered individuality and the restriction of their voices. According to Gilman, their expected selflessness has rendered them nameless. As Fleener states, "Gilman was working against her own culture's definition of women" (143). Furthermore, in those same stories, the male characters are named "John," which is the most common name for men. The name "John" functions as a symbol that implies not only that these characters represent all men but also that men in society feel deserving of their male privilege.

In all these ways, Charlotte Perkins Gilman uses literary and poetic devices effectively to deepen the readers' experience of her short stories. By employing a stream of consciousness technique in "Through This," coupled with poetic devices that repeat sounds, Gilman creates an almost frenzied experience for readers as the narrator describes event after event as she gets through her day. The repetition of words and sounds (assonance, alliteration, and consonance) reinforces this frenzy as these poetic devices help provide a cadence, almost a drumbeat, that paces the narrative. Gilman uses a journal entry approach in "The Yellow Wallpaper" to engage the reader in the narrator's progressive decline in mental health, an engagement only intensified by a shift to second person that invites the reader to experience what she is experiencing. In "Making a Change," Gilman uses dialogue to pace the narrative, shifting from ineffective

to effective communication between the characters, a process that enables Julia to overcome the patriarchal constraints the other narrators could not. Essentially, as the dialogue improves, so do the lives of the characters. The use of symbol is another literary device Gilman uses effectively in "Through This" and "The Yellow Wallpaper." The namelessness of the narrators in these stories suggests that women are not highly valued in contemporary society, particularly those who are overwhelmed or who remain trapped by their culturally ascribed gender roles. Finally, the yellow wallpaper itself is symbolic, as is the toadstool pattern the narrator sees in the wallpaper, for the pattern emphasizes the toxic nature of society for women. This poisonous characteristic of patriarchal society is clear, too, in "Making a Change," in which Julia has become *figuratively* dead—"mechanical" according to the metaphor—and this "poison," the gendered demands society makes of her, nearly leads to her *literal* death. The use of these literary devices enhances Gilman's overarching theme that the patriarchal dominance of the society in which they lived was toxic to women and that they were essentially in bondage and deserved a chance to express themselves and to fully discover their identities.

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Figurate Numbers: A Historical Survey of an Ancient Mathematics

David Shane

Faculty Sponsor: Dr. Kathleen Fick
Department of Mathematics

Introduction

Figurate numbers comprise one of the oldest areas of mathematics, dating back to the Pythagoreans of the 6^{th} century BCE and capturing the attention of many mathematical luminaries, such as Fermat, Euler, and Gauss. In contemporary times, however, figurate numbers are studied only by student mathematicians, largely because of their aesthetic link to geometric objects. Interest in figurate numbers and in number theory generally has been in decline since the Age of Enlightenment, due to mathematicians' lean towards application and the scientific customer. Modern mathematics is largely defined by logic and scientific application rather than philosophical excursion or theoretical notion. Nonetheless, despite the professionalization of the subject of mathematics, figurate numbers remain a rich subject for teaching about philosophical relationships between arithmetic and geometry, and, while the body of knowledge still does not have any apparent application, perhaps future mathematics may find a diamond that has been lying in the rough for several millenia.

Origins

The earliest recorded forms of mathematics contain rudimentary concepts of numbers and counting with hardly any notion of abstract throught. The small archaeological record that does exist establishes the ancients' preoccupation with problems largely related to infrastructure and agriculture. Exercises in trade and commerce that appear on several archaic clay tablets and papyrus suggest that numbers were largely understood by the ancients as a property of the actual physical object(s). For example, the sensation of water may be described as hot, tepid, or cold, in relation to the internal temperature of the water. Regardless of whether one tests the temperature of water, the water will always have a property that describes its current internal temperature. Similarly for the ancient view of numbers, the abstract

quantity of three is something that cannot be transferred among objects, such as from goats to coins: these numbers are different types of threes that belong to specific groups of objects. Ancient thinkers eventually discovered how to apply the abstract in mathematics, but the process was slow and chaotic. The first and perhaps largest step toward a modern understanding of numbers comes from the ancient cult of the Pythagoreans. Not much is known about the leader, Pythagoras, and what is known comes from historians who lived hundreds of years after Pythagoras's death. Despite the lack of contemporaneous reports, the records from Iamblicus, Aristotle, and others relay the life and philosophy of Pythagoras in the form of ancient biography.[1]

The mathematician Morris Kline highlights the interesting fact that the Pythagoreans did not completely develop an abstract notion of numbers, which is to say that, when the Pythagoreans claimed everything was made of numbers, they meant it in a literal sense. Similar to our current understanding that atoms are the building blocks of the universe, the Pythagoreans' belief was that numbers were our atoms.[3] The Pythagoreans did not believe that atoms were in the shape of numbers, but rather that each and every possible arrangement was a specific number. The Pythagoreans organized the various numbers first by geometric arrangement and then by size; today, mathematicians call these arithmetic progressions "figurate numbers." Using geometry as the basis for all physical things, the smallest geometric figure in the traditional sense is the triangle; hence, the base progression of figurate numbers is known as triangular numbers. Notations for figurate numbers vary, so this author has chosen a notation that lends itself well to the different aspects of the discussion. Let $F_m^d(n) = x$ denote a figurate number in dimension d with geometric arrangement m, side length count n and total unit count x, where $d, m, n, x \in \mathbb{N}$ and $m \geq 3$. Because the Pythagoreans held that the monad (the number one) was the most fundamental element from which all else stemmed, each geometric arrangement was composed of this self-replicated unit, as illustrated in Figure 2:

Figure 1: A depiction of Pythagoras of Samos[2]

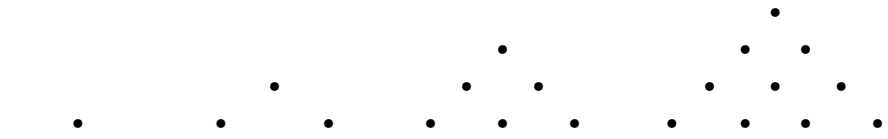

Figure 2: The four smallest triangular numbers

If one considers the total count of units for each figure in Figure 2, this arithmetic series takes shape: $F_3^2(n) = \{1, 3, 6, 10, 15, 21, \ldots, \frac{n(n+1)}{2} : n \in \mathbb{N}\}$. Taking note of the difference between each triangle and the next, one can deduce that the next largest triangle will be formed by adding a row of $n + 1$ units to one of the three sides of the preceding figure. This deduction leads to the following formula for the total number of units in a triangular number:

$$\begin{aligned} F_3^2(n) &= F_3^2(n-1) + n \\ &= F_3^2(n-2) + (n-1) + n \\ &\quad \vdots \\ &= 1 + 2 + 3 + \ldots + (n-1) + n = \sum_{i=1}^{n} i. \end{aligned}$$

Although it lacks the rigorous standards of modern proofs, the famous derivation of the triangular formula by the child Friedrich Gauss, later a noted mathematician, earns homage here:

$$\begin{aligned} F_3^2(n) &= 1 + \quad 2 + \quad 3 + \ldots + (n-1) + n \\ +F_3^2(n) &= n + (n-1) + (n-2) + \ldots + \quad 2 \quad + 1 \end{aligned}$$

$$2F_3^2(n) = (n+1) + (n+1) + (n+1) + \ldots + (n+1) + (n+1) = n(n+1)$$

$$\therefore F_3^2(n) = \frac{n(n+1)}{2}.$$

An absence of evidence suggests the Pythagoreans did not develop a concept of zero; hence, the smallest possible value for each arithmetic series is the number one. This idea—that one is the smallest possible value—is a central component of Pythagorean philosophy, which interestingly establishes a formulation for monotheism: every arithmetic progression of figurate numbers includes the monad, and the monad is the only number that appears in every geometric arrangement. Thus, to the Pythagoreans, the monad is a perfect, self-replicating unit that births every possible geometric shape: each figurate number is comprised of just the monad and self-replicated copies, which form the various sizes and arrangments. Perhaps

this line of reasoning also explains why the Pythagoreans adopted the $F_3^2(4)$ triangle as their sacred object (triangular numbers serve as a basis for all other figurate arrangments) and also why they were devastated after the discovery of an incommensurate number: the foundation for their entire philosophy was disproven.

Theorem 1: Every integer greater than one can be expressed as the difference of two consecutive triangular numbers.

Proof: Since every triangular number can be expressed in the algebraic form $\frac{n(n+1)}{2}$*, the preceding triangular number may be expressed as* $\frac{(n-1)(n)}{2}$ *by replacing* n *with* $n-1$*, where* $n \in \mathbb{N}$*. Then, the application of algebraic laws provides the proof:*

$$\frac{n(n+1)}{2} - \frac{(n-1)(n)}{2} = \frac{1}{2}[n(n+1) - (n-1)(n)]$$

$$= \frac{1}{2}[(n^2+n) - (n^2-n)]$$

$$= \frac{1}{2}(n^2+n-n^2+n)$$

$$= \frac{1}{2}(2n)$$

$$= n.$$

The second arithmetic progression aligns itself to the geometric shape with four equilateral sides and congruent angles (see Figure 3), hence the name square numbers. While figurate numbers have been all but forgotten in the realm of mathematics, the naming convention and usage of square numbers are perhaps the only remnant still in use. In large part, mathematicians promoted square numbers over the others due to their ease of use and significance in quadratic equations.

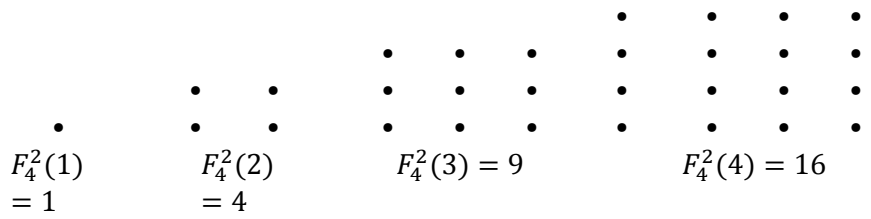

Figure 3: The four smallest square numbers

Using the same argument for the construction of triangular numbers, each square number is generated by adding a corner section along the top and right of the previous shape. This new strip that is repeatedly added to the previous figure is called a *gnomon,* and it is unique for each figurate number type. For square numbers, the gnomon takes on an "L" shape and matches the Greek word **γνωμων** (gnōmōn), the name for the L-shaped carpenter's square. The formulation of the arithmetic series of square numbers is $F_4^2(n) = \{1, 4, 9, 16, \ldots, n^2 : n \in \mathbb{N}\}$ and the difference between each number is simply each odd integer of corresponding size. Thus, one can deduce that the series for square numbers is

$$\begin{aligned} F_4^2(n) &= F_4^2(n-1) + (2n-1) \\ &= F_4^2(n-2) + (2n-1) + (2n-3) \\ &\vdots \\ &= 1 + 3 + 5 + \ldots + (2n-3) + (2n-1) = \textstyle\sum_{i=1}^{n} 2i - 1 \end{aligned}$$

and can determine the formula for square numbers by applying the aforementioned Gaussian method:

$$\begin{aligned} F_4^2(n) &= 1 + 3 + 5 + \ldots + (2n-3) + (2n-1) \\ +F_4^2(n) &= (2n-1) + (2n-3) + (2n-5) + \ldots + 3 + 1 \\ \hline 2F_4^2(n) &= (2n) + (2n) + (2n) + \ldots + (2n) + (2\mathrm{n}) = n(2\mathrm{n}) \\ \therefore F_4^2(n) &= \frac{2n^2}{2} = n^2. \end{aligned}$$

An interesting aspect of square numbers is that one can decompose a square number into the sum of two consecutive triangular numbers. This fact can be demonstrated by simply drawing lines to connect the units of a square figurate into two right triangles, or, alternatively, it may be proven using algebra, as follows:

Theorem 2: Square numbers decompose into two consecutive triangular numbers.

Proof: Let $F_3^2(n)$ *denote an arbitrary triangular number with the previous triangular number being* $F_3^2(n-1)$. *Straight-forward computation yields the following:*

$$F_4^2(n) = n^2 = \frac{2n^2}{2}$$

$$= \frac{n^2 + n}{2} + \frac{n^2 - n}{2}$$

$$= \frac{n(n+1)}{2} + \frac{(n)(n-1)}{2}$$

$$= F_3^2(n) + F_3^2(n-1).$$

Hence, every square number can be expressed as the sum of two consecutive triangular numbers.

In general, one may continue to perform this line of inquiry in order to establish the arithmetic progressions of the infinitely many figurate numbers for side count $n > 4$; however, the author now moves to establish a general formula that generates all two-dimensional figurate number formulas. First, consider the following table of figurate numbers, Table 1:

Table 1. Table of figurate numbers

Figure	Formula	Difference
Triangle	$F_3^2(n) = \frac{1n^2 - (-1)n}{2}$	$F_4^2(n) - F_3^2(n) = \frac{n^2 - n}{2}$
Square	$F_4^2(n) = \frac{2n^2 - (0)n}{2}$	$F_5^2(n) - F_4^2(n) = \frac{n^2 - n}{2}$
Pentagon	$F_5^2(n) = \frac{3n^2 - (1)n}{2}$	$F_6^2(n) - F_5^2(n) = \frac{n^2 - n}{2}$
Hexagon	$F_6^2(n) = \frac{4n^2 - (2)n}{2}$	$F_7^2(n) - F_6^2(n) = \frac{n^2 - n}{2}$
⋮	⋮	⋮

Notice that the difference between every two consecutive formulas is the same value (constant). This information is valuable in that it can be used to construct a proof using the principle of mathematical induction.

Theorem 3, the base formula for two-dimensional figurate number series

Proof: Proceeding via the principle of mathematical induction, let P(m) denote the statement that "every arithmetic series for figurate numbers may be generated by the formula $\frac{(m-2)n^2-(m-4)n}{2}$, *where* $m, n \in \mathbb{N}$ *and* $m \geq 3$." *The basis step* $m = 3$ *produces* $P(3) = \frac{n^2+n}{2}$, *which is the formula for triangular numbers and thus a true statement. Proceeding now to the inductive hypothesis, let* $P(k)$ *denote the statement that every arithmetic series for figurate numbers can be*

generated by the formula $\frac{(k-2)n^2-(k-4)n}{2}$, *where* $k, n \in \mathbb{N}$. *The ensuing steps demonstrate that* $P(k+1)$ *necessarily follows:*

$$P(k+1) = \frac{[(k+1)-2]n^2 - [(k+1)-4]n}{2}$$

$$= \frac{(k-1)n^2 - (k-3)n}{2}$$

$$= \frac{(k-2)n^2 - (k-4)n}{2} + \frac{n^2 - n}{2}$$

$$= P(k) + \frac{n^2-n}{2}.$$

Given that $\frac{n^2-n}{2}$ *is the constant value between figurate number formulas, this proof has demonstrated that P(k+1) is true. Therefore, by the principle of mathematical induction, every arithmetic series for two-dimensional figurate numbers can be generated by the formula* $\frac{(m-2)n^2-(m-4)n}{2}$, *where* $m, n \in \mathbb{N}$ *and* $m \geq 3$.

The Pythagoreans produced a lasting impact on mathematics that was spawned by their philosophy, which had the worship of numbers as its central tenet. The Pythagoreans' ideas influenced the works of Plato, Aristotle, and most notably Euclid, although the geometric representation had been drastically reduced from *n*-gonal numbers to only square and oblong (rectangular) numbers. Evidence of this may be found in Euclid's *The Elements*, where definitions 15-19 in Book VII discuss integers in relation to geometric orientation.[4] However, Euclid had trouble absorbing the arithmetic series of figurate numbers,[4] as noted by Heath in his translation and commentary:

> The words *plane* and *solid* applied to numbers are of course adapted from their use with reference to geometrical figures...Iamblicus tells us that in the old days they represented the quantuplicities of number in a more natural way by splitting them up into units, and not, as in our day, by symbols. Aristotle too mentions one Eurytus as having settled what number belonged to what, such a number to a man, such a number to a horse, and so on, "copying their shape with pebbles, just as those do who arrange numbers in the forms of triangles or squares."[5]

However, mathematicians who appear immediately after Euclid, such as Nichomachus, Theon of Smyrna, and Diophantus, called into question Euclid's notion of representing numbers as lines, areas, and volumes, specifically when it came to the representation of the operation "a number multiplied by one."[5] Here, Euclid's definitions encounter problems as some operations call for a construction in x dimensions yet the result appears to be in y dimensions. For example, consider the statement "three multiplied by one equals three." Because the operation is multiplication, Euclid's definitions characterize the result as a two-dimensional object, line multiplied by line, producing an area. However, the number three prior to the operation was already a one-dimensional representation (a line). Here, a line multiplied by a line did not produce an area but another line, which is paradoxical according to the working definitions. This was just one of several areas that was revised by the Neo-Pythagoreans, who kept the mathematics developed by the original Pythagorean school but chose to rework the taxonomy and philosophical components.

The Neo-Pythagoreans

One of the earliest figures in Neo-Pythagoreanism was Nicomachus, about whom little is known. Nichomachus, pictured in Figure 4, was heavily influenced by Plato and the original Pythagoreans, whose traditions were still extant in Nichomachus's day. Although Nichomachus subscribed to the many established doctrines of the Pythagoreans, he differed with their traditional views on education. Nichomachus maintained that, of the four subjects stressed by Plato's academy, arithmetics was superior.[3] The emphasis placed on arithmetics by Nicomachus was a bold assertion since the traditional model called for an equal balance of study among the various subjects. Subsequently, Nichomachus made many contributions in arithmetic and figurate numbers, where he expanded on the original ideas and invented several more.

Figure 4: A depiction of Nicomachus[6]

One of Nichomachus's assertions for figurate numbers was that the "(n-1)st triangular number added to the nth k-gonal number gives the nth (k+1)-gonal number."[3] Here is a proof of Nichomachus's assertion:

Theorem 4, Nicomachus's first figurate theorem: The nth (k+1)-gonal number may be written as the sum of the (n-1)th triangular number plus the nth k-gonal number.

Proof: Let $F_{k+1}^2(n)$ *represent the nth (k+1)-gonal number and* $F_k^2(n)$ *represent the nth k-gonal number. Applying Theorem 3 yields the following:*

$$F_{k+1}^2(n) = F_3^2(n-1) + F_k^2(n)$$

$$\frac{(k-1)n^2-(k-3)n}{2}$$

$$= \frac{(3-2)(n-1)^2-(3-4)(n-1)}{2} + \frac{(k-2)n^2-(k-4)n}{2}$$

$$= \frac{(n-1)^2+(n-1)}{2} + \frac{(k-2)n^2-(k-4)n}{2}$$

$$= \frac{n^2-n}{2} + \frac{(k-2)n^2-(k-4)n}{2}$$

$$= \frac{(k-1)n^2-(k-3)n}{2}.$$

In addition to discovering a connection among all the figurate numbers, Nichomachus made the curious discovery that the sum of the first *n* number of odd integers is equal to *n* squared (see Table 2):

Table 2. Sum of first *n* number of odd integers equals *n* squared.

The First *n* Odd Integers	Summation
1	1^2
1+3	2^2
1+3+5	3^2
1+3+5+7	4^2
1+3+5+7+9	5^2
⋮	⋮

He also asserted that a number cubed is equal to the summation of odd integers that start at $F_3^2(n-1)$ and run to $F_3^2(n-1)+n$ (see Table 3):.

Table 3. Summation of sequential odd integers equals *n* cubed.

Run of *n* Odd Integers	Summation
1	1^3
3+5	2^3
7+9+11	3^3
13+15+17+19	4^3
21+23+25+27+29	5^3
⋮	⋮

In honor of Nichomachus, the author offers the following proof, linking triangular numbers and square numbers (two-dimensional figurate) to cubed numbers (three-dimensional figurate).

Theorem 5, triangular numbers to cubed numbers: Every cubed integer greater than one is the difference of two square numbers whose indices are consecutive triangluar numbers.

