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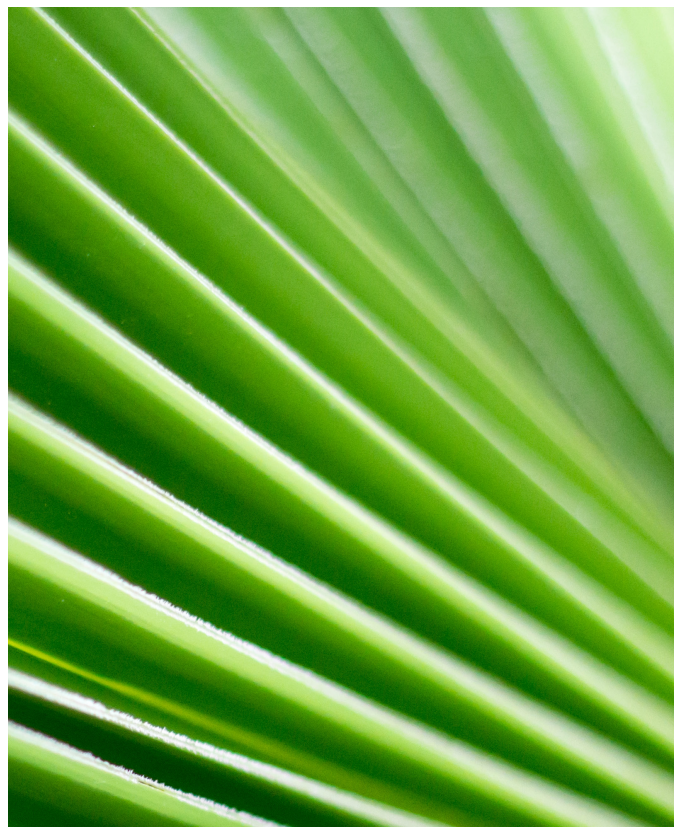
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LETTER FROM THE EDITORS

Dear Reader,

As we conclude our sophomore volume, we are reminded of the tremendous efforts and continued support of administrators, faculty, staff, students, and the university who are committed to the mission of engaging the intellectual energy of the IU undergraduate community. As a student-run and faculty-mentored publication, IUJUR aims to showcase the enthusiasm, passion, and intellectual curiosity of the talented students and dedicated faculty mentors conducting undergraduate research at Indiana University across a broad spectrum of academic disciplines. We are encouraged by our progress to advance this mission, which has been made possible with the significant energy and dedication of the IUJUR staff, expertise of the Faculty Advisory Board, and guidance of our wonderful faculty advisers. We would like to thank the countless people who have contributed to the Journal and the growth of IUJUR as an organization.

We received an impressive number of submissions this year that reflected the broad diversity of scholarship and creative activity conducted at all eight IU campuses. This issue celebrates the student authors who have been selected to be published in Volume II of the Journal. The submissions not only exhibit genuine passion for the research process, but they further showcase the impressive talents and intellectual capacity of the student body. Additionally, we wish to recognize the wonderful faculty mentors for advising, supporting, and challenging their student authors to push the boundaries of current knowledge forward. The support of faculty mentors, along with the time and effort of our Faculty Advisory Board, are instrumental in ensuring the quality of the undergraduate research featured in this journal. Thank you for your help and encouragement toward this pursuit.

As our organization aims to bridge together diverse areas of study and encourage the vibrant culture of curiosity at Indiana University, we are optimistic about the role of the Journal in providing a forum for the growing undergraduate research community. Looking forward, we are excited to grow and learn as an academic publication and student organization and we welcome your feedback and criticism. We thank you for your support and truly hope you enjoy this issue.