Proof:

$$F_4^2[F_3^2(n)] - F_4^2[F_3^2(n-1)] = \left[\frac{n(n+1)}{2}\right]^2 - \left[\frac{n(n-1)}{2}\right]^2$$

$$= \frac{n^2(n+1)^2}{4} - \frac{n^2(n-1)^2}{4}$$

$$= \frac{n^4+2n^3+n^2}{4} - \frac{n^4-2n^3+n^2}{4}$$

$$= \frac{n^4+2n^3+n^2-n^4+2n^3-n^2}{4}$$

$$= \frac{4n^3}{4}$$

$$= n^3$$

The following Table 4 illustrates the results of Theorem 5:

Table 4. Triangular numbers to cubed numbers

Run of n Odd Integers	Summation
3^2-1^2	2^3
6^2-3^2	3^3
10^2-6^2	4^3
15^2-10^2	5^3
21^2-15^2	6^3
…	…

Besides Nichomachus, the other leading Neo-Pythagorean who contributed to the advancement of figurate numbers was Diophantus of Alexandria, portrayed in Figure 5. Diophantus wrote several books on mathematics and took the first steps toward the development of a completely abstract system, which later blossomed into algebra. In his work, Diophantus focused on deducing the arithmetic properties of figurate numbers, such as deducing the number of sides, the different ways a number can be expressed as a figurate number, and the formulation of the arithmetic progressions.[7]

Figure 5: A depiction of Diophantus of Alexandria[8]

It appears that Diophantus was influenced by Euclid's work but strove to re-establish Euclid's views on numbers through the syncretism of ancient Pythagorean representation. By utilizing discrete values in the form of pebbles rather than lines, Diophantus assisted in the taxonomy of numbers at the expense of neglecting the development of incommensurate numbers. Regardless of his motivation, Diophantus not only revived but also furthered the theory of figurate numbers, with one specific addition being the following algorithm, which tests whether an integer is of a certain m-gonality[9]:

Definition: The Diophantus Algorithm

Step 1. Test an arbitrary integer n *to determine if it is a perfect square:*

$$8(m-2)F_m^2(n) + (m-4)^2 = x, \quad x \in \mathbb{N}$$

Step 2. If x *is a perfect square, then n is obtained for the m-gonal number through*

$$2n(m-2) - (m-4).$$

The Diophantus Algorithm requires two computational steps, which is justified given the complete lack of algebra during the 2nd century CE. An alternative method to test m-gonality uses the established facts that every number can be expressed as the difference of two triangular numbers (Theorem 1) and every square number is the difference of two consecutive triangular numbers (Theorem 2).

Theorem 6, *M*-gonal test via the linear combination of consecutive triangular numbers: Every integer can be tested for m-gonality by the formula $\mathbf{x = F_3^2(n) + (m-3)F_3^2(n-1), x \in \mathbb{N}}$ **.**

Proof: From Theorem 3, every two-dimensional figurate number can be expressed in terms of the formula $F_m^2(n) = \frac{(m-2)n^2-(m-4)n}{2}$ *. Thus,*

$$\frac{(m-2)n^2-(m-4)n}{2} = \frac{(m-2)n^2-(m-4)n}{2} + \frac{n(n+1)}{2} - \frac{n(n+1)}{2}$$

$$= \frac{n(n+1)}{2} + \frac{(m-3)(n^2-n)}{2}$$

$$= \frac{n(n+1)}{2} + (m-3)\frac{n(n-1)}{2}$$

$$= F_3^2(n) + (m-3)F_3^2(n-1).$$

Therefore, every integer can be tested for m-gonality via the formula $x = F_3^2(n) + (m-3)F_3^2(n-1)$.

Theorem 6 allows the mathmatician to input an unknown value x and test arbitrary values for m where solutions have integer values for n. However, the true power of this theorem lies in the following corollary, which states that m-gonality can be checked through the well-known quadratic formula:

Corollary 1: *M*-gonal test via the quadratic formula

$$x = \frac{n^2 + n}{2} + \frac{(m-3)(n^2 - n)}{2} \Longrightarrow$$

$$(m-2)n^2 + (4-m)n - 2x = 0, \qquad A = (m-2), B = (4-m), C = -2x.$$

For example, one can test an arbitrary integer, say 215, to see if it is a hexagonal number $(m = 6)$:

$$(6-2)n^2 + (4-6)n - 2(215) = 0$$

$$4n^2 - 2n - 430 = 0$$

$$n = \frac{1 \pm \sqrt{1721}}{4}.$$

Since the desired solutions for n are positive integers, one can conclude that 215 is not a hexagonal number because these two solutions are both irrational. Alternatively, consider the number 1551 to see if it is a triagontagonal number (a 30-sided figure):

$$(30-2)n^2 + (4-30)n - 2(1551) = 0$$

$$28n^2 - 26n - 3102 = 0$$

$$n = \frac{-141}{14} \; or \; n = 11.$$

Thus, 1551 is the 11th triagontagonal number because this equation results in an integer solution.

Diophantus was one of the first mathematicians to systematically seek solutions for equations of specific forms, especially those that have multiple unknowns. For example, Diophantus commonly examined problems of the form $x^2 + y^2 = z^2$, which generates Pythagorean triplets when $x, y, z \in \mathbb{Z}$. Due to the nature of mathematics during his day, Diophantus often sought only integer solutions to these types of problems and was often satisfied upon finding a single solution. However, solving equations of this type often leads to parametric solutions where infinitely many solutions satisify the equation. In honor of Diophantus, equations of the form $Ax^n + By^n = Cz^n$ are now known as Diophantine equations. Continuing with the example of the second-degree Diophantine equation,

$x^2 + y^2 = z^2$, one sees that both $(3,4,5)$ and $(5,12,13)$ are two of the infinitely many solutions given by the parametric solutions $x = st,\ y = \frac{s^2-t^2}{2},\ z = \frac{s^2+t^2}{2}$.

The ability to solve these types of equations allows the mathemetician to answer more advanced questions on figurate numbers, such as "which triangular numbers are also square numbers?" One obvious approach would be to set up an equation in which the triangular number formula is equal to the square number formula, resulting in the Diophantine equation (alternatively called a Pell equation since there is only one coefficient),

$$\frac{s^2+s}{2} = t^2n^2 + n = 2m^2 .$$

As mentioned earlier with parametric solutions, mathematicians of Diophantus's time were satisfied with a single, non-trivial solution like (8,6): $(8)^2 + (8) = 2(6)^2 = 72$. These solutions were often obtained through trial and error, and it was not until 1778 that the great Leonhard Euler showed that a parametric solution existed for which triangular numbers are also square numbers:

$$N_k = \left[\frac{(3+2\sqrt{2})^k - (3-2\sqrt{2})^k}{4\sqrt{2}}\right]^2 .$$[10]

After Diophantus, a large shift occurred in the realm of mathematics, and development was neglected for several centuries until Fibonnaci reintroduced the western world to mathematics in the 12th century CE. Building on Fibonacci and Diophantus, the next major steps were taken by the pioneering fathers of modern number theory, Blaise Pascal and Pierre de Fermat.

Birth of Modern Number Theory

During the 17th century, mathematics underwent sweeping reforms in the western world. A large majority of these revolutionary skirmishes took place in response to the mathematicians Descartes, Pascal, and Fermat, whose work in arithmetic and algebraic methods challenged the prevailing models during their time.[11,12] Several of these newer developments resulted in famous mathematical feuds, as the new creative methods were demonstrating the same explanatory power as geometry without the need for geometric principles.

Blaise Pascal (see Figure 6) excelled at mathematics and science even as a child. In his early adulthood, he created a precursor to the calculator known as Pascal's calculator, or a Pascaline. Pascal's work in mathematics spanned several different areas, with his most recognized contribution being his work in probability theory. In 1653, Pascal wrote his *Treatise on the Arithmetic Triangle,* which discusses the triangular array known as Pascal's triangle. This triangle—rife with numerical patterns and mathematical connections—is primarily used for the identification of

Figure 6: Blaise Pascal[13]

binomial coefficients. As shown in Figure 7, one of the more interesting patterns that occurs in Pascal's triangle is along the third diagonal in both directions: the reader's old friends, the triangular numbers. In fact, all of the rows for Pascal's triangle correspond to figurate numbers, known as the figurate numbers of simplices. In geometry, a simplex is the consideration of a triangle in arbitrary dimensions, and, in the notation used here, the simplex is every arithmetic series of the form $F_3^x(n)$ where $x \in \mathbb{N}$. Pascal was not the first person to establish this triangular array, as much work on the figurate numbers of simplices had already been carried out by Chinese and Neo-Pythagorean mathematicians in previous centuries. However, Pascal was instrumental in making the previously unidentified connections between binomial coefficients and combinatorics.[11]

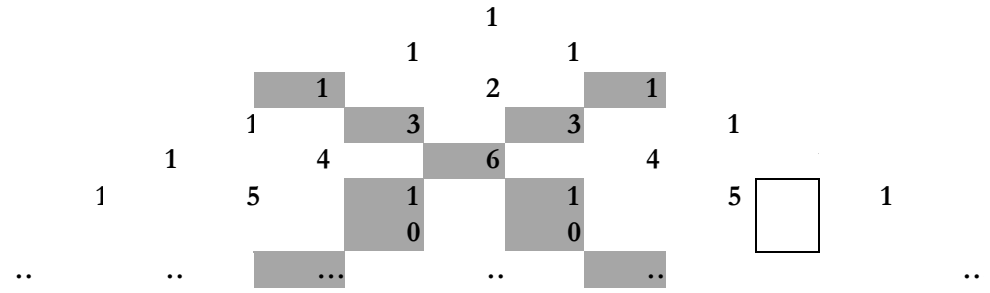

Figure 7: Pascal's Triangle (triangular numbers are shaded)

Offered in the spirit of Pascal, the following proof demonstrates that every positive consecutive integer product is divisible by the summation of integers less n.

Theorem 7: The positive consecutive summation of n-1 terms divides a positive consecutive product of n terms. The product of positive consecutive integers $\mathbf{n!}$ is divisible by the summation less n: $\mathbf{F_3^2(n-1)\,|\,n!}$.

Proof:

$$\frac{n!}{F_3^2(n-1)} = \frac{1*2*3*\ldots*(n-1)*n}{1+2+3+\cdots(n-2)+(n-1)}$$

$$= \frac{1*2*3*\ldots*(n-1)*n}{\frac{(n-1)*(n-2)}{2}}$$

$$= \frac{2*2*3*\ldots*(n-1)*n}{(n-2)*(n-1)}$$

$$= 2*2*3*\ldots*(n-4)*(n-3)*n.$$

Corollary 2: Every triangular number greater than three is composite.

In Pierre de Fermat's time, algebra had matured to the point that it was powerful enough to challenge the notion that geometry was the bedrock of mathematics, and it was these advancements that enabled Fermat to develop significant components of the theoretical nature of numbers. It must be understood that during the Age of Reason, the profession of mathematician was non-existent; hence, for Pascal, Fermat, Descartes and company, mathematics was seen more as a leisure activity than an academic pursuit: most of the mathematical advancements during this time were made via public intellectual contests and personal correspondence between academicians. Pierre de Fermat (see Figure 8) was no exception to this rule, and the bulk of his contributions are known through Fermat's correspondence with friends and colleagues.[14]

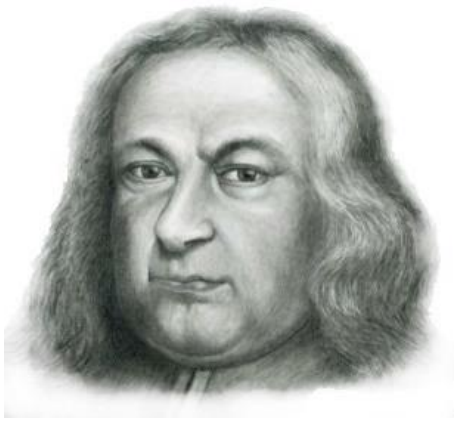

Figure 8. Pierre de Fermat[15]

Besides the tomes of personal correspondence left by Fermat, some of his work comes from notes scribbled in his personal books. Fermat penned one of his most legendary passages in the margin of his copy of Diophantus's *Arithmeticae*: "I have discovered a truly remarkable proof of this theorem which this margin is too small too contain."[14] In similar vein, many of Fermat's contributions to mathematics appear as motivational challenges to the math community at large. In regard to his work on figurate numbers, Fermat pushed Diophantus's work further by creating even more connections. One of the most famous of these was Fermat's figurate

number theorem, which states that every number n can be written as the sum of at most n figurate numbers of n-gonal sides. While it seems unlikely that Fermat ever solved this conjecture due to the lack of required mathematical theory in his time, several advances were made over the next century and the eventual proof was derived in 1813 by Cauchy.

After Fermat, number theory and figurate numbers were never the same: new ideas were formulated and several gaps were bridged. For instance, mathematicians began noticing connections such as the relationship of triangular numbers to Pell-Lucas numbers (fractions whose values increasingly approximate $1 + \sqrt{2}$, the silver ratio).

Theorem 8, deriving non-trivial factors of triangular numbers from Pell-Lucas numbers

Proof: It is well-known that $(P_n + P_{n-1})^2(P_n)^2 = F_3^2(n)$ *, where* P_n, P_{n-1} *denote Pell-Lucas numbers. Since every triangular number greater than three is composite (Corollary 2), one seeks to establish possible non-trivial factor pairs:*

$$\frac{n(n+1)}{2} = \frac{4}{4}\left[\frac{n(n+1)}{2}\right]$$

$$= \frac{4n^2 + 4n}{8}$$

$$= \frac{(2n+1)^2 - (-1)^{2n}}{8}$$

$$= \frac{(2n+1) + (-1)^n}{2} * \frac{(2n+1) - (-1)^n}{4}.$$

From the Pell identity it is known tha t $(P_n + P_{n-1})^2 = \frac{2n+1+(-1)^n}{2}$ *and* $P_n^2 = \frac{2n+1-(-1)^n}{4}$ *because* $P_n \leq P_n + P_{n-1}$ *. Now, since the term* $(-1)^n$ *alternates signs as n alternates, there are two cases for each equation, making a total of four required solutions. Arbitrarily choosing to solve* $(P_n + P_{n-1})^2$ *first, the mathematician finds the following:*

Case 1: n is even

$$(P_n + P_{n-1})^2 = \frac{2n+2}{2}$$

$$= n + 1.$$

Case 2: n is odd

$$(P_n + P_{n-1})^2 = \frac{2n}{2}$$

$$= n.$$

And now the mathematician solves P_k^2 *for solutions:*

Case 3: n is even

$$(P_n)^2 = \frac{2n}{4}$$

$$= \frac{n}{2}.$$

Case 4: n is odd

$$(P_k)^2 = \frac{2n+2}{4}$$

$$= \frac{n+1}{2}.$$

In conclusion, because one seeks factors of triangular numbers, it follows that when n *is even, case 1 and case 3 are the factors. Similarly, when* n *is odd, case 2 and case 4 are the factors.*

Figurate Numbers in Modern Times

In the present day, the rise of science has shifted the focus for mathematicians, and developments in figurate numbers have mostly stalled. Mathematics with immediate connections to physical applications, such as calculus and differential equations, have taken priority over the more philosophical theories, which have become novelties. For figurate numbers, the advancements have largely been grounded in geometric properties, such as mirroring the different polytopes and creating new arithmetic series corresponding to figures in higher dimensions. For example, the following Table 5 outlines the expansion of triangular numbers into the third and fourth dimensions:

Table 5: Figurate numbers in higher dimensions

geometric object	dimension	n=1	n=2	n=3	n=4	n=5	...
triangle	2	1	3	6	10	15	...
tetrahedron	3	1	4	10	20	35	...
hypertetrahedron	4	1	5	15	35	70	...

Similar to the expansion in higher dimensions, figurate numbers continue to be developed in two dimensions under alternative discrete arrangements. For example, Table 6 compares hexagonal numbers, which form the traditional figurate number set, with their cousins, the centered hexagonal numbers:

Table 6: An alternative figurate number arrangement

geometric object	formula	n=1	n=2	n=3	n=4	n=5	…
hexagonal	$2n^2 - n$	1	6	15	28	45	...
centered hexagonal	$n^3 - (n-1)^3$	1	7	19	37	61	...

Unfortunately, the continuing advancements made in the field of figurate numbers have not been sufficient to garner the attention of serious mathematicians, who have largely shifted their focus to other theories that have immediate application. This emphasis has been brought about by the scientific revolution, which continues to guide the role and purpose of mathematics in contemporary societies. However, even though the theory of figurate numbers does not have any apparent modern use, history has shown that previously established mathematics sometimes have an unforseen purpose.

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"The Bridge Between Continuous and Discrete," *Mathematical Masterpieces: Further Chronicles by the Explorers,* Ch. 1, Springer, New York, 2013, pp. 26-41.
13. David Simpson, "Blaise Pascal (1623-1662)," *Internet Encyclopedia of Philosophy, iep.utm.edu,* n.d.
14. Sam Seeskin, "A 'Converse' to Fermat's Last Theorem?," *Mathematics Magazine,* Vol. 35, No. 4, Sep. 1962, pp. 215-217.
15. "Pierre de Fermat y Su Ultimo Teorema," *Alef: Libera el Conocimiento, alef.mx,* n.d.

Artists' Statements

Heather Miller

Selfie—Distorted: The title *Selfie* is more of a definition of distortion or distorted self. A selfie is not a true reflection of a person. The picture has gone through a process of many retakes, cropping, and filtering before being posted to social media. Some profile pictures are unrecognizable and unrealistic.

Pondering: Pondering was composed with multiple layers and angles. Each sitting of the model created another dynamic and layer of the drawing. I made this piece in 2016 at Cameron University, Oklahoma.

Sierra Romero

Reveal: This painting in acrylics on bristol board was meant to challenge my understanding of color values. Thus, I was limited to using acrylic paint in just a few colors although otherwise there were no limits on the design. The main objective of the piece was to match the values of the colored portions of the piece to the black-and-white portions. My design had a chrysanthemum in the top left corner and, in the lower right corner, a wave of water. There was no real significance in my choice of these subjects. I just wanted a piece that had numerous curved lines throughout and created a wide range of values so the piece would set me quite a challenge in matching the values by eye.

Monochromatic Life: My main objective with this collage of magazine images on bristol board was to create a monochromatic photo montage that would essentially merge the different shapes and values from the selected images. Each image was thoughtfully selected, drawing from a multitude of magazines. The ultimate arrangement created implied lines and also kept a variety of values in the piece. I wanted viewers to examine and ponder where all the image fragments might have come from and what they were originally part of.

Tony Taylor, Jr.

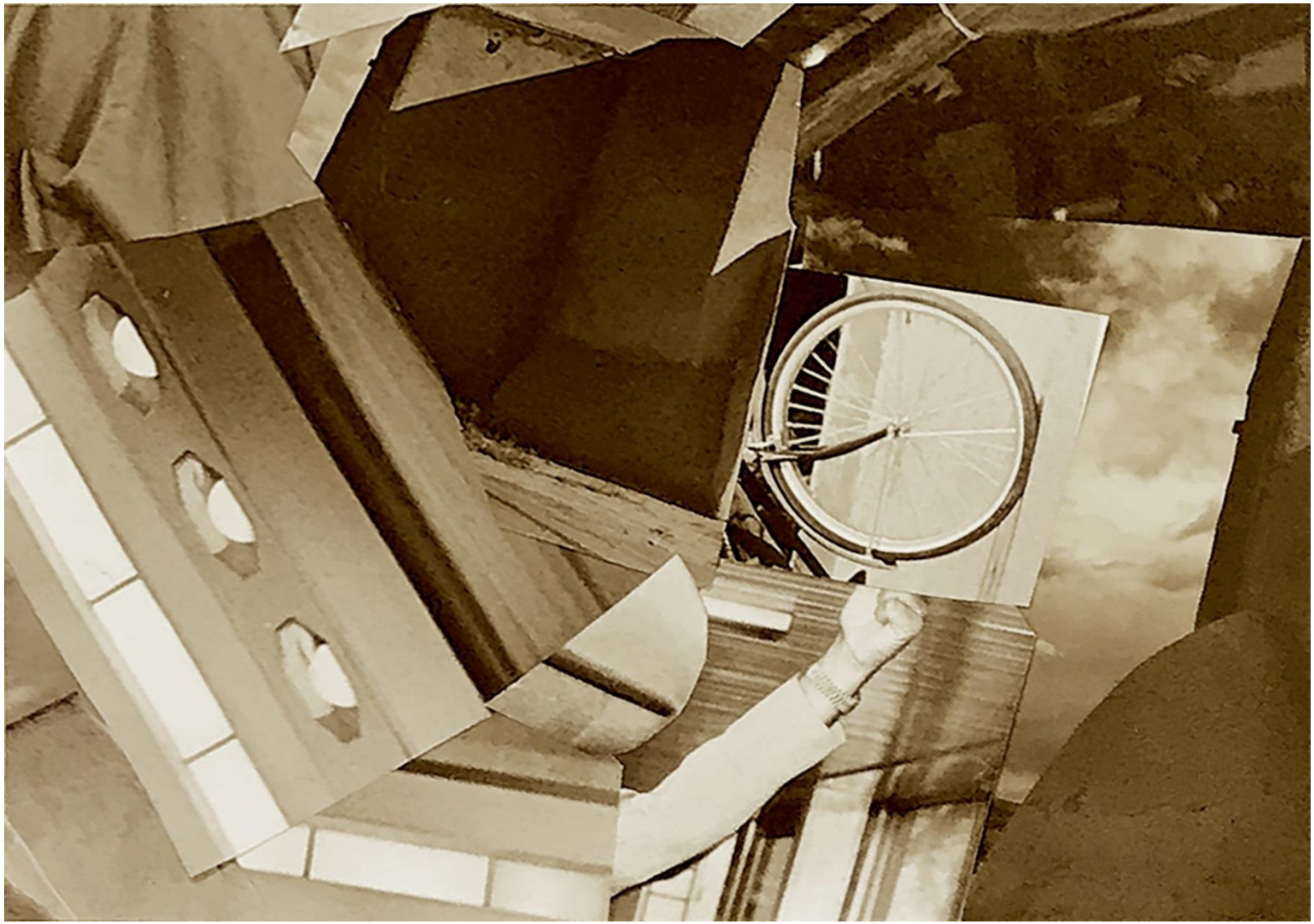
Mother Nature: In this 9"x12" linoleum print, the image depicts Mother Nature as an elderly woman, blowing wind through some mountains. The focus of the piece is the use of lines. The fine lines in the woman's face and in the mountains create an intense texture. This contrasts with the more open and relaxed lines of the clouds and distant skylines. The rhythm in the piece helps convey the beauty and delicacy of nature.

Caged Bird: This piece, an 11"x17" photo manipulation, refers to the metaphor of the "caged bird," expressed in poet Paul Laurence Dunbar's line "I know why the caged bird sings," which the late Maya Angelou borrowed for the title of her autobiography. Although the caged bird is trapped, it still sings a song of freedom. I took a line from Angelou's work and tried to illustrate its meaning. The words in the design resemble scars that have been cut into the person's flesh. Although these scars are painful, the individual is not hiding them. The scars make us who we are, and we should not be ashamed of them.

Heather Miller *Selfie—Distorted*

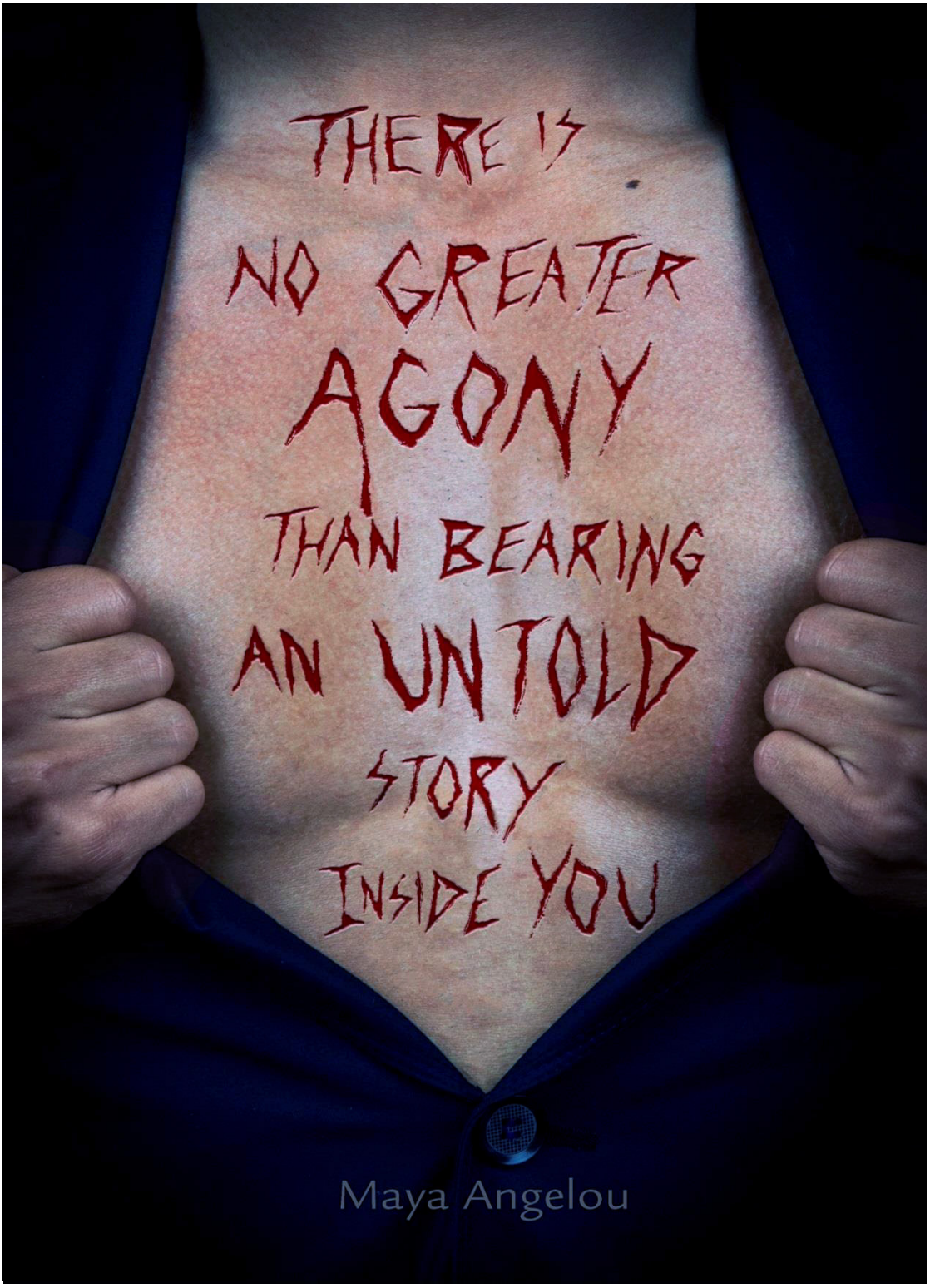
Heather Miller *Pondering*

Sierra Romero *Reveal*



Sierra Romero *Monochrome Life*

Tony Taylor, Jr. *Mother Nature*



Tony Taylor, Jr. *Caged Bird*

Eighteenth Century Mastery: Strategies, Resources, and Behaviors of White Power

Cheri Todd Molter

Faculty Sponsor: Dr. Patrick O'Neil
Department of History

> "Around us everything is hostile. …[M]en and more men, slaves and masters, the masters slaves themselves. Fear motivates the former, hatred the latter, all other forces are silent. All are enemies or rivals." ~Primo Levi

On May 30, 1788, Lewis, a "Negro Man" described by his owner, Beckwith Butler, to be "about 35 years of age, five feet ten inches high" with "very little beard, thick lips, [and] a surly look," ran away from Butler's "plantation in Mattox Neck" in Westmoreland County, Virginia.[1] Supposedly, Lewis traveled either north toward Maryland or south to reconnect with family left behind in Richmond County, Virginia, after being sold from the estate of his former owner.[2] He "read well" and bore the scars from repeated whippings.[3] According to Butler, Lewis had "rebellious principles," and, by running away, Lewis made it obvious that he resisted the societal conviction that he was mere property and strove to reposition himself in colonial society as a free man.[4] In contrast, Butler, a white plantation owner and master of enslaved people, could not tolerate Lewis's defiance; Butler publicly behaved in a manner meant to reassert his socially expected power over Lewis, and, if successful, the result—Lewis's capture—would reaffirm Butler's dominance over his slaves to everyone, slaves and whites alike. Butler repeatedly requested the public's cooperation to aid him in maintaining the cultural status quo; he placed three advertisements in different newspapers, appealing for assistance to help him reclaim his escaped slave.[5] In fact, Lewis had been missing for two and a half years when

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[1] Beckwith Butler, Advertisement in *Virginia Herald* and *Fredericksburg Advertiser,* November 4, 1790, *The Geography of Slavery*, http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=vg1790.xml&adId=v1790110051

[2] Butler, Advertisement in *Virginia Herald* and *Fredericksburg Advertiser,* November 4, 1790.

[3] Ibid.

[4] Ibid.

[5] Butler, Advertisement in *Virginia Herald,* November 4, 1790.
Beckwith Butler, Advertisement in *Maryland Gazette,* July 17, 1788, *The Geography of Slavery*, http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=md1788.xml&adId=m1788070002

Butler placed the last recorded runaway slave advertisement. Even if Butler reclaimed him after the last ad was published, Lewis had been successful in eluding Butler's grasp for a prolonged period of time despite his master's best efforts to regain control of him.

As exhibited by Butler's ads, the runaway slave advertisements in *The Geography of Slavery* web archive reveal the unequal distribution of power between the white planter class and the enslaved African Americans they exploited. That unequal power distribution favored white men and their desire for profit from agricultural pursuits, and became the foundation of the eighteenth-century model of white mastery. Written primarily by white men for a white audience, the runaway ads expose some patterns in the white masters' behaviors and perspectives as they worked to maintain dominance over an ever-increasing number of African Americans in Virginia and Maryland. Many white masters described the slaves' distinguishing marks, attributed dangerous or animalistic characteristics to them, advised the public of the runaway's level of education, and warned their communities to uphold the laws concerning runaways in their attempts to project a semblance of control while requesting aid in reclaiming their escaped property, a contradictory situation in itself. Butler did each of those things in all of the runaway slave ads he placed while trying to secure Lewis's capture.[6] Nevertheless, Butler did not resort to what seems to be one of the last strategies left to the white masters who had lost control of an enslaved person: a reward offered for the return of the slave either "dead or alive." However, eight white masters—John Wormeley, John Smith, Charles Floyd, John Woodlief, Sr., John Holt, Thomas Dansie, Henry Batte, and David Jones—did; the advertisements they published were particularly revealing and are discussed in this paper.[7] As evidenced by the many successful displays of resistance by runaway

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Beckwith Butler, Advertisement in *Virginia Independent Chronicle,* June 18, 1788, *The Geography of Slavery*, http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=vg1788.xml&adId=v1788060031

[6] Butler, Advertisement in *Virginia Herald,* November 4, 1790.

[7] John Wormeley, Advertisement in *Virginia Gazette* (Hunter), Williamsburg, May 30, 1751, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg51.xml&adId =v1751050084

John Smith, Advertisement in *Virginia Gazette*, February 4, 1768, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg68.xml&adId=v1768020237

Charles Floyd, Advertisement in *Virginia Gazette* (Rind), Williamsburg, October 27, 1768, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg68.xml&adId=v1768100309

John Woodlief, Sr., Advertisement in *Virginia Gazette*, April 29, 1773, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg73.xml&adId=v1773040853

John Holt, Advertisement in *Virginia Gazette* or *American Advertiser* (Hayes), Richmond, June 28, 1783, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=vg1783.xml&adId=v1783060036

Thomas Dansie, Advertisement in *Maryland Gazette*, March 15, 1749, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=md1749.xml&adId=m1749030001

Henry Batte, Advertisement in *Virginia Gazette*, February 7, 1771, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg71.xml&adId=v1771020538

African Americans, white masters were balanced atop a pedestal that was prone to tipping from time to time, although it was a more privileged position than either the white women or African Americans held. Despite what some historians have said about the secure dominance of white mastery, the white masters' position of power was insecure. Those men had to negotiate their resources, determine strategies, and modify their behaviors to keep their balance at the top.

According to the archived runaway slave ads, when a few eighteenth-century masters believed the status quo had been disrupted too much or too often by the enslaved, they put differing amounts of value on the corpses of returned slaves or on their decapitated heads rather than the living, whole-bodied laborers. Based on the approximately 4000 eighteenth-century runaway slave advertisements in the *Geography of Slavery* archive, only Wormeley, Smith, Floyd, Woodlief, Sr., Holt, Dansie, Batte, and Jones placed equal or greater value on the remains of their runaway slaves. Those men published appeals in newspapers that revealed the aforementioned verbal patterns of behavior that masters were utilizing as a means of preserving their status as dominators in slaving society.[8] At the same time, they publicized their failure to maintain control over certain enslaved individuals and expressed a willingness to pay money for the bodies or heads of their dead slaves to be returned to them.[9] The evidence pertaining to the complexities of and contradictions in the social construction of white mastery contained in their advertisements suggests that masters in the eighteenth century were trying to maintain a balance between portraying themselves as unbending, dominant overlords and intelligent, patriarchal benefactors. The advertisements placed by those eight men in particular provide a glimpse into what it meant to be a white master in the eighteenth century.

Historians have had much to say about the dominance of white plantation owners over their enslaved people. After reading and analyzing the letters and records of nineteenth century plantation owner Charles Manigault, William Dusinberre argues that it was more likely that slaves were not "active shapers of their own destinies," despite recent historical analysis that enslaved individuals were able to assert their personal autonomy within the social structure of white mastery.[10] However, since Manigault was the author of Dusinberre's evidence, it seems reasonable to assume a bias. Manigault was a master who wanted to be viewed as successfully dominant, a motivation that would have influenced how he presented himself in his records and his letters, affecting the credibility of those sources in portraying an accurate assessment of the slaves' negotiation for power. Dusinberre claims that Manigault's runaways—except John Izard, who ran away but was not sold on his return due to his blood relation to the plantation owner—either returned voluntarily or were caught, then were punished and sold to emphasize his control over their destinies.[11] Dusinberre acknowledges only Manigault's reclaimed

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David Jones, Advertisement in *Virginia Gazette* (Dixon & Nicolson), Williamsburg, March 12, 1779, *The Geography of Slavery, http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=vg1779.xml&AdId=v1779030007*

[8] Ibid.

[9] Ibid.

[10] William Dusinberre, *Them Dark Days: Slavery in the American Rice Swamps,* (Oxford: Oxford University Press, 1996), 121.

[11] Dusinberre, *Them Dark Days*, 115.

dominance over the enslaved instead of recognizing also that runaways were successfully resisting Manigault's power, even if only for a short period of time; thus, it seems that the historian's argument is biased in favor of the white master.

In contrast, Drew Gilpin Faust maintains that the "master-slave relationship is never static, but of necessity evolutionary."[12] By analyzing the manner in which James Henry Hammond, the new master of Silver Bluff plantation, "sought to assert both dominance and legitimacy" over the enslaved, Faust realized that Hammond's slaves "strove to maintain networks of communication and community as the bases of their personal and cultural autonomy."[13] Faust states, "This struggle, which constantly tested the ingenuity and strength of both the owner and his slaves, touched everything from religion to work routines to health, and even determined the complex pattern of unauthorized absences from the plantation."[14] Although she utilizes a different set of sources, Faust's assertion that Hammond, a white master, reacted to slaves' attempts to undermine his socially appointed dominance by strategizing to maintain at least the appearance of orderly mastery, correlates with the power dynamics evident in the runaway slave advertisements.

In their advertisements, all eight masters used descriptive language and phrases to assist strangers' efforts to identify the runaway slaves. For example, in March 1749, Thomas Dansie described his slave Jack Spurlock as "a sensible Virginia born Negro Fellow" with "a Scar on his Face, occasion'd by a Burn, and large Whelks on his Back."[15] Dansie did not attempt to dehumanize Jack, recognizing that the slave was "sensible" and that he spoke "good English," but he alluded to prior behavioral issues that reflected Jack's dissatisfaction as a slave.[16] In addition, in February 1768, John Smith offered a description of "about 5 feet six inches high" and "about 50 years old" for "a Negro man named Mann."[17] Like Dansie, Smith did not dehumanize his slave; he explained that Mann gave "very sensible answers," which either alluded to Mann's ability to speak thoughtfully or Mann's mastery of the English language, which enabled the listener to understand him.[18] Mann also had "a slit in one of his ears," a physical marking that was obtained either voluntarily, possibly as part of a cultural tradition, or by force, resulting from a punishment of some sort.[19] In March 1779, David Jones, a man somehow affiliated with the hospital in York garrison, described his runaway slave, Will, as "a Virginia born negro man…about 23 or 24 years of age, about 5 feet 10 inches high, [and] very stout made."[20] Jones also shared that Will was "a very good cooper" who was "very apt to stammer when surprised or questioned sharp," and he had "a lump in the bend of his arm, occasioned by bleeding."[21] After reading this description, one could determine

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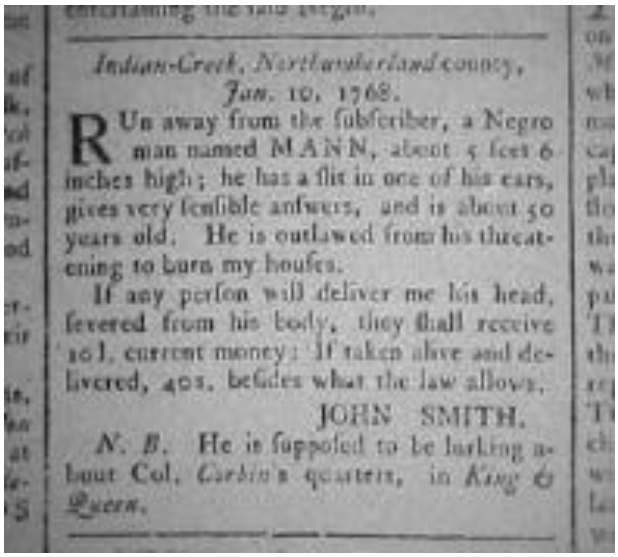
12 Drew Gilpin Faust, "Culture, Conflict, and Community: The Meaning of Power on an Ante-Bellum Plantation," *Journal of Social History*, Vol. 14, No. 1 (Autumn, 1980), 84.
13 Faust, "Culture, Conflict, and Community," 83.
14 Ibid., 84.
15 Dansie, Advertisement in *Maryland Gazette*, March 15, 1749.
16 Ibid.
17 Smith, Advertisement in *Virginia Gazette*, February 4, 1768.
18 Ibid.
19 Ibid.
20 Jones, Advertisement in *Virginia Gazette* (Dixon & Nicolson), Williamsburg, March 12, 1779.
21 Ibid.

that Will was good at his trade and nervous around authority figures. Additionally, the description of the "lump in the bend of his arm" provided a unique identifying marker that may have aided in Will's recapture.[22] Furthermore, John Woodlief, Sr., not only offered identifying physical attributes of his slave Bob, such as "of a brownish Complexion upwards of six Feet high, about fifty Years old, bow-kneed…[with] a long Visage, a Roman Nose, and one of his upper fore Teeth [was] out," but also included descriptions of the clothing Bob wore, which, if detailed enough, could have aided in the runaway's capture.[23] Many of these descriptions were flimsy at best, since there were many men of a similar age, height, and complexion; therefore, proper identification depended primarily on scars and other physical markings, which may have encouraged the masters to punish the enslaved by branding, a strategy with dual value, not only for deterrent punishment but also for easier identification of their property. Recorded examples of the practice of branding appear in a variety of slave ads other than the eight that stressed that masters wanted the runaways back dead or alive: In 1766, Hardin Perkins describes the "HUP," which were probably his initials, branded on the cheek of his runaway slave, Guy, as an identifying marker, revealing the white master's desire to make his ownership of Guy visible to the community in much the same manner and for a similar reason as ranchers branded their cattle.[24]



Indian-Creek, Northumberland county,
Jan. 10, 1768.

RUn away from the ſubſcriber, a Negro man named MANN, about 5 feet 6 inches high; he has a ſlit in one of his ears, gives very feaſible anſwers, and is about 50 years old. He is outlawed from his threatening to burn my houſes.

If any perſon will deliver me his head, ſevered from his body, they ſhall receive 10l. current money: If taken alive and delivered, 40s. beſides what the law allows.

JOHN SMITH.

N. B. He is ſuppoſed to be lurking about Col. *Corbin's* quarters, in *King & Queen*.

John Smith's advertisement for the runaway Mann. Advertisement in the *Virginia Gazette*, February 4, 1768.

As evidenced in the eight runaway slave ads, another strategy of masters was to advise their readers of the locations of the runaway slaves' families or details pertaining to their past owners in an attempt to pinpoint the runaways' destinations. John Wormeley and John Smith had heard rumors of the runaways' whereabouts and included them in their ads: Wormeley stated that his slave Charles was "suppos'd to be at Hampton or James-Town," and Smith reported that his slave Mann may have been "lurking about Col. Corbin's quarters, in King & Queen [County]."[25] John Holt had been informed that

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[22] Ibid.

[23] Woodlief, Sr., Advertisement in *Virginia Gazette*, April 29, 1773.

[24] Hardin Perkins, Advertisement in *Virginia Gazette,* August 1, 1766, *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg66.xml&adId=v1766080185

[25] Smith, Advertisement in *Virginia Gazette*, February 4, 1768.
Wormeley, Advertisement in *Virginia Gazette* (Hunter), Williamsburg, May 30, 1751.

his slave George was "somewhere about" the Long Bridge or the "Four-Mile Creek" area, and had "hire[d] himself as a freeman to work on vessels."[26] In addition, Holt divulged that George was a "very good sawyer, and clapboard carpenter," so, by offering details about George's talents and the rumors he heard, Holt hoped to alert the areas' citizenry who either employed those craftsmen or required their services to watch for his escaped slave. David Jones felt it important to discuss Will's past: Jones wrote, "He formerly belonged to William Powell in Warwick county [*sic*],…lived in Lancaster, at 'squire Bristow's' quarter, [was] well acquainted in Gloucester,…[had] a pass, and endeavor[ed] to pass for a free man."[27] Will had a pass, so he had probably grown accustomed to having some measure of independence as he traveled and handled himself accordingly, similar to the manner in which free men behaved; plus, he was familiar with several places and presumably had contacts who might be willing to help him in each. Jones wanted everyone in those areas to know that, if Will was there, there was a monetary reward and the runaway should be apprehended. Likewise, John Woodlief, Sr., wanted someone to help him regain custody of his slave Bob; he revealed to readers that Bob had "a Wife at Mr. John Nelson's in Louisa" and suggested that the slave was being "harboured by some of his Negroes."[28] White masters, like Woodlief, recognized the familial bonds of those they enslaved only when it suited them to do so. When masters wanted to attempt to control their slaves, they would often threaten to sell or separate the loved ones as a means of quelling resistance and exerting their control. The existence of the runaway ad proves that Woodlief was unsuccessful in his negotiations of power distribution with Bob; Woodlief sought to regain his power by exposing and exploiting Bob's emotional ties with his wife, who was physically removed from him.