Sincerely,

Song Kim & Taylor Ballinger
Editors-in-Chief

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HUMANITIES

Bared Teeth, Plucked Feathers, Broken Eggs: Reading Human-Animal Relationships through Audubon

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In this paper, I study John James Audubon's famed drawings of wildlife to uncover his perspective on the evolving relationships between humans and animals during the era of American westward expansion. Using three engravings from *Birds of America*, along with his accompanying essays, I look beyond the animals in the foreground to examine the human settlements often lurking in the background. I discover that Audubon portrays three distinct types of human-animal relationships, which I then compare to the human presence shown in two of his later works, the engravings of *Viviparous Quadrupeds of North America* and their subsequent essays. This second set of drawings undercuts any attempt to derive an optimistic interpretation of the *Birds* plates, for they reveal an unsustainable relationship between humans and the animals whose habitats they invade. I conclude that while *Birds* and *Quadrupeds* glorify their animal subjects, rightly qualifying as artistic and scientific triumphs, their depiction of human activity carries a much darker weight, suggesting that human presence in nature necessarily causes damage. Ultimately, this idea recasts Audubon as a thinker who transcends his historical location and offers a relevant perspective on the environment occupied by the modern reader.

KEYWORDS: Audubon, *Birds of America*, *Quadrupeds of North America*

Since 1827, when John James Audubon began publishing his portrayals of American birds through Robert Havell's firm, Audubon's *Birds of America* has widely been considered a triumph in the fields of both artwork and ornithology. The past two centuries have brought no shortage of praise for the images themselves, as critics laud the incredible, striking detail of the birds' features and the lush, enchanting colors of their feathers. In the whirlwind of attention given to the aesthetics of the birds, observers often overlook the presence of humans in several of Audubon's plates. The subtle human activity in the backgrounds of several images actually provides the viewer with information just as rich as the knowledge gleaned from studying the birds of the foreground. In this essay, I have chosen three representative plates from Audubon's *Birds of America*, supplemented by the essays Audubon wrote for these plates, in order to offer a slightly different view of Audubon's achievement. As I will show, the landscapes behind Audubon's depictions of the Glossy Ibis, the Snowy Heron, and the Long-billed Curlew represent three distinct types of relationships between humans and nature – relationships which are complicated by Audubon's later representations of quadrupeds in *The Viviparous Quadripeds of North America* (1845-1848). Given the lack of sustained critical scholarship on either *Birds* or *Quadrupeds*, these interpretive moves break new ground in approaching Audubon's work, establishing him as a scientist with much to say about humans' present treatment of the environment.

<center>***</center>

Of the three plates selected from Audubon's *Birds of America*, the monochromatic scene that forms the background of the

Figure 1. Robert Havell, Jr. after John James Audubon, Glossy Ibis. 1837. Aquatint engraving from *Birds of America*, plate 386. Courtesy of the Lilly Library, Bloomington.

1837 Glossy Ibis plate most closely depicts a coexisting relationship between humans and nature (see Figure 1). Robert Havell's greyish landscape, lying just beyond the lushly colored feathers of the ibis, contains four log buildings: "a woodcutter's cabin," his outhouse, and the two buildings of his neighbor (Audubon, 1838, p. 609). The human presence here is undeniable, yet Havell portrays it as subtly thriving alongside nature, rather than at nature's expense. The log cabins, built with patched roofs and uneven timbers, appear to possess the same rugged, wild qualities as the

environment around them, casting the human dwellings as merely small dots in the larger landscape. More significantly, Havell's decision to wash the background in muted colors emphasizes the deep scarlet and emerald found in the ibis's plumage. Upon first glancing at the plate, the viewer's eye rushes to explore the intricate linear patterns that form the bird's neck feathers, as well as the scale-like etchings that cover the ibis' wings and legs. The presence of background human dwellings does not enter into the viewer's field of vision until he or she has spent several minutes taking in the arresting beauty of the creature in the foreground.