Not only did Woodlief exploit Bob's marital status, which was not legally recognized or respected within the framework of the slave-owning society, but he also disclosed a feeling of derision for white individuals who did not support the societal constructions of such a society. Woodlief wrote, "I suppose some evil disposed Person [gave Bob] a Pass, that he [might] pass for a Freeman."[29] This seems like a strange thing to say to his readers when Woodlief actually needed their assistance; such dependence might have been a bitter pill to swallow for a plantation owner. Apparently, Woodlief felt it significant to inform his audience that he did not entirely trust them to uphold the laws of the society. Perhaps offering a public excuse for Bob's successful escape was a means of maintaining his reputation as a successful master in his community, or the statement was a mild warning to anyone tempted to deviate from the rules regarding runaways, ensuring them that he was not unaware of what might have occurred to enable Bob to slip away. Either way, there was a notable, surprising discord between the white master and his predominately white audience. Moreover, Woodlief is not the only master to exhibit the tension between himself and the population of the society in which he operated. Jones blatantly warned the public not to assist his runaway slave; he stated, "ALL persons are forewarned from harbouring the said fellow [Will], as they will be

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[26] Holt, Advertisement in *Virginia Gazette* or *American Advertiser* (Hayes), Richmond, June 28, 1783.

[27] Jones, Advertisement in *Virginia Gazette* (Dixon & Nicolson), Williamsburg, March 12, 1779.

[28] Woodlief, Sr., Advertisement in *Virginia Gazette*, April 29, 1773.

[29] Woodlief, Sr., Advertisement in *Virginia Gazette*, April 29, 1773.

punished to the utmost rigour of the law."[30] Jones's emphasis on the word "all" signified that the white master would stand against anyone who tampered with his claim of ownership of Will, alluding to the empowerment of Jones to enforce the laws governing runaways. The law was on Jones's side, and he was not hesitant to utilize that power. However, the fact that he felt the warning was necessary implies that there were deviants within the society who disagreed with its restrictions. Masters might benefit from the laws, but their supremacy within that society was not necessarily supported by other whites in their communities. As a result, some masters, like Jones and to some extent Woodlief, felt it necessary to confront those who might not comply with the mandates of their social hierarchy with warnings and threats, even as they asked those same readers of their advertisements for help. So, a tension existed in that society that white masters tried to confront openly using societally sanctioned laws as a resource or to overcome by promising monetary rewards. Therefore, not only were the plantation owners in the process of power negotiations with those they enslaved from within their ascribed roles, but also those masters were actively engaging local citizens of every class through their advertisements, negotiating their resources in a fluid process that originated from vulnerability. They had lost control of their slaves, and that social deviance would not be eradicated without outside assistance. Indeed, white masters like Dansie, Jones, Woodlief, Wormeley, Smith, Holt, Floyd, and Batte pooled varying resources—accurate descriptions of the runaways, the family history of the runaways, warnings that the law is on their side, and money—into personalized strategies, all meant to inspire their community to support their crumbling veneer of dominance.

The readers of those eight "dead or alive" runaway slave advertisements had several options: they could do nothing; they could assist the slaves and face the penalties enforced by the owner if caught; they could capture the slave, return him to his owner, and collect the reward; or they could kill the slave, give the master the disembodied head, and collect the reward. Regardless of which choice they made, the public knew that the plantation owners who published runaway slave ads had not been successful in legitimizing their dominance in at least one situation. The citizens knew they could respond to the masters' requests in compliance with their individual moral standards—thereby revealing to the public how they felt about the institution of slavery—or they were motivated to capitalize on an opportunity to better their own financial situations at the plantation owners' expense.

Similarly, as masters tried to legitimize and reestablish their dominance publicly with the assistance of their peers, the advertisements they wrote disclosed some of the measures they took to quell their rebellious slaves' efforts to resist. As the white masters' desperation to make African Americans submit to subordinate positions within the slave society increased, the degree of violence meted out to slaves increased too. Many masters branded, whipped, or physically burdened the enslaved with iron shackles and collars, which served the dual purposes of disciplining deviant slaves and marking them for easier identification if they ran away. Finally, a few masters, like the eight who advertised for the return of their slaves' severed heads, resorted to committing or arranging murders, acts of supreme violence.

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[30] Jones, Advertisement in *Virginia Gazette* (Dixon & Nicolson), March 12, 1779.

Although none of the eight masters discussed in this analysis mentioned using iron shackles or collars in their ads, other masters did. In the 1750s, two masters, William Pickett and Peter Jefferson, admitted to using iron collars to physically suppress their slaves' attempts to gain more power in their relationships.[31] Pickett wrote that his slave, John Saunders, "had on, when he went away, an Iron collar about his Neck, with which he could not have travelled; therefore it [was] supposed some evil-disposed Person [took] it off," which was similar to Woodlief's statement in 1773.[32] The problem of "evil-disposed" people seemed to persist throughout the years, which was further proof of tension between divergent social attitudes in a society that did not wholeheartedly support plantation owners' overall entitlement to supreme mastery.

On the next level of the spectrum of violence in the runaway slave ads, masters branded enslaved African Americans who questioned their masters' authority or misbehaved in some other manner that threatened their masters' positions of power. Dansie and Woodlief both informed their readers that their slaves had been burned, although neither specified if the burns were inflicted intentionally.[33] However, in 1792, Wade Mosby described his "mulatto fellow," Davy, as "very impertinent, and…branded on one of his jaws by his former master for [that] fault, with the letter M," which demonstrates that such practices occurred as a form of punishment.[34] It is interesting that Mosby felt it important to pay more for each word necessary to communicate that the inflicted burn was not his doing. Perhaps his audience would not be inclined to help a cruel master who was too heavy-handed with his slaves, so Mosby sought to avoid that type of negative public characterization.

In addition, three of the eight masters who wanted their slaves back dead or alive informed their readers that the runaways had been whipped prior to their escapes. Dansie and Jones both referred to the scars on their slaves' backs. Dansie described his slave Jack Spurlock as having "Large Whelks on his back," or scars from being whipped, which became identifying markings.[35] Moreover, Jones wrote that Will had "several marks on his shoulders, occasioned by whipping [sic]."[36] As their advertisements portrayed, Dansie and Jones either used the whip to physically beat slaves into submission or ordered someone else to do the deed for them; regardless of who wielded the whip, the violence was used to maintain control over enslaved people. Equally important, in 1771, Henry

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[31] William Pickett, Advertisement in *Virginia Gazette* (Hunter), Williamsburg, September 2, 1757. *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg57.xml&adId=v1757090143

Peter Jefferson, Advertisement in *Virginia Gazette* (Hunter), Williamsburg, November 7, 1751. *The Geography of Slavery,* http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg51.xml&adId=v1751100092

[32] Pickett, Advertisement in *Virginia Gazette* (Hunter), Williamsburg, September 2, 1757.
Woodlief, Sr., Advertisement in *Virginia Gazette*, April 29, 1773.

[33] Dansie, Advertisement in *Maryland Gazette*, March 15, 1749.
Woodlief, Sr., Advertisement in *Virginia Gazette*, April 29, 1773.

[34] Wade Mosby, Advertisement in *Virginia Gazette* and *General Advertiser,* February 22, 1792, *The Geography of* Slavery, http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=vg1792.xml&adId=v1792020027

[35] Dansie, Advertisement in *Maryland Gazette*, March 15, 1749.

[36] Jones, Advertisement in *Virginia Gazette* (Dixon & Nicolson), March 12, 1779.

Batte stated that his slave Will had "been much whipped for the Crime he committed, and expect[ed] to be hanged if taken," thereby acknowledging that Will might be dangerous—he literally was running to save his life—and admonishing the white community to secure the slave well if they caught him.[37] Will's crime, according to Batte, was thievery; supposedly he stole some items from Batte's store. However, from Will's point of view, the slave probably believed he was only taking what was his due for his labor.[38] Nevertheless, Batte was of the opinion that Will's attempt to gain more from their association overstepped the bounds of appropriate negotiation for power. As a result, Batte displayed the behavior of an insulted, vulnerable master who sought vengeance for Will's audacious, socially deviant behavior. It is probable that Batte whipped Will not only for punishment, but as an outlet for Batte's aggression and a public display of his dominance too. Furthermore, Batte let it be commonly known that Will was to be hanged if returned, perhaps because whipping the slave did not satisfy Batte's injured pride. Murdering a person is the ultimate act of violence against the individual, but the act becomes more heinous when the murder is planned and implemented as a means of exerting control over the people who relate with the murdered victim, thus victimizing all who witness the example.

Dansie, Jones, Batte, Wormeley, Smith, Floyd, Woodlief, and Holt all wanted and were willing to pay to have the runaways returned to them dead or alive. None were willing to pay more for their property to be returned alive rather than dead, but Dansie, Batte, and Jones did place the same monetary reward amount on the return of their runaway slaves whether dead or alive. In 1749, after his slave Jack had been missing for almost a year, Dansie wrote, "Whoever brings the said Negro, dead or alive, to me…shall receive Two PISTOLES Reward."[39] Batte declared that he would give ten pounds to anyone who returned Will to him, and "TEN POUNDS Reward for [Will's] Head, if separated from his Body," emphasizing the monetary amounts in all capital letters to draw his readers' eyes to them first.[40] Finally, in 1779, Jones stated, "A reward of ONE HUNDRED DOLLARS will be given on delivery of the said negro (dead or alive) to Mr. David Jones, at the hospital in York garrison."[41] Jones mentions the phrase "dead or alive" in a parenthetical afterthought; his slave's condition did not seem to be relevant to him. Jones also utilized capital letters to emphasize the monetary gain that was available to the person who succeeded in apprehending his slave.

The remaining five masters—Wormeley, Smith, Woodlief, Holt, and Floyd—offered more money for their slaves' severed heads than for the return of the live runaways. For example, in pursuit of his runaway slave Charles, Charles Floyd offered his readers "a reward of fifteen pounds for [Charles's] head, severed from his body, or ten pounds if brought alive."[42] The slave Charles, a "Virginia born Negro" who was a "sawyer and shoemaker by trade," had previously run away from Floyd on February 16,

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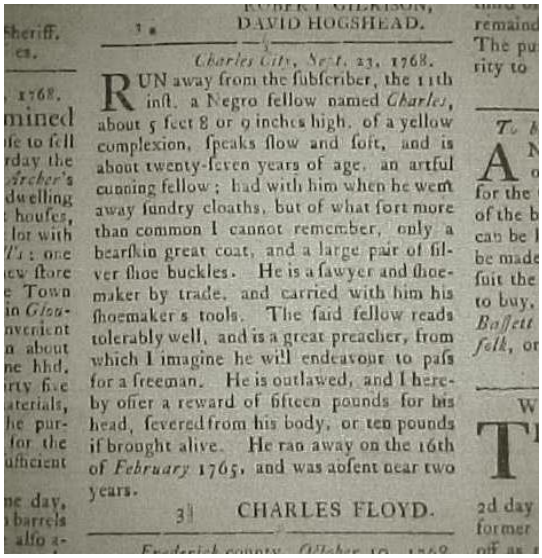
37 Batte, Advertisement in *Virginia Gazette*, February 7, 1771.
38 Ibid.
39 Dansie, Advertisement in *Maryland Gazette*, March 15, 1749.
40 Batte, Advertisement in *Virginia Gazette*, February 7, 1771.
41 Jones, Advertisement in *Virginia Gazette* (Dixon & Nicolson), March 12, 1779.
42 Floyd, Advertisement in *Virginia Gazette* (Rind), Williamsburg, October 27, 1768.



DAVID HOGSHEAD.

Charles City, Sept. 23, 1768.

RUN away from the subscriber, the 11th inst. a Negro fellow named *Charles*, about 5 feet 8 or 9 inches high, of a yellow complexion, speaks slow and soft, and is about twenty-seven years of age, an artful cunning fellow; had with him when he went away sundry cloaths, but of what sort more than common I cannot remember, only a bearskin great coat, and a large pair of silver shoe buckles. He is a sawyer and shoemaker by trade, and carried with him his shoemaker's tools. The said fellow reads tolerably well, and is a great preacher, from which I imagine he will endeavour to pass for a freeman. He is outlawed, and I hereby offer a reward of fifteen pounds for his head, severed from his body, or ten pounds if brought alive. He ran away on the 16th of *February* 1765, and was absent near two years.

3] CHARLES FLOYD.

Charles Floyd's 1768 advertisement. in the *Virginia Gazette* (Rind), Williamsburg, October 27, 1768.

1765, and "was absent near two years."[43] In the first ad, published in May 1766, Floyd described the blankets, clothing, and shoes the runaway took with him, labeled him "outlawed," and promised to give a reward of five pounds to anyone who located Charles in Virginia, or ten pounds to anyone who returned him from farther away.[44] However, in the advertisement printed in October 1768, Floyd reported that Charles was "an artful cunning fellow" and "a great preacher," who took "a bearskin great coat, and a large pair of silver shoe buckles" with him when he ran away.[45] Floyd also disclosed Charles's past runaway experience, stated again that the slave was "outlawed," and offered a higher reward—fifteen pounds—for Charles's "head, severed from his body" than the ten pounds promised if his slave was returned to him alive.[46] Although Charles was outlawed two years prior to the final ad, it was only after his second runaway attempt that Floyd placed a higher value on his decapitated head than his living person. Murder had become Floyd's last resort as a means of control. Likewise, Wormeley, Smith, Woodlief, and Holt attempted to ensure that, when and if the runaway slaves were captured, it would be just the severed heads that were returned.

At that point in the master-slave relationship, all negotiations had ceased; the masters were not only ready to lose their initial investments of their slaves' purchase prices, but were also willing to pay high prices for other people to kill the runaways and return their murdered slaves' heads to them. For whatever reason, the runaway slaves named in those ads were too threatening to their masters, too rebellious against their socially enforced oppression, to be permitted back into plantation life. Instead, those eight masters wanted their dominance fully restored and the deviant runaways destroyed. Despite the economic irrationality of the situation, those white masters were willing to use one of their resources—money—to obtain proof of their rebellious slaves' deaths—their heads—and, with that proof, achieve closure. Furthermore, since most of those masters wanted to maintain an outward appearance of being patriarchal benefactors to their other slaves, having the runaways' heads returned to them also offered an

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[43] Charles Floyd, Advertisement in *Virginia Gazette* (Rind), Williamsburg, May 2, 1766, *The Geography of* Slavery, http://www2.vcdh.virginia.edu/gos/search/relatedAd.php?adFile=rg66.xml&adId=v1766050172

Floyd, Advertisement in *Virginia Gazette* (Rind), Williamsburg, October 27, 1768.

[44] Floyd, Advertisement in *Virginia Gazette* (Rind), Williamsburg, May 2, 1766.

[45] Floyd, Advertisement in *Virginia Gazette* (Rind), Williamsburg, October 27, 1768.

[46] Ibid.

opportunity to support that persona: Because the masters were not the ones who killed the runaways personally, slaveholders could present themselves as 'fatherly' caretakers, showing their other enslaved individuals the bodiless heads as an example of what happened to those who resisted the rules of the society and tried to go North. Consequently, the plantation's remaining slave population could be frightened into subordination. Hence, the money for the decapitated heads was actually an investment if it helped the masters, who had already been proven vulnerable by the slaves' escapes, nonetheless maintain an appearance of dominance over those who remained enslaved. However, the fact that some white masters considered themselves father figures did not mean that the enslaved people held the same view. In fact, the existence of a multitude of runaway slave advertisements proves that many slaves were dissatisfied with their masters and the oppressive restrictions of the slave society.

Although slaveholders were powerful, their dominance was never guaranteed and they had to assess the conditions around them, use their resources, and strategize to maintain their precarious position at the top of the social hierarchy of the eighteenth century. Faust was correct in her assessment that within every relationship, "[e]ach participant confronts the other with demands and expectations, seeking continually to enhance his own power within the framework of their interaction."[47] John Wormeley, John Smith, Charles Floyd, John Woodlief, Sr., John Holt, Thomas Dansie, Henry Batte, and David Jones all had to negotiate their positions of power with those they enslaved and, when the resistance they met outweighed their control and slaves ran away, they composed advertisements in which they attempted to publicly disguise their vulnerability, while mustering all their resources to gain their communities' support.

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[47] Faust, "Culture, Conflict, and Community," 84.

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Modern Day Segregation: An Examination of Affirmative Action Bans

Katayoon Dowlatshahi

Faculty Sponsor: Dr. David Rogoff
Department of Sociology

The term "affirmative action" initially appeared in President John F. Kennedy's Executive Order 10925 in 1961, which urged the federal government to make employment opportunities available to minorities (Chrisman, 2013, p. 71). The popularity of this phrase grew immensely as legislators strived to address the racism that persisted throughout the Civil Rights era (Chrisman, 2013, p. 71). Affirmative action essentially champions the principle of the "structured readjustment and redistribution of economic resources and opportunities" as a way to rectify past instances of discrimination against minorities (Chrisman, 2013, p. 72). These minorities constitute a vast group of individuals who have experienced prejudice or inequality based on their race, ethnicity, gender, or religion. Affirmative action significantly impacts the college admissions process, as it is still utilized by some universities to generate a more diverse student body (Long, 2007, pp. 315, 327). However, in recent years, several states have enacted affirmative action bans in the admissions process of their states' colleges and universities. This has led to an ongoing, heated debate that focuses on how these affirmative action bans in college admissions can create greater inequalities for racial and ethnic minorities. The purpose of this work is to offer an analysis of the influence of affirmative action bans on the demographic constitution of institutions of higher education in the United States. As research will show, affirmative action in college admissions is critical to promoting the advancement of minority students in academia, with its retraction not only being harmful to establishing a more well-rounded student body but also resulting in a form of institutionalized racism in a nation still healing from the "separate but equal" doctrine.

Following the enactment of the Civil Rights Act of 1964, affirmative action gradually began to have an important role in the college admissions process (Long, 2007, p. 315). The power that affirmative action has in college admissions decisions continues to be met by opposition, with numerous court cases reflecting how disagreement in the general population has endured. The divided 1978 verdict of the U.S. Supreme Court in the *Regents of the University of California v. Bakke* was the turning point in the application of affirmative action to the admission of minority students, with Justice Lewis Franklin Powell emphasizing that a student's race and ethnicity should count as a single factor among multiple other components of the admissions decision (Long, 2007, p. 315). In

1995, the Board of Regents of the University of California (UC) passed the resolution Special Policy-1, which terminated the use of affirmative action in the admissions process of universities in the UC system (Long, 2007, p. 316). The passage of the California Civil Rights Initiative in 1996 eliminated the use of race, ethnicity, sex, and national origin from directly influencing the university admissions process (Long, 2007, p. 316). Policies like these that prohibit the use of affirmative action in admissions decisions in the state of California were enacted in other states, including Texas, Washington, Florida, and Georgia (Long, 2007, p. 316).

While the ramifications of affirmative action bans in the colleges and universities of these five states were initially unclear, recent studies have found significant reductions in minority enrollment. The admission rates of black and Hispanic applicants at several top UC institutions experienced a decline of approximately 20% to 30% following the passage of the California Civil Rights Initiative (Card & Krueger, 2004, p. 6). Researchers have estimated that the complete elimination of affirmative action would reduce the acceptance rates of Hispanic and black students by about 14% and 22%, respectively (Espenshade & Chung, 2005, p. 298). These statistics in turn dissuade many minority students from even considering applying to institutions that have imposed affirmative action bans (Espenshade & Chung, 2005, p. 295). The reduction in the proportion of minority students further creates a sense of not belonging among minority students on campus since they may lack the necessary support from peers who hail from similar backgrounds (Espenshade & Chung, 2005, p. 295). In order to combat these potentially damaging effects, universities in the states with affirmative action bans have implemented various alternative programs that they believe will serve the purpose of developing a diverse student body. For example, the introduction of affirmative action bans has resulted in the adoption of the top X percent program in the states of California, Texas, and Florida, which guarantees acceptance to a state university based on a scholar's academic proficiency determined through his/her grade point average (Long, 2007, p. 319). In addition, these states have also created programs, such as the Texas A&M Century Scholars program and the Longhorn Opportunity Scholarship program, with the aim to offer financial aid, advising, and resources to low-income and minority students (Long, 2007, p. 320). Furthermore, colleges and universities with affirmative action bans have also begun to include prompts in their college applications that inquire about socioeconomic status, second-language speaking ability, and adversities the applicant has overcome, in order to better take into consideration the students with varying racial and ethnic profiles (Long, 2007, p. 319). Another tactic that has become widely used by institutions of higher education is targeted recruitment at high schools that have educational disadvantages and a larger percentage of low-income students (Long, 2007, p. 320). While these alternative programs appear promising, colleges and universities in states that enforce affirmative action bans continue to observe declines in minority enrollment.

The states that have imposed affirmative action bans in college admissions have been met by both support and opposition. The relatively elevated approval for affirmative action bans is evident as nearly 75% of Americans disapprove of giving preferential treatment to minorities in college admissions and job hiring (Wilson, 2012, p. 6). One survey conducted among U.S. adults found that 71% of whites, 59% of Hispanics, and 53% of African Americans believe that blacks should be held responsible

for their own shortcomings (Wilson, 2012, p. 7). These individuals are also convinced that economic and educational outcomes should result from one's efforts and talent, despite the potential inequalities one may have encountered (Wilson, 2012, p. 7). Interestingly, younger African Americans have been found to support this view to a greater extent than more mature African Americans (Wilson, 2012, p. 7). This may be a consequence of the time frames in which these age groups received their education, with more opportunities becoming available for the younger generation of African Americans during the years following desegregation. Proponents of the bans also emphasize that racial and ethnic advantages given to minority applicants may hinder white students with similar educational backgrounds (Long, 2007, p. 317). Studies have shown that black and Hispanic applicants are statistically more likely to gain admittance into a college or university than white applicants with the same qualifications (Long, 2007, p. 317). Critics of affirmative action further argue that college admissions decisions that factor in race or ethnicity often allow for the acceptance of minority students without the same level of preparedness or accomplishments as other applicants (Long, 2007, p. 327).

However, the supporters of affirmative action bans either do not take into account the numerous educational inequalities and the constant economic burden that many minority applicants have faced throughout their lives, or may simply believe that such conditions are not insuperable. Due to policies such as redlining, many African American students have been forced to live in low-income neighborhoods with substandard schools (Wilson, 2012, p. 8). These students may not have access to additional tutoring or academic resources that can promote their educational growth, despite possessing the same level of intellectual interest and curiosity as their white peers. Research conducted on economic mobility has found that nearly 70% of black children living in the most disadvantaged locations in the United States will likely remain the residents of these types of neighborhoods as adults (Wilson, 2012, p. 8). Thus, measures involving affirmative action bans tend to promote a form of institutionalized discrimination that deepens segregation in the educational system in the United States.

The Obama administration (2009-2017) persistently worked to advance racial diversity on college campuses throughout the United States (Wilson, 2012, p. 5). Many proponents of affirmative action applauded these efforts, as they believed that diversity on college campuses was critical to a more well-rounded classroom experience (Mottley, 2015, p. 160). In the liberal arts model of higher education, classroom discussion requires a wide range of viewpoints to promote the understanding of differing perspectives among the students (Mottley, 2015, p. 160). A multicultural education is rewarding to students as it allows them to gain the competence to better interact with the diverse population of the United States and around the world (Curfman, Morrissey, & Drazen, 2013, p. 74). Affirmative action also enables minority students to attend higher quality institutions, which yields greater economic and social returns later in life (Long, 2007, p. 318). These socioeconomic gains can extend to providing opportunities to their children and grandchildren. In addition, studies have shown that minority students who benefit from affirmative action tend to engage in community and volunteering programs to a greater degree than their non-minority peers (Long, 2007, p. 318). The advantages that arise from affirmative action not only aid in the socioeconomic mobility of minorities but also generate a greater awareness and understanding among all members of the student

body, arising from the wide range of distinct experiences and outlooks found in a diverse student population.

Affirmative action has shaped the college admissions process for many minority students. The implementation of affirmative action measures has provided educational opportunities to minority students who have endured racism, economic disadvantages, and limitations in their academic prospects. In several states with affirmative action bans, some universities have aimed to mitigate the effect of the bans through alternative programs to encourage enrollment of low-income, minority, and otherwise disadvantaged students. But the alternative programs continue to reinforce racial and ethnic inequality. This report focused on whether affirmative action bans have the capacity to directly influence the demographic of minority students in colleges and universities in the United States. Research findings from states that have applied affirmative action bans to university admissions have shown that minority enrollment has substantially decreased in relation to the proportion of minority students in high school classes. These states' alternative programs to attract minority and low-income college applicants have failed to stop the decline in minority enrollment, leading to the conclusion that a practical alternative to affirmation action does not appear to exist.

Some of the states with affirmative action bans, like California and Texas, have highly diverse populations. Limiting the number of minority students enrolling in colleges will not only result in student bodies that are more homogeneous, more white and privileged, but also make it significantly more difficult for minority individuals to obtain jobs that offer decent compensation. It is critical for the general workforce to mirror the society it serves; otherwise, both trust and societal progress cannot be firmly established (Curfman, Morrissey, & Drazen, 2013, p. 74). This report's findings effectively liken affirmative action bans to a form of institutionalized segregation, ensuring that the American dream is impossible to secure. Thus, the institution of higher education as a whole in the United States continues to be riddled with discrimination, with true equality to be achieved only after affirmative action is no longer needed to develop a diverse student body that is representative of the entire population.

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Artists' Statements

Khalil Coleman

In Need of Change: This is a linocut print made by using the reduction printmaking process. The inspiration for the piece came from the feelings I had in response to police brutality and the Black Lives Matter movement. I continually pray that one day we can all truly come together and love one another and let go of all the hate.

My Second Home: This is a charcoal drawing I did of the William F. Bethune Canter For Visual Arts building. I call this my second home because I am always here no matter what time of day or night. As art majors, we are continually working on art pieces for class and sometimes we need to come to the studio to work in a quiet and creative place. I love coming to the art building after class hours with my friends and classmates to work on our projects and receive constructive criticism from my peers.

Mary Sue Parker

Untitled 1: For this work, I cut out several random and varying rectangular shapes from black and white pictures. I then made a collage with these cutouts. On a separate canvas I copied the collage by painting with a selection of acrylic colors, matching the values to that of the original.

Untitled 2: The objective for this piece was to experiment with geometric and organic shape, positive and negative space, implied line, layout spacing, and the visual effect of overlay.

Karen Britton

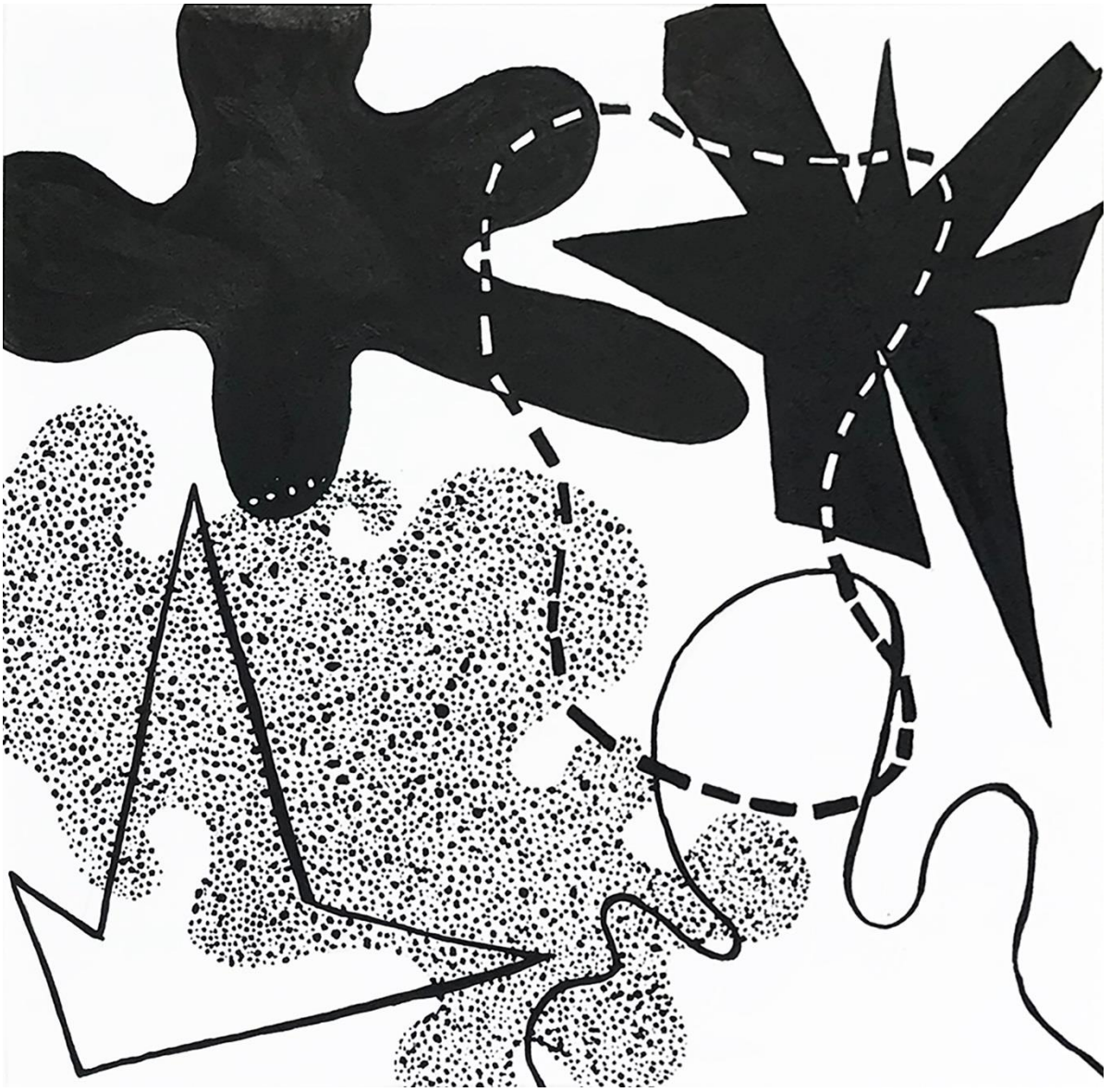
Desert Sand: Created for my Foundations of Design II class, *Desert Sand* is a design for tile. I entered the graphic design program late and had little knowledge of how to compose artworks. I filled about five pages of my sketchbook with varying hues and patterns before settling on the piece before you. The visual texture of the background is my favorite part of this piece and is what I enjoyed creating the most. I wanted *Desert Sand* to have a rustic feel and attempted to evoke that feeling through my color choices and the almost wood-like background.

Khalil Coleman

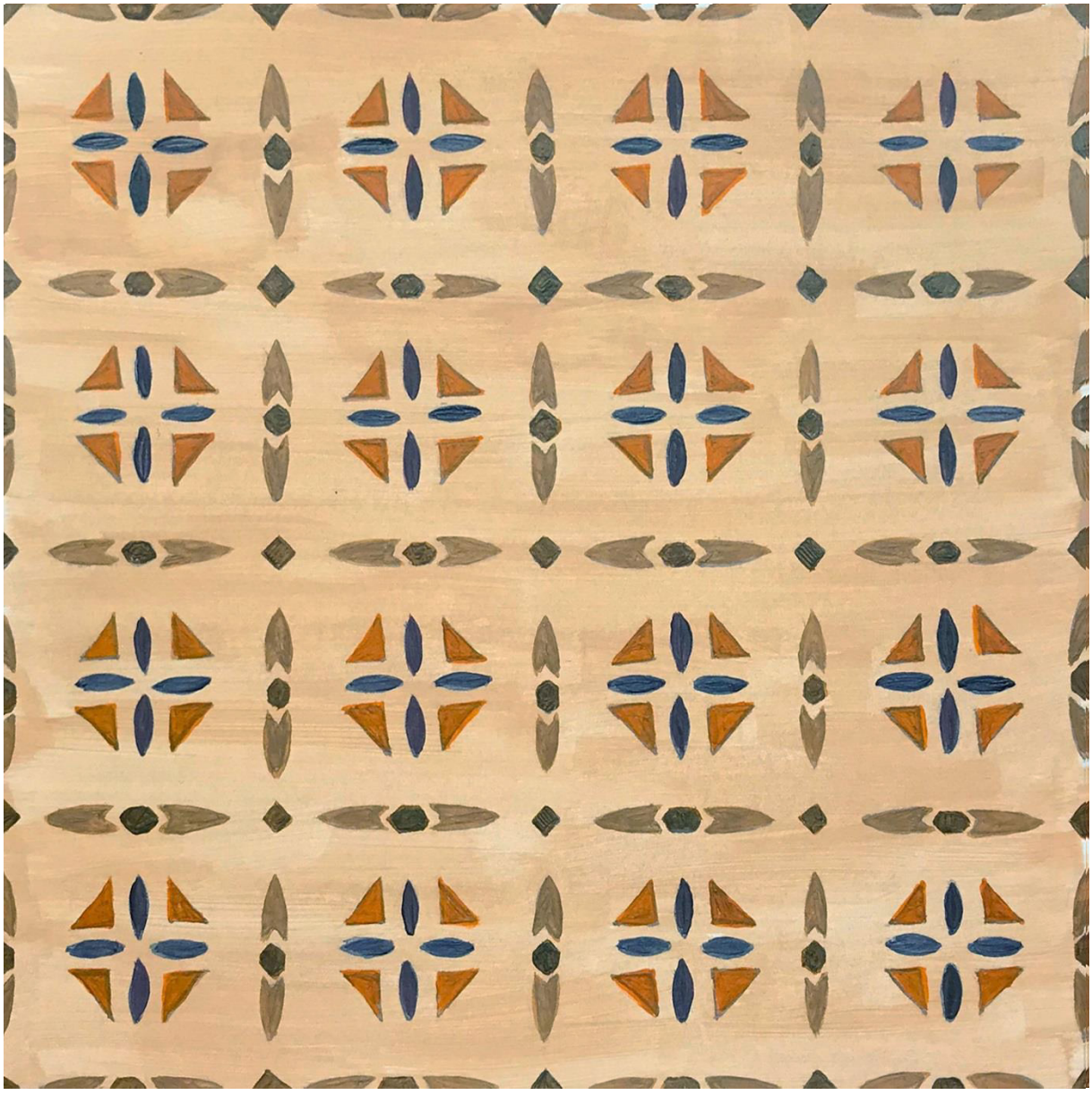
In Need of Change

Khalil Coleman *My Second Home*

Mary Sue Parker *Untitled #1*



Mary Sue Parker *Untitled #2*



Karen Britton *Desert Sand*

Compassion

Sheryl Brock

Faculty Sponsor: Dr. Jennifer Rohrer-Walsh
Honors Program

The Dalai Lama once stated, "If you want others to be happy, practice compassion. If you want to be happy, practice compassion" (Tenzin Gyatso, 14th Dalai Lama, as quoted in *Cognitively-Based Compassion Training Manual* OB 4). But just what is compassion? According to the *Cognitively-Based Compassion Training (CBCT) Manual*, compassion entails both action and intention, that is, "Compassion requires the wish to alleviate the suffering of another" (*CBCT Manual* OB 1). Many words are often confused with compassion; some of those words include empathy, sympathy, affection, and love. But these experiences are not compassion. For example, the *CBCT Manual* states that sympathy relies on feelings of pity and sorrow for someone's misfortune while empathy incorporates the ability to recognize and be sensitive to the experience of others, whether that is joy or sorrow. Further, affection is a deep endearment and tenderness for others while, lastly, love is the wish for others to be happy. These states are easily confused with compassion because they share the same basic concept: to show some sort of support for others. With these misconceptions of compassion, according to the *CBCT Manual*, comes the misguided belief that individuals help one another primarily to enhance their own happiness. Sympathy, empathy, affection and love do not enhance an individual's happiness like compassion does; rather, compassion allows the individual to feel a sense of purpose when helping other people for their own good and not for personal gain. Actions alone do not create happiness. There must be a desire for someone else to be happy—or at least not to be suffering. Not only do people have to relinquish their selfish desires, but they must work toward alleviating the suffering of another, regardless of their circumstances and the risks to themselves. This is what constitutes compassion.

Throughout the course of the Methodist University (MU) class, Honors 2000 entitled "Great Books and Compassion," the participants aimed to recognize and feel compassion for themselves and for others. While studying the art of compassion, the class explored various questions, such as "How does compassion lead to personal happiness?," "Why do we need to be compassionate? How do we benefit from compassion?," "Is being compassionate a natural state or something we struggle to attain?," and "How do we cultivate compassion?" The class considered these questions through cognitively based compassion training, or CBCT. This training program was developed by Geshe Lobsang Tenzin Negi, A Tibetan Buddhist teacher and professor of Religion at Emory University, as he tried to find a correlation between compassion

meditation and the reduction of depression levels among students. Over the course of several weeks, trainees learn the six stages of CBCT, which can be summarized as, first, developing the right state of mind in an individual; next, developing appreciation, affection and empathy for others; and, finally, reaching the goal of engaged compassion. The overall intention of CBCT is to

> gradually learn to relate to experiences without getting immediately caught up in them, transforming the way an individual experiences craving and aversion. That in turn allows an individual to practice self-compassion, because they now have the tools to gradually wean themselves away from emotions and thought patterns that lead to suffering, by not giving in to them, and instead strengthen constructive emotions and thought patterns that lead to greater well-being and happiness for themselves and others. (*CBCT Manual* section 2)

Self-compassion is the best form of compassion because, at this point in the training, the individual has successfully put others first regardless of personal interest or biases, promoting a sense of happiness at alleviating others' suffering. The Honors 2000 students used the tools of CBCT to determine how compassionate behavior was exemplified in an MU play, an independent film, and a foreign film, turning for additional guidance to a few Great Books in order to observe the effects of compassion in themselves and in others.

CBCT logo. *Compassionatelove.net,* 2013.

The MU production of *A Young Lady of Property,* written by Horton Foote, revealed insights into compassion. In this play, a young girl lives with her extended family members because her mother has passed away and her father is remarried. Practicing compassion, the family becomes closer when they recognize their similar mindsets, understand their past relationships, and place someone else's needs and desires before their own. The first glimpse of compassion is shown before the events of the story take place. The extended family members have given a home to the young girl, demonstrating that they were willing to put someone else's needs before their own and alleviate her potential suffering as she was not able to take care of herself. CBCT identifies this as the stage of "developing appreciation, affection, and empathy for others" (*CBCT Manual* section 2). Because of the young girl's lack of connection with her immediate family, she is on bad terms with her father and is displeased to find out that he is trying to sell her home. Compassion is again shown when the newly wedded wife urges her husband, the young girl's father, to forget about the home and find money for their future elsewhere. In this way, compassion embodies the cultivation of mindfulness, meaning that in order to incorporate happiness one must be mindful of the actions and/or emotions one projects towards others. The *Tao Te Ching* advises, "Weakness and tenderness may be the pathway to life and the Tao and the mysterious

force of life" (Laozi). The young girl's father shows such "weakness" through his vulnerability to his daughter when he gives in to the idea that he does not need the house to be sold in order to move on with his life. After the father express this vulnerability, the entire family is able to move on and find happiness. Compassion—through intent and action—not only alleviates the young girl's suffering, but brings together the entire family.

The independent film *Lars and the Real Girl,* written by Nancy Oliver, focuses on a middle-aged man named Lars who feels isolated and has drifted into a state of hopelessness, which leads to his purchase of an imaginary friend, a sex doll. At the beginning, Lars's sister-in-law invites him over to alleviate his isolation, but the attempt is not successful. Her gesture is not based in compassion, but in sympathy. It is categorized

Poster for *Lars and the Real Girl.* Sinfield Dot Org (Designer). IMP Awards, 2007 Movie Poster Gallery. Web.

as sympathy because Lars's sister-in-law has only her own agenda in mind when scheduling the invitation, not Lars's interests. Her intent is not for Lars to be happy; rather it is to coax Lars into becoming normal. That is, the sister-in-law feels sorry for Lars and, instead of trying to alleviate Lars's suffering, just wants him to conform to her idea of making things better. However, by accepting Bianca, Lars's sex doll, the community shows a form of compassion. The community members understand that, in order to alleviate Lars's suffering, they must accept what makes him comfortable; only that will make him feel more welcomed and hopeful. Lars experiences compassion when

his family and other members of his community struggle to help him feel more comfortable and less isolated. According to CBCT, "Compassion isn't simply a fickle or irrational emotion, but rather an innate human response embedded into the folds of our brain" (*CBCT Manual* section 1B). The more the community accepts and interacts with Bianca, the more Lars relinquishes his obsession and, with it, his belief that he needs someone else to make him happy. CBCT also states, "when people perform behaviors associated with compassionate love—warm smiles, friendly hand gestures, affirmative forward leans—their bodies produce more oxytocin. This suggests compassion may be self-perpetuating" (*CBCT Manual* section 1B).