Though many of Audubon's essays mix scientific descriptions of the birds' vivid colors with lively accounts of the writer's adventures and discoveries, his entry for the Glossy Ibis remains uncharacteristically vague. Despite Audubon's praise of the ibis being a "beautiful species" with "superb plumage," the bird's most prominent characteristic in this passage is its elusiveness (Audubon, 1838, p. 608-609). Sighting a glossy ibis in the United States is, as it would turn out, an "exceedingly rare occurrence" – so rare, in fact, that Audubon "unfortunately had no opportunity of verifying" even the most basic of its dietary and migratory habits (Audubon, 1838, p. 608-609). This unfamiliarity inevitably breeds misconceptions about the rare bird, and Audubon repeatedly expresses frustration regarding the inability of previous ornithologists to agree whether the American ibis is a unique species, or the same as another species already known to exist on other continents. Such is the rarity of this bird that Audubon himself is only able to corroborate the facts of this taxonomic disagreement after examining ibis specimens from America, Mexico, and India (Audubon, 1838, p. 611).

Taken together, the visual and written elements of Audubon's representation of the glossy ibis suggest an apparently balanced relationship between humans and nature. This is not to say that pioneers in these types of settlements possessed some deep connection to the world around them. Audubon's emphasis on the difficulty of tracking an ibis points out the ostensible separation between humankind and nature, as well as the illustration of a fence around the cabin, establishes some rudimentary barrier between the 'tame' and the 'wild.' Nonetheless, just as elements from both human and natural worlds overlap without devastating consequences ('wild' foliage can be seen on either side of the fence, and a 'tame' well has been built by the river), so do humans and creatures seemingly exist in the same area without resulting in undue harm to either. In such an environment, the bird in question is still free to thrive, unhindered by encroachment upon its natural territory. From the pale pastels of the flowers, which complement the lush hues of the plumage, to the curve of the ibis's back, which almost perfectly parallels the diagonal line of the ground below it, the persistence of unity between bird and earth indicates that nature has yet to feel the effects of human trespass. Audubon therefore captures the fleeting moment between human arrival in wilderness and the first

symptoms of natural depletion, a brief point of time in which humans and animals existed parallel to each other, occupying the same geographic space but encountering minimal conflict.

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In Audubon's 1835 plate of the Snowy Heron, or White Egret, the human presence does not so quietly accept a secondary role to nature (see Figure 2). In contrast to Havell's monochromatic renderings of the settlements of Florida woodcutters, Audubon's assistant George Lehman here adds the sprawling landscape of a South Carolina plantation. Whereas the long, low cabins represented humans dwelling within (though not with) the natural world, the more "civilized" architecture of plantation houses signifies an attempt to subjugate the land—an example of "labor in the earth to change it into a garden" (Merchant, p. 34). A neatly constructed fence cleanly reinforces the implicit division of the human realm from the natural, and the only passage through this boundary line is the human-made road, a symbol of development stretching out from the plantation house and plunging into the "wild" world beyond the borderline. Even the coloring of the plate echoes this aesthetic difference in relationship. The dark rocks, tangled moss, and tall grass that occupy the bird's world of the foreground contrast with the bright, sun-kissed hues

Figure 2. Robert Havell, Jr. after John James Audubon, Snowy Egret. 1835. Aquatint engraving, from *Birds of America*, plate 242. Courtesy of the Lilly Library, Bloomington.

of the human estate in the background. Admittedly, this juxtaposition is necessary to emphasize the pure whiteness of the Snowy Heron, which stands out from its surroundings as neither a creature of the untamed swamp nor of the conquered farmland. Nevertheless, the association of civilization with light and wilderness with dark, interpreted in light of Audubon's frequent "distillation of nature into narratives of good versus evil," evokes the idea that human activity has begun to subdue nature's unruliness (Heitman, 2011).