A similar instance of compassion occurs in the *Ramayana*, an ancient epic poem narrating the venturous journey of Rama (Rajagopalanchari & Valmiki). Rama has done what he thought best to save the family's reputation as a battle approaches and a man from the family must go off to help. Rama's father, much like Lars, experiences isolation when he is left with nothing but the hope that his son will return and restore the family. Rama shows compassion to his father when he willingly takes his place in battle and represents the family. The effect of compassion in the two stories is that both Rama and Lars ultimately regain their place in society, enhancing their relationships and their own happiness.

The Italian film *Terraferma*, directed by Emanuele Crialese, demonstrates an interesting struggle between the laws of the land and the laws of the sea, and how compassion towards the enemy can settle this dispute. Buddhism's advice in such a situation is to address conflicts with both a "soft belly and a strong back." In the movie, the issues between the immigrant mother and the Sicilian mother who is taking care of her are caused by a lack of sympathy and compassion. According to the Buddhist concept of Jen, "a person of Jen or humanity who finds happiness and brings it to others, brings the good of others to completion and does not bring the bad in others to completion" (Keltner & Simon-Thomas 8B).This message from Buddhist scriptures denotes that in order to create happiness in a world that is corrupt, such as the one in the movie, one must work toward alleviating the suffering of others. Compassion is given to the immigrants when they receive help from a Sicilian family who could have easily thrown them off the boat. Not only does this compassion alleviate suffering, but it also creates happiness for the immigrants and allows the family to grow closer together. According to Keltner and Simon-Thomas's course, *The Science of Happiness,* "Kindness, often motivated by compassion, significantly boosts happiness" (Keltner & Simons-Thomas section 3). When the local people learn that the unborn child the immigrant mother is carrying was conceived through rape in a forced bargain for her family to gain freedom, the Sicilian mother is more willing to offer compassion to the immigrant and her family. Because of the sadness that the immigrant mother feels, the relationship between the two women grows stronger. The "soft belly and a strong back" guidance from Buddhism highlights how the Sicilian family's compassion leads them to take risks: they could have easily reported the immigrants to the police, but instead show compassion and take care of these strangers even though they know how dangerous it could be. These dynamics also reveal the distinction between compassion and sympathy. The Sicilian mother feels saddened by the rape the immigrant mother suffered and is later able to find compassion to help the woman, without expecting anything in return; sympathy would not have entailed such active assistance and risk-taking.

In order for these stories to gain a "happily ever after" ending, compassion is needed. None of these situations could have had happy outcomes without some form of deliberate struggle to alleviate others' suffering. These films, this play, and some of The Great Books help the audience to view compassion as challenging but rewarding. In an article titled "Can Compassion Change the World?," Daniel Goleman tells an interviewer that "[w]e need to get all of our destructive and disturbing emotions under control before we act in the world... If we can manage our distressing emotions in advance, and have calm, clarity, and compassion as we act, then we'll act for the good, no matter what we do" (Suttie). Certainly, leading a compassionate life is not easy, but striving to alleviate someone else's suffering demands accepting the necessary risks in the hope of bringing others happiness. Again, the reader may recall the words of the Dalai Lama: "If you want others to be happy, practice compassion. If you want to be happy, practice compassion" (Dalai Lama XIV, as quoted in *CBCT Manual* OB 4). It is important to realize that selfishly pursuing happiness on one's own will not garner long-term happiness, but focusing on someone else's happiness may. When an individual commits to compassion—the deliberate intent and action to reduce or alleviate someone else's suffering—he or she just may reap happiness. For these reasons, practicing compassion is something that every individual needs to pursue.

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The Incidence of False Confessions Under High Cognitive Load

Taylor M. Porter and David McNeil

Faculty Sponsor: Dr. Katharine Snyder
Department of Psychology

Abstract

The present study assesses circumstances under which an individual may be vulnerable to false confessions. By understanding how false confessions occur, researchers can enable interrogators to obtain more reliable information. The purpose of this research is to explore the possibility of physiological responses, particularly electrical activity in the prefrontal cortex, as an indicator of when someone is falsely confessing or lying. Also, the research studies how cognitive fatigue, which is reduced decision-making capacity during times of high mental demand, can affect a person's memory in interrogation settings. In this study, participants were given two lists of words that have been proven to elicit false memories (Underwood, 1965), and then they were instructed to cross out any words that appeared on both lists. In the presence of a light that was a cue to respond truthfully, the subjects were asked about words they had seen on the two word lists earlier and were instructed to verbally recall from memory if they had or had not crossed out the words earlier. In this research, a false confession was defined as a subject stating that he or she had crossed out a word not crossed out earlier. Given prior research on cognitive load, it is anticipated that greater cortical activation, especially in the prefrontal cortex, will occur for untruthful responses during false confessions. An analysis of variance was conducted on the data collected through electroencephalography, but no significance was found, likely due to low statistical power. If there had been a real effect in the data, the high degree of variance that was present prevented it from showing. A Pearson correlation was conducted on the multiple choice and recall scores of the subjects, and a correlation was found between a subject's memory and the rates of false confessions and lies. A statistical significance was found between a subject's memory and the rate of false confessions. This finding supports the hypothesis that, under conditions of higher cognitive load, an individual may be more susceptible to false confessions. Applications to interrogation techniques and the Innocence Project will be discussed.

Introduction

In the legal system, a suspect's confession is a prosecutor's strongest weapon against the defense. However, the credibility of confessions is controversial due to the chance that a suspect may have falsely confessed. One of the most counterintuitive ideas in life is the proposition that an individual might falsely confess to doing something he or she has not

done, especially in the context of the criminal justice system, which jeopardizes life and liberty of the accused. Since the emergence of the Innocence Project in 1992, 349 individuals have been exonerated, with DNA evidence confirming that 25% of them had falsely confessed (Innocence Project, 2017). False confessions can be internalized by individuals, leading them to believe they have done something they have not. Internalized false confessions occur due to an individual's memory being manipulated (Kassin, 2008, pp. 249-251). The pressure a subject is exposed to during an interrogation can render the suspect's memory vulnerable to these manipulations. The purpose of the present study is an empirical investigation of electroactivity in the brain during a switch in executive functioning as well as the impact that truthfulness and deceptiveness have on the accuracy of memory. A small sample size compromised the statistical power of the study and created a high degree of variance, which prevented any real effect in the data from being shown. However, the research did find that subjects who were induced to make false confessions and subjects who were induced to lie had a statistically significant higher degree of inaccuracy in their memory, whereas subjects who were more truthful had a statistically significant higher degree of accuracy in their memory.

Interrogations can last for many hours and put great stress on the individual to recall past activities. Psychological research has found that, when an individual experiences an increase in cognitive load, short term memory (STM) recall will be less accurate. The more demanding a task, the less recall an individual will have. According to Barrouillet, Bernardin, and Camos (2004), if a cognitive load is kept constant, then an individual's recall performance should remain unchanged. Additionally, this study presented a time-based resource-sharing model. The model assumes that an individual's memory is dependent on attention and that, as soon as attention is turned away, memory begins to decay (Barrouillet et al., 2004). A separate study discovered that longer retention times led to decreased performance, a widely understood phenomenon referred to as cognitive load (Ricker, Vergauwe, Hinrichs, Blume & Cowan, 2015). When the results of these two psychological studies are considered together, the assumption arises that, when a task is difficult and an individual has to retain information for a longer time before recalling it, both the rates of recall and the accuracy of recall will be decreased. This assumption helps to explain why someone may falsely confess in an interrogation, which often will last for an extended period of time and cause cognitive fatigue. Not only do cognitive load and retention time affect the ability to recall, but associative factors have also been found to affect recall ability.

In a replication study by Roediger and McDermott (1995), a list of words that were associated with another word, or "paired associate learning," was used and proved to be a powerful technique to elicit and study false memories. This research contributed to the present study a pre-established word list that has been empirically studied and proven to elicit false memories (Roediger & McDermott, 1995).

A reliable and accurate means of detecting lies and truth in the justice system is needed because the United States leaves verdicts to be decided by a jury. However, behavioral and social research has proven that humans are good at lying and poor at judging when a person is lying (Vrij, 2014). The most common means of lie detection used today is the polygraph. The polygraph records the physiological activity of arousal in an individual's autonomic nervous system (ANS). Research laboratories at the University of Minnesota report that empirical evidence from studies involving polygraph tests and

mock crimes have found the accuracy of polygraphs in detecting deception to be from 70% to 85% (Lykken, 1974, p. 30). However, both children and those with a diminished IQ are more likely to falsely confess, and likewise the accuracy of a polygraph decreases when used with the more vulnerable populations (Gudjonsson, 2010, pp. 166-168).

Technology advance today has shifted the focus of lie detection from ANS response to brain imaging. Recently, functional magnetic resonance imaging (fMRI) of the brain has been studied in attempt to differentiate deception and lying from truth-telling (Langleben & Moriarty, 2013). At the Medical University of South Carolina's Center for Advanced Imaging Research, a fMRI study on the neural correlates of deception revealed that, when an individual is lying, his or her brain activity increases (Kozel, Padgett & George, 2004). A second fMRI research project focused on the Machiavellian personality type, a term for those who commonly use deception and manipulation to cheat and "outsmart" others (Verbeke et al., 2001). The results from this second study displayed significantly higher activity in the prefrontal cortex in those who are lying (Verbeke et al., 2011).

An original study by Daryl Bem (1966) entailed inducing false confessions and aimed to prove that a false confession can distort recall of past behavior if the confession is given with the association of cues that are indicative of the individual telling the truth. Results from Bem's research showed that false confessions in the presence of the truth cue will produce more errors of recall than false confessions given in the presence of the lie cue or no confession at all; true confessions that were given in the presence of the lie cue were found to have produced errors of recall (Bem 1966, pp. 709-710). A replication of Bem's research was later performed by Christina Maslach (1971). As a replication study, it was expected to result in findings similar to and reflective of those of Bem. However, Maslach's replication did not support Bem's findings, which has led to controversy in the field (Maslach, 1971).

With controversy in the field of psychology regarding false confessions, this research project was an attempt to support Bem's findings through a replication of his experiment. Contrary to conventional polygraph methods, which utilize galvanic skin resistance as a means to detect deception, this study used electroencephalography (EEG) in an attempt to distinguish between truth and deception. Emphasis was placed on the electrical activity in the prefrontal cortex. Subjects were exposed to tasks that taxed their cognitive load and caused cognitive fatigue. Measurements were taken of the subject's ability to accurately recognize or recall as a means of gauging how cognitive fatigue affects memory. It was anticipated that, during the baseline assessment, there would be a significantly higher frequency shift in the frontal lobe when someone was falsely confessing or lying than when he or she told the truth. Secondly, the researchers anticipated that, during the assessment of the measured variable, there would be a significantly higher frequency shift in the frontal lobe when someone was falsely confessing or lying than when he or she was telling the truth. Lastly, the researchers anticipated a main effect on learning, such that the participant presented false confessions while believing he or she was telling the truth.

Method

Participants

Participants were solicited from various undergraduate psychology classes at Methodist University and recruited on a volunteer basis. The participants in the research experiment were 18 years or older, came from various demographical backgrounds, and included both males and females.[1] All participants had hairstyles that allowed the electrodes on the EEG cap to reach their scalp to collect usable data. Participants in the research experiment who were currently enrolled in a psychology class at Methodist University received extra credit for their participation, and every participant received a $15 gift receipt to the Methodist University Bookstore upon completing the experiment.

Materials

An informed consent (see Appendix A) was completed by each participant, and a form for extra credit was completed if applicable (see Appendix B). Before going through the experiment, each participant was also given a self-questionnaire to complete (see Appendix C). The EEG cap, used to measure the physiological reactions of participants, was hooked up to a computer, and the reactions were measured using Lab Scribe software. Electro Gel was applied with a gel applicator inside the sensors of the EEG cap, and two foam circles were placed on the forehead, which allowed the sensors to record the participant's brainwaves. In order to properly place the EEG cap on an individual's head, measuring tape and a marker were used to determine the precise alignment of the foam circles. A word list of 90 words (see Appendix D) and a separate word list of 45 words (see appendix E) were given to the participant to later recall. The words from both lists were randomly selected from lists of words pre-established by Roediger and McDermott (1995) and empirically proven by them to elicit false memories. The word list was intended not only to induce false confessions from the participant but also, due to the level of difficulty and focus required, to cause the participant to suffer cognitive fatigue resulting in memory decay. While the participant was being questioned, a red or a green light was lit according to the condition the individual was assigned to and the question asked. One of two different types of word tasks, either multiple choice (see Appendix F) or free recall (see Appendix G), was used in the last part of the experiment to record which words the participant could recall from earlier. The multiple-choice test was created by the researchers using the same words that had been randomly selected from the word lists of Roediger & McDermott (1995).

Design and Procedure

The experimenter went over the informed consent with each participant so that all participants would be aware of the risks involved with the experiment and of their right to withdraw at any time during the experiment. The participants were randomly split between Condition A, Condition B, Condition C, and Condition D. In Condition A and

[1] The researchers did not collect demographic information for analysis because the subject pool was limited in size and diversity while the investigative procedures and data analysis measures were time-consuming. Therefore, due to time constraints, analysis of subject demographics was not pursued.

Condition B, the participant was instructed to give a true response when the light was green and an untrue response when the light was red. However, those assigned to Condition A received a multiple-choice test at the end of the experiment, whereas those assigned to Condition B received a free-recall test at the end of the experiment. In Condition C and Condition D, the participant was instructed to give a true response when the light was red and an untrue response when the light was green. Those participants assigned to Condition C received a free-recall task at the end of the experiment, whereas participants assigned to Condition D received a multiple-choice test at the end of the experiment.

After the participants signed the informed consent and any applicable extra credit form, they were given one word list of 90 words and another list of 45 words, and were instructed to cross out any words on the 90-word list that were also on the 44-word list. They were not given a time limit to complete this task. Once they finished crossing out the duplicated words, they were given a 20-item self-questionnaire created by the researchers, which was intended to divert the participants' attention from the word task they had previously completed and enable researchers to gather a physiological baseline assessment of each participant when telling a lie and when telling the truth.

After the self-questionnaire, one of the researchers measured the head circumference and the distance from middle of the forehead to base of the head to find and mark the halfway point between nasion (middle point of the nasofrontal suture) and inion (the external occipital protuberance of the skull). The number of the circumference was changed by placing a decimal between the two numerals and dividing the new number by two. The resulting number set the distance of marks to the right and left of the mid-forehead mark, and on those two marks the foam circles were placed. The placement of the EEG equipment followed the ordinance of the 10/20 method (Trans Cranial Technologies, 2012, pp. 1-2). Having completed the measurements, the researcher placed the EEG strap and cap on the participant, and instructed the participant to be as still as possible while wearing the EEG equipment.

One researcher informed the participant of the rules for the green and red lights, and how the participant should answer depending on his or her assigned condition. That same researcher began to ask the participant for his or her answers on the self-questionnaire by asking for true or untrue responses depending on the color of the light, red or green. At the same time, the second researcher marked each question on the computer software collecting the EEG data. After collection of the baseline data, the first researcher asked the participant whether he or she had crossed out words from the word list presented earlier, and the second researcher continued to mark the questions on the EEG software. During these questions in Condition A and Condition B, the green light was on to show that the participant was to answer truthfully. In Conditions C and D, the red light was on to indicate the participant was to answer truthfully. Lastly, the EEG equipment was removed, and the participant was given either a multiple-choice word task or a word-recall task; there was no time limit for these tasks.

The experimenter debriefed each participant about the subject of the experiment. For completing the experiment, each participant received a $15 gift receipt to spend at the Methodist University Bookstore. After the participant left, one of the researchers scored how many false confessions, lies, and truths the participant gave when asked about the words he or she had crossed out. In this research, a false confession was operationally defined as a participant claiming to have previously crossed out a word that he or she had not crossed out, and a lie was operationally defined as a participant claiming *not* to have crossed out a word actually crossed out earlier. A truth was operationally defined as a participant accurately reporting that he or she did cross out a word in fact crossed out earlier or saying that he or she had not crossed out a word actually not crossed out earlier.

Results

After analyzing the baseline EEG data, the researchers determined the mean frequency shift for each subject during truthful answers and the mean frequency shift during lies/false confessions. The researchers then scored the subjects' word-recall tests and the multiple-choice tests. For every true or false answer, the researchers determined the mean frequency and then calculated the difference between that frequency and the baseline true or false frequency. This was repeated for each subject in all conditions. An analysis of variance (ANOVA) was conducted on the data collected through EEG, but there was no significance found. The confidence interval for the EEG data analysis was True (-1.3618, 2.5636) and False (-1.2734, 2.6520). See Table 1.

Table 1. Confidence Interval (95%) on EEG Analysis

				95% confidence	interval
Factor	n	m	SD	lower	upper
True	10	0.6009	2.8297	-1.3618	2.5636
False	10	0.6893	3.0737	-1.2734	2.6520

Pooled StDev = 2.95419
n=number of subjects
m=Mean
SD= Standard Deviation

Upon further analysis of the data, a Pearson correlation was conducted on the multiple-choice and recall scores of the subjects, and a correlation was found between a subject's memory and the rates of false confessions and lies. A statistical significance was found between a subject's memory and the rate of false confessions, such that, when more lies and false confessions occurred, the subject's multiple-choice and recall scores decreased and, as the number of truths increased, the multiple-choice and free-recall scores increased. This finding is supportive of the hypothesis that under conditions of higher cognitive load an individual may be more susceptible to false confession.

Subjects responded to 48 questions, and a few significant results were found as anticipated (n=24). Subjects who falsely confessed during the experiment had significantly lower multiple-choice scores (r=-0.709, p=0.0099) or significantly lower free recall scores (r=-0.649, p=0.0225). As a built-in design replication, there was also significance found between truthful responses and higher multiple-choice scores (r=0.7116, p= 0.0094) or higher free recall scores (r=0.789, p= 0.002). See Table 2.

Table 2. Multiple-Choice and Recall Task Scores

	Multiple Choice		Free Recall	
	r	p-value	r	p-value
False Confessions	-0.709	0.0099**	-0.649	0.0255*
Lies	-0.501	0.0974	-0.569	0.0535
Truth	0.712	0.0094**	0.789	0.0023**

r= correlation coefficient

*p < .05

**p < .01

Discussion

Data for the EEG portion of the experiment was collected from a total of 24 subjects. Upon analysis of the data, it was determined that the data from four of the subjects needed to be eliminated from the study due to the equipment being faulty and not recording any data (administrator error).

It is believed that the EEG results did not come out as anticipated due to the small number of subjects—only 20, ultimately—and time constraints, which created little statistical power and a high degree of variability in the data. Additionally, even if there were a real effect in the data, the high degree of variance would prevent it from being shown.

Partial support for the hypothesis was found. Although there was no significance in the EEG data, significant findings were observed that provide strong support for the cognitive load hypothesis. Results from the research showed that, as the number of false confessions increased, multiple-choice and recall scores decreased. As the number of lies increased, multiple-choice and recall scores decreased. As the number of truths told throughout the study increased, the scores on the multiple-choice and recall tests increased. This suggests that the poorer one's memory, the more likely one will falsely confess and the better one's memory, the more likely one will tell the truth. Furthermore, the better one's results on the recall or multiple-choice task, the less likely one is to falsely

confess. This strong correlation between truthful responses and higher scores on the multiple-choice and free-recall tasks reinforces the current theory that truthful behavior requires a lower cognitive load and is therefore easier to remember.

The purpose of this study was to conduct a replication the research by Bem (1966) and Maslach (1971) and to confirm one of the differing results. Bem (1966) demonstrated in his research that the effect of a truth cue was to elicit more false confessions, whereas Maslach (1971) contended that subjects were more accurate in recall regardless of light conditions. The present research assumed that an increase in cognitive load would generate more false confessions; however, the data supported the conclusions of Maslach (1971) and refuted the earlier claim by Bem (1966). Future research should include the use of galvanized skin response in conjunction with the collection of EEG data. This may assist future researchers in determining if subjects are willfully being dishonest or if they are genuinely unsure of the given response. Additionally, future researchers should focus primarily on the difference between true and false confessions and not include the operational definition of internalized confessions. This strategy may give researchers a better understanding of the basic processes before they focus on the more complex issue of false internalized confessions, i.e., false statements that a subject may believe to be true.

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Appendix A

Physiological Effects of Confessions

1. **Purpose**: The research's purpose is to study different physiological effects of confessions
2. **Procedure**: You'll be presented with a word task complete along with a self-information questionnaire. You will have physio equipment applied to you, and then you will be asked questions from your self-information form and be instructed to respond by lying or by telling the truth. Next, you will be asked about particular words you may have seen earlier. You are to say if you did or did not cross out each word you are asked about. Your answer must be in a complete sentence. Lastly, you will be given an assessment test to see how well you're able to remember the words from the word task from the beginning of the experiment.
3. **Anonymity of Participants and Confidentiality**: The information you will share with us, if you participate in this study, will be kept completely confidential and anonymous.
4. **Discomfort and Risks**: There are no risks associated with this research. This research will include the placement of a chest strap to hold the EEG cap in place. A female researcher will be utilized for the placement of the chest strap on female participants. Male participants will have either a female researcher or a male researcher place their chest strap according to the level of the participant's comfort. An EEG cap will be worn on the head and a gel will be placed on the sensors using an applicator. You may feel some slight pressure on your scalp during the application of the gel; however, it will not be painful. If you experience any discomforts, please let the researcher know.
5. **Benefits of the Study**: Your participation will help to advance knowledge in understanding the physiological effects confessions. You may also receive extra credit in one of your classes and monetary compensation.
6. **Freedom to Withdraw**: You are free to withdraw your participation at any time without penalty. You may also skip any part of the study at no penalty.
7. **Approval of Research**: This research is approved as a class project under the supervision of Dr. Snyder. If you have any questions, feel free to contact us:

Katherine Snyder, Ph. D. Ksnyder@methodist.edu
Taylor Porter tporter@student.methodist.edu
David McNeil dmcneil@student.methodist.edu

By signing below, you freely consent to participate in this physiological study of confessions.

_____ _____ _____

Subject's Name Signature Date

Appendix B

Extra Credit Information

_____

Course

_____

Course Professor

Appendix C

Self-Questionnaire/Information Sheet

1. How old are you?
2. What is your gender?
3. What is your class classification?
4. What is your major?
5. What is your favorite color?
6. Are you a commuter student or a residential student?
7. Do you work?
8. How many siblings do you have?
9. What color are your eyes?
10. Do you have any tattoos?
11. How many languages do you speak fluently?
12. Do you smoke?
13. What month were you born?
14. What city are you from?
15. What type of food do you not like?
16. What is your favorite TV show?
17. Do you have any allergies?
18. What is your favorite season?
19. What is your favorite drink?
20. What size shoe do you wear?

Appendix D

Word List

Woman	Enrage	Doze
White	Tired	Cake
Daughter	Surgeon	Rubber
Fast	Pillow	Brown
Sandwich	Ice	Tarantula
Injection	Orange	Physician
Shoe	Husband	Screen
Valley	Slice	Delay
Mad	Aunt	Toast
Low	England	Cotton
Mississippi	Toe	Tall
Table	Thread	Insect
Bumpy	Niece	Temper
Bed	Rugged	Peak
Crust	Uncle	Air
Vegetable	Emotion	Gravel
Web	Climb	Seat
Hot	Up	Throne
Boat	Swim	Crook
Jazz	Awake	Sister
Lawyer	Dark	Symphony
Speed	Quick	Fluffy
Chocolate	Legs	Wood
Banana	Crown	Shutter
Queen	Bug	Father
Blue	Mouth	Sugar
Steal	Sky	Bridge
Hard	Summit	Syringe
Orchestra	Freeze	Honey
Radio	Knitting	Frame
Smooth	Criminal	Knee
Curtain	Dentist	Kiwi

Appendix E

Alphabet List

Criminal	Peak	Ice
Table	Crown	Shoe
Lawyer	Husband	Chocolate
Speed	Crust	Legs
Cake	Symphony	Vegetable
Curtain	Gravel	Fluffy
Mad	Toast	Brown
Pillow	Tired	Jazz
Blue	Queen	Air
Frame	Uncle	Knee
Bed	Bridge	Physician
Knitting	Sky	Temper
Up	Injection	Web
Rugged	Fast	Daughter
Orange	Bug	Steal
Boat	Valley	Sister

Appendix F

Directions: Circle the words you crossed out earlier in the word task.

1. A. Anger
   B. Temper
   C. Enrage
   D. Emotion

2. A. Dark
   B. White
   C. Blue
   D. Black

3. A. Bread
   B. Sandwich
   C. Slice
   D. Toast

4. A. Wood
   B. Table
   C. Seat
   D. Chair

5. A. Freeze
   B. Cold
   C. Hot
   D. Ice

6. A. Lawyer
   B. Dentist
   C. Doctor
   D. Surgeon

7. A. Foot
   B. Shoe
   C. Mouth
   D. Toe

8. A. Banana
   B. Kiwi
   C. Vegetable
   D. Fruit

9. A. Girl
   B. Niece
   C. Sister
   D. Aunt

10. A. Up
    B. Low
    C. High
    D. Tall

11. A. King
    B. Queen
    C. Throne
    D. England

12. A. Woman
    B. Father
    C. Husband
    D. Man

13. A. Valley
    B. Mountain
    C. Summit
    D. Climb

14. A. Music
    B. Radio
    C. Jazz
    D. Orchestra

15. A. Thread
    B. Syringe
    C. Needle
    D. Knitting

16. A. Mississippi
    B. River
    C. Boat
    D. Swim

17. A. Rugged
    B. Smooth
    C. Bumpy
    D. Rough

18. A. Sleep
    B. Doze
    C. Tired
    D. Awake

19. A. Quick
    B. Slow
    C. Delay
    D. Fast

20. A. Pillow
    B. Hard
    C. Soft
    D. Cotton

21. A. Web
    B. Tarantula
    C. Insect
    D. Spider

22. A. Sweet
    B. Sugar
    C. Chocolate
    D. Honey

23. A. Crook
    B. Thief
    C. Robber
    D. Criminal

24. A. Curtain
    B. Screen
    C. Window
    D. Shutter

Appendix G

Directions: To the Best of Your Ability, Recall and Write down the Words you crossed out in the Word Task Earlier.

An Analysis of Major Depressive Disorder and the Effectivity of Effexor XR® (Venlafaxine Hydrochloride) in its Treatment

Katayoon Dowlatshahi

Faculty Sponsor: Dr. Stephanie Hooper Marosek
Department of Chemistry

Abstract

Major depressive disorder is characterized as the second leading cause of disability in developed nations. Common antidepressants like selective serotonin reuptake inhibitors (SSRIs) are often not effective in treating major depressive disorder in certain individuals. This has led to the rapid development of newer types of antidepressants like venlafaxine hydrochloride, which is sold under the brand name Effexor. Venlafaxine undergoes metabolism in the liver, with its main metabolite being O-desmethylvenlafaxine (ODV). Venlafaxine and ODV function in the inhibition of neuronal 5-hydroxytryptamine and norepinephrine reuptake, along with a much weaker inhibition of dopamine reuptake. This inhibitory effect results in venlafaxine's function as an antidepressant. Studies report that venlafaxine hydrochloride has a higher degree of efficacy than SSRIs and that it also demonstrates greater safety than tricyclic antidepressants. However, venlafaxine's success may also result in lower tolerability; in a double-blind clinical trial, various participants experienced nausea and vomiting following the use of venlafaxine, but these side effects proved to be early onset and gradually dissipated over the course of the trial. The research findings show that the advance of venlafaxine's dual function, as both an SSRI and a selective norepinephrine reuptake inhibitor, is critical to its usefulness in relieving depressive disorders that could previously not be properly treated by the leading antidepressants.

Introduction

Major depressive disorder (MDD) is the leading type of illness among mental and neurological disorders.[1] It has been reported that MDD is the main cause of worldwide disability, chiefly in middle- and high-income countries, which are equipped with extensive healthcare facilities that can lead to the proper diagnosis of MDD.[1] Depression affects approximately 121 million individuals worldwide, with major depression affecting 15 million Americans.[2] It has been predicted that depression will be the second most common health problem in the world by 2020.[2] Treatment for major depression varies, with pharmacological and psychological methods being employed.[2] The use of antidepressant medication still remains the primary method to treat major depression.[2]

Antidepressants contribute to the improvement of symptoms of major depression in approximately 65% to 70% of patients, but these medications also have side effects that discourage many patients from using them.[3] This has resulted in the development of several new types of antidepressants, intended to improve both efficacy and tolerability.[3] Research shows that patients who take Effexor (venlafaxine hydrochloride), a more recent pharmaceutical formulation, have often previously used another type of antidepressant, such as tricyclic antidepressants, selective serotonin reuptake inhibitors, and monoamine oxidase inhibitors.[4] These patients are also likely to have a more severe type of depression and have experienced thoughts of suicide prior to taking venlafaxine.[4,5] The main motive of the present work is to comprehensively study the progress that has been made in MDD diagnosis and treatment over time, as well as to establish how a pharmaceutical innovation like Effexor can yield better outcomes for MDD patients. The effectivity of Effexor in the management of MDD will be detailed through an analysis of its distinctive chemical structure, its mechanism of action following ingestion, and the positive results attained by those prescribed Effexor in multiple clinical trials.

History of Depression

Depression is currently defined as a mental condition characterized by emotional dejection, feelings of sadness greater than can be justified by reason, gloominess, constant feelings of inadequacy, lack of self-worth, and the inability to properly concentrate.[6] The first written account of a depressive state of mind, termed "melancholia," can be traced to ancient Mesopotamian texts dated 2000 B.C., when the general population believed that any mental illness was caused by the possession of one's soul by demons.[6] Individuals exhibiting melancholia were often treated through rather brutal techniques, such as starvation and beatings.[6] In about 400 B.C., the Greek physician Hippocrates attributed melancholia to an excess of black bile in the spleen, which he treated by bloodletting to cleanse the bodily fluids.[6] The standards of mental healthcare did not improve much as time passed. In the European Middle Ages, individuals suffering from depression were forced to live in the horrid conditions of mental asylums.[6] With the advancement of medicine and science, many doctors sought to identify the root of depression.[6] In 1917, Sigmund Freud proposed a form of treatment called psychoanalysis; he asserted that patients could settle inner conflicts through this type of "talking cure."[6] Lobotomies also became increasingly prevalent in the early 1900s, the notion being that the severing of connections in the prefrontal cortex of the frontal lobes of the brain would aid in the treatment of severe depression by producing a calming effect.[6] Most of these surgical procedures resulted in undesirable personality changes or coma, and occasionally proved fatal.[6] The 1950s were the turning point in the treatment of depression, with the use of medications to combat mental illness.[6] This progress in the treatment of depression has not only led to changes in the perception of mental illness but also provided individuals with the hope of being cured.[6]

Antidepressants

The first generation of antidepressants included tricyclic antidepressants (TCAs) and monoamine oxidase inhibitors (MOAIs), which first appeared in the 1950s.[7] TCAs function by binding to 5-hydroxytriptamine (5-HT) and noradrenaline reuptake inhibitors

to prevent the reuptake of serotonin and noradrenaline from the synaptic cleft.[7] The MAOIs work by inhibiting the enzyme monoamine oxidase from breaking down monoamines, which allows for greater monoamine availability.[7] Although MAOIs are effective, they have numerous unfavorable side effects, such as liver dysfunction, low blood pressure, erectile dysfunction, and problems with urination.[7] Various undesirable side effects are also attributed to TCAs, inspiring scientists to research other methods of treating depression.[7]

The second-generation antidepressants were the selective serotonin reuptake inhibitors (SSRIs), which gained prominence in the 1970s and 1980s.[7] The use of SSRIs emerged as a form of first-line medication for MDD because of their effectiveness, tolerability, and safety as antidepressants.[7] SSRIs function by blocking the reuptake of serotonin and increasing its extracellular concentration in the brain.[7] While SSRIs remain the most widely prescribed form of antidepressants, they may not prove effective in treating patients with more severe forms of depression.[7]

The shortcomings of SSRIs have led to the generation of newer forms of antidepressants like serotonin-norepinephrine reuptake inhibitors (SNRIs).[7] Venlafaxine hydrochloride is the first SNRI to be used as an antidepressant, with studies reporting increased efficacy compared to SSRIs.[7] SNRIs function through the dual inhibition of serotonin and norepinephrine reuptake, allowing for an increase in the concentration of these neurotransmitters in the synaptic cleft.[7]

Diagnosis

Depression is characterized as a multifaceted disorder that can be attributed to various etiologies.[8] While multiple classification systems have been developed in the diagnosis of depression, there is still no single reliable method of classification that can be used in primary care.[8] The criteria for the diagnosis of depression articulated in the tenth revision of the *International Statistical Classification of Diseases and Related Health Problems* (ICD-10) and in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) share numerous similarities but also have subtle differences, which are shown in Table 1.[8] In the ICD-10 method of diagnosis, a patient must exhibit two of the first three listed symptoms, which include a depressed mood, loss of interest in everyday activities, and a reduction in energy, as well as two of the remaining seven symptoms.[8] In the DSM-IV method of diagnosis, a patient must have either a depressed mood or loss of interest, and at least five of the remaining eight symptoms.[8] These two methods of diagnosis require the symptoms to be present for at least two weeks before proper diagnosis can be made.[8] The ICD-10 and DSM-IV utilize a classification system that categorizes depressive episodes as mild, moderate, or severe based on the number and severity of the symptoms.[8] A recent modification to the diagnosis of depression has led to the addition of a type of depressive state that is referred to as subthreshold, which is evident when a patient exhibits fewer than five of the symptoms outlined by the DSM-IV.[8] The intensity of the symptoms and the level of impairment in function are used to differentiate between mild depression, moderate depression, and severe depression.[8]

Table 1. Comparison of symptoms required for diagnosis according to the ICD-10 and DSM-IV methods. Core symptoms are marked with an asterisk (*). Adapted from source.[8]

ICD–10	DSM–IV major/minor depressive disorder
Depressed mood*	Depressed mood by self-report or observation made by others*
Loss of interest*	Loss of interest or pleasure*
Reduction in energy*	Fatigue/loss of energy
Loss of confidence or self-esteem	Worthlessness/excessive or inappropriate guilt
Unreasonable feelings of self-reproach or inappropriate guilt	
Recurrent thoughts of death or suicide	Recurrent thoughts of death, suicidal thoughts or actual suicide attempts
Diminished ability to think/ concentrate or indecisiveness	Diminished ability to think/concentrate or indecisiveness
Change in psychomotor activity with agitation or retardation	Psychomotor agitation or retardation
Sleep disturbance	Insomnia/hypersomnia
Change in appetite with weight change	Significant appetite and/or weight loss

Following the diagnosis of MDD, treatment proceeds in three stages: the acute phase, the continuation phase, and the maintenance phase.[8] During the acute phase, depression symptoms improve; the continuation phase represents the absence of symptoms for a period of four to six months.[8] The maintenance phase is indicative of recovery; the main goal is prevention of the recurrence of depression symptoms.[8]

The Guideline Development Group has prepared a diagnostic tool based on a condensed set of DSM-IV symptoms to make diagnosis less complicated for primary care specialists.[8] Those symptoms include a depressed mood, diminished interest, feelings of worthlessness or guilt, impaired concentration, and recurrent thoughts of death or suicide.[8] Another method of diagnosis is the Hamilton Rating Scale for Depression (HRSD), which is an assessment scale that uses questions to gather information on the patient's depressive symptoms.[9] Atypical symptoms like hypersomnia (excessive sleepiness) and hyperphagia (excessive hunger) are not properly assessed by the HRSD.[9] A score of 0 to 7 on the HRSD is considered normal, meaning the patient is in the state of clinical remission.[9] A score of 20 or higher on the HRSD, which is typically required for participating in clinical trials, is indicative of the presence of moderate to severe depression.[9]

Causes

The serotonin hypothesis, which links depression to serotonin levels, was initially expressed in a paper by Alec Coppen in 1967.[6] He stated that MDD is caused by abnormal operation of the 5-HT system.[6] He proposed that the activity of the 5-HT system be enhanced by antidepressant strategies that restore euthymia, i.e., a tranquil mental state.[6] An association between specific symptoms based on the deficiency of a

select group of neurotransmitters has also been proposed.[6] It has recently been hypothesized that a 5-HT deficiency is related to anxiety and obsessions; that reduced norepinephrine neurotransmission is characterized by decreased alertness, low energy, and problems with concentration; and that dysfunctional dopamine activity is related to the lack of motivation or pleasure.[6] Scientists believe that depression is caused by multiple factors attributed to biological, psychological, and social causes.[6] It is critical to note that depression can be treated in various ways, based on the individual patient and the severity of symptoms.[6]

Synthesis of Venlafaxine Hydrochloride

Effexor (venlafaxine hydrochloride) has a chemical structure that was recently synthesized to serve as an antidepressant.[10] Unlike other antidepressants, venlafaxine hydrochloride lacks the tricyclic or tetracyclic structure.[10] Venlafaxine hydrochloride, as depicted in Figure 1, has the chemical designation of (R/S)-1-[2-(dimethylamino)-1-(4-methoxyphenyl)ethyl] cyclohexanol hydrochloride or (±)-1-[α-[(dimethyl-amino)methyl]-p-methoxybenzyl] cyclohexanol hydrochloride, and has the empirical formula of $C_{17}H_{27}NO_2HCl$. It has a molecular weight of 313.87 g/mol.[10]

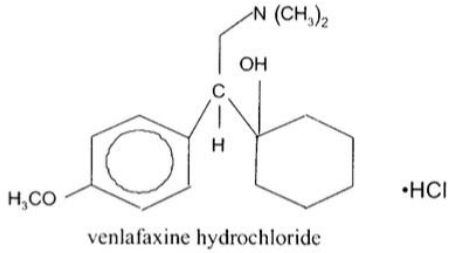

Figure 1. The chemical structure of venlafaxine hydrochloride. Adapted from source.[10]

Venlafaxine was initially synthesized through the nucleophilic addition of 4-methoxyphenyl acetonitrile (7.5.30) with cyclohexanone (7.5.31), using lithium diisopropylamide or butyllithium to generate (RS)-1-[cyano-(4methoxyphenyl) methyl] cyclohexanol (7.5.32).[7] The catalytic hydrogenation of (RS)-1-[cyano-(4methoxyphenyl) methyl] cyclohexanol through the use of the rhodium over alumina catalyst (Rh/Al_2O_3) generates (RS)-1-[2-amino-1-(4-methoxypheny) ethyl]-cyclohexanol (7.5.33).[7] This product undergoes dimethylation using a reductive amination Eschweiler-Clarke procedure in order to produce venlafaxine.[7] The overall yield of the process outlined in Figure 2 is approximately 25%, which led to efforts to improve the chemical synthesis of venlafaxine in order to procure a higher yield.[7] The pyrophoric reagents used in the reaction, n-butyllithium (n-BuLi) and lithium diisopropylamide (LDA), were replaced with sodium methoxide (CH_3NaO).[7] In addition, the costly Rh/Al_2O_3 catalyst was replaced with Raney nickel, which is a solid catalyst composed of a nickel-aluminum alloy, to further simplify the process.[7] These adjustments to the previous method of synthesis increased the overall yield to 55%.[7] The addition of a hydrochloride (HCl) salt to venlafaxine aids in the solubility of Effexor when it is orally administered.[7]

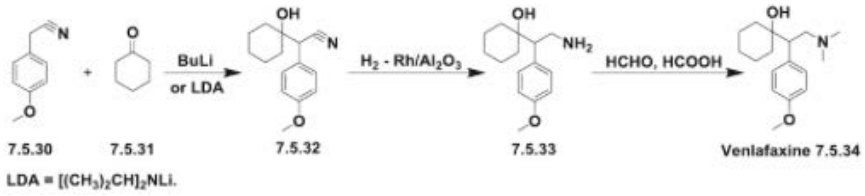

Figure 2. This reaction represents the chemical synthesis of venlafaxine, the active ingredient in Effexor. Adapted from source.[7]

Several other methods for the synthesis of venlafaxine have also been proposed to further expedite the process in a cost-effective manner.[7] While it has been suggested that both enantiomers of venlafaxine serve as antidepressants, it was previously hypothesized that the (+)-enantiomer functions in the inhibition of serotonin reuptake and the (-)-enantiomer functions in the inhibition of norepinephrine reuptake.[7]

Drug Development

Pharmacokinetics

Following the oral administration of venlafaxine hydrochloride, venlafaxine is rapidly absorbed and metabolized in the liver into O-desmethylvenlafaxine (ODV), which is its main metabolite.[10] Mass balance studies indicate that approximately 92% of a single dose of venlafaxine is absorbed and that 87% is excreted through the urine after 48 hours.[10] The composition of venlafaxine recovered in the urine is 5% unchanged venlafaxine, 29% unconjugated ODV, 26% conjugated ODV, and 27% minor inactive metabolites.[10] The bioavailability of venlafaxine is 45%.[10] Approximately 27%$\pm$2% of venlafaxine binds to human blood plasma at concentrations of 2.5 ng/mL to 2215 ng/mL, with 30%$\pm$12% of ODV binding to human blood plasma at concentrations of 100 ng/mL to 500 ng/mL.[10] In patients suffering from cirrhosis, a chronic condition leading to liver damage, the elimination half-life of venlafaxine was increased by 30% and that of ODV was prolonged by 60%.[10] In dialysis patients, the venlafaxine elimination half-life was increased by 180%, and the ODV elimination half-life also increased by 142%.[10]

Pharmacodynamics

The mechanism of action for venlafaxine hydrochloride involves the increase in potentiation of the neurotransmitters serotonin and norepinephrine in the central nervous system.[10] Venlafaxine and its main active metabolite, ODV, function in the inhibition of neuronal serotonin and norepinephrine reuptake.[10] Both venlafaxine and ODV also partake in the weak inhibition of dopamine reuptake.[10] In vitro studies have shown that venlafaxine and ODV do not have an affinity for α-1 adrenergic, muscarinic, and histaminergic receptors.[10] A recent study showed that venlafaxine has a higher affinity for the inhibition of the reuptake of serotonin compared to norepinephrine.[11] The reuptake of serotonin is initially inhibited, then followed by the inhibition of

norepinephrine reuptake.[11] Also, venlafaxine hydrochloride reportedly functions as an SSRI at lower doses, such as at 75 mg.[11]

Metabolites

In both in vitro and in vivo studies, venlafaxine was metabolized to its active metabolite, ODV, by Cytochrome P450 2D6 (CYP2D6).[10] Venlafaxine is also metabolized to N-desmethylvenlafaxine, N,O-didesmethylvenlafaxine, and other minor metabolites.[10]

Manufacture and Clinical Trials of Effexor

Manufacture

In 1993, Wyeth introduced venlafaxine hydrochloride immediate release (Effexor IR) tablets.[12] Effexor IR was available in doses ranging from 25 mg to 100 mg, with patients being required to take two tablets of Effexor IR each day.[12] The microencapsulated extended release version of Effexor (Effexor XR) was released in 1997.[12] Patients were prescribed only one capsule each day.[12] The clinical advantage of Effexor XR was that it reduced the main side effects of nausea and dizziness through its gradual release of the active ingredient.[12] In 2009, Pfizer purchased Wyeth and decide to manufacture only Effexor XR capsules.[12]

Composition, Dosage, and Administration

Effexor XR is a capsule that should be taken once daily with food.[13] Venlafaxine is a white to off-white crystalline solid, which has a solubility of 572 mg/mL in water.[10] The active ingredient in Effexor XR is venlafaxine; the inactive ingredients are cellulose, ethyl cellulose, gelatin, hypromellose, iron oxides, and titanium dioxide.[10] Capsules should be stored in a dry place at temperatures that range from 20°C to 25°C.[10] The recommended dose for a patient taking Effexor XR for the first time is 75 mg each day, as shown in Figure 3.[10] The Effexor XR capsules are available in dosages of 37.5 mg, 75 mg, 150 mg, and 225 mg.[10] Depending both on tolerability and on the severity of the depression symptoms, the dose can be increased up to 375 mg/day; however, increases in dosage by more than 75 mg should take place over a period greater than four days.[10] The high doses of Effexor XR are divided into three doses each day, to prevent possible irritability or other side effects from taking an excessive amount of the active ingredient.[10] The total daily dose should be reduced by up to 50% in patients with hepatic or renal impairment.[10] For individuals over the age of 18, the prescribed dose does not need to be adjusted based on the patient's age or gender.[10] Effexor is not currently approved for use in children.[10] A randomized, double-blind, placebo-controlled study that compared the extended release and immediate release formulations of venlafaxine hydrochloride concluded that patients experienced greater tolerability taking venlafaxine hydrochloride XR.[13] Generic venlafaxine hydrochloride is available in both extended release and immediate release forms.[13]

Figure 3. The 75 mg and 150 mg Effexor XR capsules. Adapted from source.[14]

Side Effects

The most commonly reported side effects encountered by patients taking Effexor XR are unusual dreams, sexual problems, loss of appetite, constipation, diarrhea, nausea, vomiting, dry mouth, fatigue, tremors, dizziness, blurred vision, sweating, headache, and an increased heart rate.[10] Most studies report that nausea is the most common side effect, especially during the initial weeks of taking the prescription.[10]

According to a study that analyzed the side effects of three doses of venlafaxine (75 mg, 225 mg, and 375 mg per day), along with a placebo, a mean increase in supine diastolic blood pressure (SDBP) of 7.2 mm Hg was evident in the group taking the 375 mg dosage of venlafaxine tablets during the sixth week of trials.[10] No significant changes in SDBP were recorded for participants taking the 75 mg or 225 mg venlafaxine tablets.[10] The elevation in SDBP levels was dose-dependent, and the researchers urged physicians to continuously monitor the blood pressure of patients taking Effexor XR at higher doses.[10]

In premarketing tests of Effexor XR, 0.26%, or 8 out of 3082 patients, reported having seizures.[10] These participants were taking doses of 150 mg/day or less.[10] A double-blind randomized clinical trial examining the efficacy of venlafaxine hydrochloride and citalopram, a SSRI, reported that twelve participants on venlafaxine hydrochloride stopped receiving treatment as a result of nausea and vomiting.[3] These side effects occurred during the first two weeks of treatment, and the participants who continued the trial did not report nausea or vomiting during the six remaining weeks of the eight-week trial.[3] It was determined that these side effects are an early onset type; a different study compared venlafaxine and fluoxetine, and reported similar findings.[3]

A study was also conducted to compare venlafaxine to other antidepressants, including fluoxetine, citalopram, and dosulepin, to determine the likelihood that the drugs put patients at risk of sudden cardiac death.[4] While both fluoxetine and citalopram are SSRIs, dosulepin is a TCA.[4] The final study focused on the reactions of the 207,384 patients taking one of the four antidepressants.[4] The results showed that venlafaxine, when compared to other antidepressants, was not associated with an increase in the risk of sudden cardiac death.[4] It was also reported that venlafaxine's association with increased fatal overdoses was related to other factors, such as the prescription of venlafaxine to patients who were at higher risk of suicide.[4] In response to an increase of

suicidal thinking in young adults ages 18-24 during trials of antidepressants, all antidepressants now carry a "black box" warning to alert both physicians and patients to the risk.[2]

Clinical Trials

A clinical trial examining the efficacy and remission rates for a select group of antidepressants was conducted by the Clinical Research and Development Department at Wyeth-Ayerst Laboratories.[15] The trial analyzed three SSRIs—fluoxetine, paroxetine, and fluvoxamine—along with venlafaxine XR, venlafaxine IR, and a placebo control group.[15] Patients in the clinical trial met the criteria outlined by the DSM-IV for at least 1 month and had minimum scores of 20 on the HRSD.[15] Participants included 68 inpatients and 1977 outpatients.[15] The doses employed were as follows: 25-100 mg/day of venlafaxine IR, 75-225 mg/day of venlafaxine XR, 20-80 mg/day of fluoxetine, 20-40 mg/day of paroxetine, and 100-200 mg/day of fluvoxamine.[15] This study defined remission as a total score that was less than or equal to 7 on the first seventeen items on the HRSD.[15]

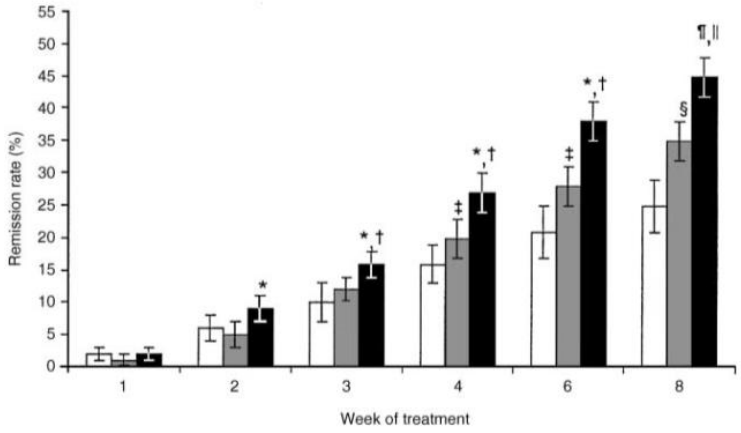

Figure 4. The remission rates of patients involved in the clinical trial examining venlafaxine, fluoxetine, paroxetine, and fluvoxamine. The black bar represents the venlafaxine; the gray bar represents the SSRIs; and the white bar represents the placebo. Adapted from source.[15]

After eight weeks of treatment, it was concluded that the final remission rates were 45% for venlafaxine, 35% for SSRIs, and 25% for the placebo control group, as displayed in Figure 4.[15] The difference in these rates was statistically significant.[15] Venlafaxine was statistically more effective than the SSRIs after the second week of treatment and more effective than the placebo after the third week of treatment.[15] Most physicians recommend that patients continue taking antidepressants for at least one year, even after their symptoms begin to ease.[15]

Another clinical trial was conducted on 123 patients with major depression, classified based on a score that was greater than or equal to 18 on the HRSD.[16] The patients received two antidepressants: one group took venlafaxine with doses starting at 75 mg/day, then increasing to 200-300 mg/day by the tenth day, and the other group was

assigned paroxetine with doses starting at 20 mg/day, then increasing to 30-40 mg/day by the eighth day.[16] Treatment response was measured by a decrease of greater than 50% on the HRSD, and remission was measured by a HRSD score of less than 10.[16] The results showed that, after a period of 28 days, a higher percentage of patients achieved remission while on venlafaxine, with a remission rate of 42%, than the patients who were taking paroxetine, which had a remission rate of 20%, as seen in Table 2.[16] The patients taking venlafaxine also experienced a greater therapeutic response, 52% compared to 33% for paroxetine. [16]

Table 2. The outcomes for patients treated with venlafaxine and paroxetine in a randomized, double-blind trial. Adapted from the source.[16]

Outcomes at 28 days	Venlafaxine	Paroxetine
Therapeutic response	52%	33%
Remission	42%	20%

Cost and Generic Alternatives

Cost

The cost of Effexor XR varies depending on the patient's insurance plan and the patient's eligibility for an Effexor XR choice card. The cost of Effexor XR for patients without insurance is shown in Table 3.

Table 3. The prices of Effexor XR for a 30-day supply based on the most commonly prescribed dosages for individuals without insurance.[17]

Dosage	Effexor XR (Without Insurance)
37.5 mg	$294.24
75 mg	$328.73
150 mg	$357.37

To make Effexor XR more affordable, Pfizer created an Effexor XR choice card program.[18] Patients who have insurance and pay an out-of-pocket expense of $130.00 or less for a 30-day supply of Effexor XR qualify to pay only $4.00 for a 30-day supply with the card.[18] The choice card covers the $75.00 co-pay for these individuals.[18] Patients who do not have health insurance and pay $130.00 or more for a 30-day supply of Effexor XR are eligible to receive a 30-day supply for $30 with the card program.[18] The choice card is accepted at selected pharmacies, such as Rite Aid, Walmart, and Food Lion.[18] The manufacturers of Effexor XR also have a website that enables patients to easily apply for the choice card and to locate pharmacies that participate in this savings program.[18] Through the program, patients are eligible to save up to $2,500.00 each year.[18]

Generic Alternatives

In August 2006, generic venlafaxine hydrochloride immediate-release tablets were made available by Teva Pharmaceuticals.[2] In 2008, Osmotica Pharmaceutical Corp. launched venlafaxine hydrochloride extended-release tablets.[2] Later, in July 2010, Teva also released venlafaxine hydrochloride extended-release capsules.[2] Now many other pharmaceutical companies also manufacture generic venlafaxine hydrochloride, including Cobalt Pharmaceuticals Inc., Pharmascience Inc., Ratiopharm, Sandoz, and Cipla Medpro.[2] While these generic alternatives aim to be less costly than the name-brand version, patients are advised to continue taking the antidepressant that is currently effective for them rather than change to a generic version.[2] A study comparing the pharmacokinetics of brand-name to generic formulations of venlafaxine was conducted in which healthy male volunteers took either Effexor XR or the generic Novo-venlafaxine XR for four days.[19] Participants were given four additional days to allow the drug to be fully excreted from their systems before taking the other venlafaxine formulation for another four days.[19] The results showed that the concentration of the active metabolite ODV was approximately 43% higher in the generic group at 3 hours and 48% higher at 5 hours.[19] Participants also reported three times more side effects while taking the Novo-venlafaxine than the brand-name Effexor XR.[19] These findings reflect how the generic form of venlafaxine is not bioequivalent to Effexor XR, with the generic formulation releasing its active ingredients at a much faster rate.[19]

Future Research

While the efficacy of Effexor has been studied in several scientific trials, studies of the impact of Effexor on pregnant patients and on individuals younger than 18 years of age have not occurred.[10] In one study, 120 mg/kg of venlafaxine was administered to rats each day during a period of 18 months, and the results did not show any teratogenic effects on the rats' reproduction or fertility.[10] Thus, additional studies should be geared toward Effexor's ability to aid minors and pregnant women, as the drug has the potential to benefit a great number of people who otherwise may continue to suffer from MDD.

Conclusion

Effexor XR or venlafaxine hydrochloride XR is type of antidepressant that functions as a dual reuptake inhibitor of norepinephrine and serotonin. This mechanism is often necessary to treat patients with severe depression and those who may not have responded adequately to SSRIs or other antidepressants. Multiple studies have shown that patients achieve higher rates of remission when taking Effexor than other SSRIs. The extended release formulation of Effexor alleviates the main side effects of Effexor immediate release, such as nausea and vomiting. The implementation of Pfizer's choice card program to make Effexor XR more affordable enables patients to receive name-brand treatment at much lower prices. The numerous positive implications associated with venlafaxine hydrochloride XR, such as its increased tolerability and efficacy, confirm the drug as an effective treatment for MDD patients.

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About Our Contributors

Karen Frances Britton grew up in Fayetteville, North Carolina, and decided to stay close to home for college. She is currently enrolled at Methodist University (MU) as a Graphic Design major and expects to graduate in 2021. Upon graduating, she will pursue a career in graphic design with a focus on public relations.

Sheryl Brock plans to graduate in May of 2019 with two bachelor's degrees, one in Biology and one in Environmental and Occupational Management with a concentration in Natural Resources and Regulatory Compliance. She is a native of Fayetteville, North Carolina. During her Methodist University career, Brock served as the president of the Lector Club, College Panhellenic Council, and Omicron Delta Kappa Honor Society while also participating in numerous other clubs and organizations. Brock has presented two of her essays, "Compassion" and "Nature and its Consequences," during the Honors Program Panel at MU's annual undergraduate research symposium. After graduation, Brock plans to attend graduate school for a degree in Coastal and Ocean Policy.

Khalil Coleman, a resident of Fayetteville NC, will graduate in May 2019 with a B.F.A. in Graphic Design. He plans to work for a great company where he can share his creative ideas and have a positive impact on the company. He has always loved art and has always known that he wanted to continue creating and expressing himself through art in his career.

Katayoon (Kate) Dowlatshahi graduated *summa cum laude* from Methodist University with a Bachelor of Science degree in Chemistry with a concentration in Biochemistry and a minor in Biology. Originally from Tehran, Iran, Kate was involved in multiple organizations while at Methodist, including Sigma Tau Delta, Health Occupations Students of America, Gamma Sigma Epsilon, Beta Beta Beta, Phi Kappa Phi, and the MU Chemistry Club. She worked extensively throughout her senior year to create the Pre-Health Professions Club to benefit undergraduate students interested in pursuing a career in healthcare. During her senior year, she was recognized with the prestigious Chemistry Mendelevium Medallion and the Ott-Cooper Science Award, and also became the first research fellow to successfully complete the Center for Undergraduate Research and Creativity Fellowship Program. She is currently a first-year medical student at the Brody School of Medicine at East Carolina University. She is deeply passionate about patient advocacy and hopes to work with underserved populations in the future.

David McNeil is a graduate of MU's Winter Class of 2017. He majored in Psychology and minored in Biology, and has presented his research at the MU symposium for undergraduate research and at the 42nd annual Carolina Psychology Conference. Currently a second lieutenant with the North Carolina National Guard, David has been accepted into the masters of counseling program at Northwestern University's online program.

About Our Contributors

Heather Miller is a ceramic sculptor and painter who teaches art to children in a home school setting with the aid of biblical principles. She is currently working toward a second bachelor's degree in Arts with a concentration in painting and ceramic sculpture at Methodist University. Heather served in the U.S. Army for eight years and is a 2005 graduate of the United States Military Academy with a concentration in sociology. She also attended Cameron University in Lawton, Oklahoma, where she studied Fine Arts and worked in printmaking, mixed media sculpture, and pencil, charcoal and pastels on paper. As a Christian, an Army wife and a mother of two boys, Heather uses her passion for art to encounter God and finds that creating art sometimes brings about revelation and other times pure joy.

Cheri Todd Molter is a researcher, writer, and historian who graduated *summa cum laude* from MU in 2017 with a triple major in History, English, and Writing. Currently, she is employed by the N.C. Civil War & Reconstruction History Center where she does genealogical research on North Carolinian USCT soldiers and works to raise awareness of the NCCWRHC's "100 Stories from 100 Counties" project. Cheri's poems and essays have been published in *Corners: Voices on Change*, *Kakalak*, *Tapestry*, *Aletheia,* and MU's *Monarch Review*.

Mary Sue Parker is majoring in Graphic Design at MU and expects to graduate in the year 2021. Originally from Saxapahaw NC, she has many dreams for future careers, such as traveling as a merchandise designer for a band and also designing on movie sets, but ultimately she looks forward to going wherever the Lord calls her.

Taylor Porter will graduate from Methodist University in May 2019 with a triple major in Psychology, Criminal Justice, and Applied Forensic Science. A member of the Psi Chi International Honor Society in Psychology and of Alpha Phi Sigma, the National Criminal Justice Honor Society, she was recognized as MU's outstanding criminal justice student in the spring of 2018. Outside school, she has completed the training and volunteers as a Guardian Ad Litem in NC Judicial District 4 and holds a job in applied behavior analysis. An interest in the Innocence Project awakened her desire to find a way to more accurately detect deception than with the common polygraph. She has presented her research findings at local, state, and national level conferences. After graduating from MU, she plans to earn a PhD in Legal Psychology and continue doing research to improve the criminal justice system.

Sierra Romero was born and raised in North Carolina. She is currently majoring in Graphic Design and minoring in Marketing, and expects to graduate in 2020. Although Sierra has always had a strong interest in the arts, it was not until she decided to attend MU that she began to aspire to a life and career as a visual artist. After graduation, she hopes to pursue a master's degree.

About Our Contributors

David Shane retired from the United States Marine Corps in December of 2014 and subsequently enrolled as a student at Methodist University. In 2018, David graduated *magna cum laude* with a Bachelor of Science degree in Mathematics and a minor in Religion. He is a graduate of the MU Honors program and a member of the Phi Kappa Phi honor society. David was the first recipient of the Best Composition Award, as well as a recipient of the Balaez-Ambrose Award for mathematics. In January 2018, David gave a presentation on Mathematical Philosophy at the national mathematics conference. He is currently focused on raising his five children and intends to pursue an advanced degree in mathematics.

Tony Taylor, Jr., is a senior majoring in Graphic Design and will graduate in May 2019. A North Carolina native from Raleigh, he has always had a creative mind. He hopes, after graduation, to work as a designer.

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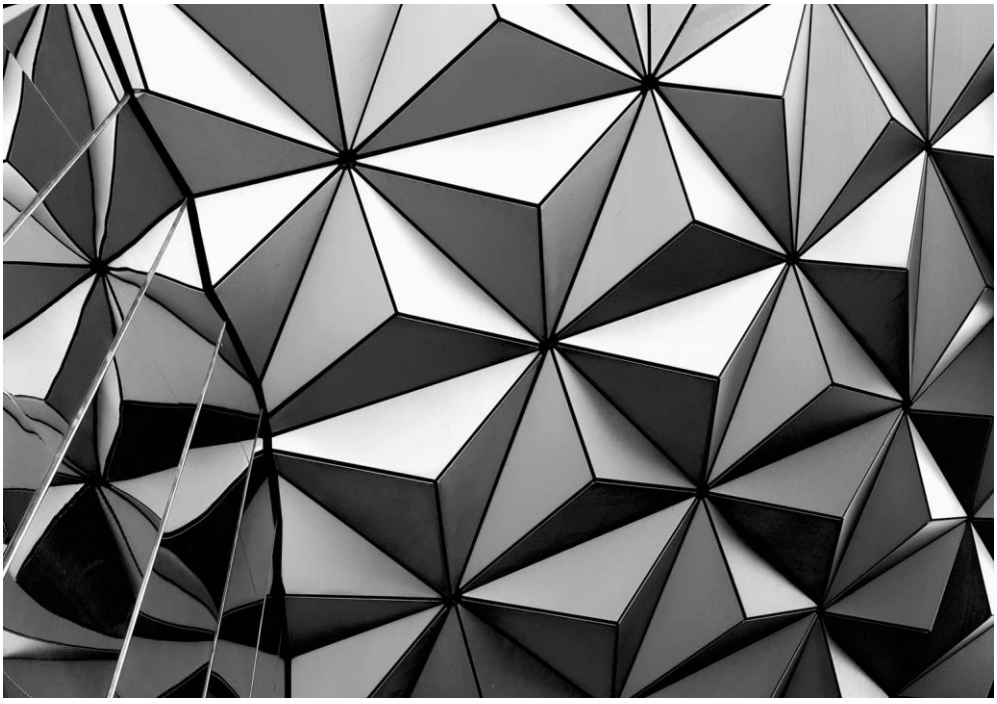

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