With the establishment of borders between humans and nature also comes more conflict between humans and animals. Audubon's entry for the Snowy Heron in the *Ornithological Biography*, Vol. III, while not overtly characterized by clashes between humans and the herons, still incorporates language of violence and exploitation into its description of the bird's habits. Audubon carefully notes the behavioral changes elicited by territorial infringement, observing that "in places where these birds are often disturbed, they breed in taller trees," and that they "keep in flocks when *not* disturbed" (Audubon, 1835b, p. 318, emphasis added). If there is any doubt as to the source of such disturbances, Audubon clarifies that humans are the perpetrators by mentioning that "many of the eggs... are carried off by men," and that, "when seized, [the herons] peck at you with great spirit, and are capable of inflicting a severe wound" (Audubon, 1835b, p. 319-320). Granted, the passage as a whole focuses more intently on the Snowy Heron's uncanny social mindset, but Audubon peppers his descriptions with these and other images of violence (such as "flesh... excellent for eating") to indicate a growing enmity between humans and animals.

This increasing degree of infringement is most evident in the Snowy Heron plate in the small figure of the hunter in the lower right-hand corner. Acting as a personification of the human desire to expand further and tame the wilderness, the man walks well beyond the boundaries of the farm and enters the dark spaces of uncultivated land. With both hands on his gun, the man watches the heron, his pure, elegant prize rising from the tangled brush. At the time of *Birds of America*'s publication, egret plumes were highly prized as ornamentation for hats, and although Audubon gives no clear explanation of the hunter's intent, his glowing descriptions of "the full beauty of their plumage" suggest that the figure might be attempting to glean egret feathers for profit (Audubon, 1835b, p. 319). Regardless, his intent is likely to kill, and consequently the plate's action captures the beginning of a disturbing trend that would only worsen as time progressed; by the end of the nineteenth century, the demand for snowy egret plumes had risen so much that the species' population hit an all-time low. The Migratory Bird Treaty Act, passed in 1918, prohibited plume hunting within the United States and thus "helped [the egrets] to regain their former levels of abundance" (Audubon Society, 2014). Even so, in both Florida and Connecticut, the bird is still considered a threatened species – a testament to the

Figure 3. Robert Havell, Jr. after John James Audubon. Long-billed Curlew. 1834. Aquatint engraving. Plate 231 from *Birds of America*. Courtesy of the Lilly Library, Bloomington.

long-term effects resulting from humans' exploitation of the egret.

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In contrast with the agricultural settlement of the Snowy Heron plate, Audubon's (1835a) plate for the Long-billed Curlew (see Figure 3) highlights an urban community in which humans have fully settled the land, confining animals to small, controlled spaces of "wilderness." Rather than peppering the horizon with two or three houses, Lehman this time displays a panorama of the Charleston cityscape, which lies close enough to the foreground for the viewer to distinguish individual buildings, yet far enough into the background that the viewer understands the large number of human dwellings crammed into one city. These buildings constitute a thin stripe in the distance, and thus they do not take up much vertical space on the canvas; however, the true length of the horizontal space occupied by the city is of far greater importance. The engraving's edge on the left and the grass in the foreground on the right both seem to interrupt the skyline and suggest that the heavily populated cityscape extends well beyond the edges of the viewer's window. This implication of horizontal continuity is reinforced by the visual portrayal of the curlews themselves, for the strong lines formed by the beaks and the back, along with the birds' heads turned to both the right and the left, echo the linear form of the city. As a result, the human presence, though visually confined to the background of the engraving, symbolically dominates the natural world of the curlews, which turn their heads in all directions as if to communicate their predicament of being surrounded by trespassing humans.

The essay accompanying this engraving only confirms the notion of the subjugation of nature that accompanies the development of urban communities. While allusions to hunting and cooking birds appear scattered loosely throughout Audubon's description of the Snowy Heron, detailed accounts of violence against birds seems to be

the prevailing theme in Audubon's entry for the Long-billed Curlews. He devotes three of the essay's six pages recounting a hunting trip to Cole Island, where he and his companions began "shooting various birds" before even searching for signs of the curlew (Audubon, 1835a, p. 242). Audubon believes that at least some of these killings can be used to glean new information about birds, since the only reason he knows that curlews have a "propensity... to ramble" is because he has "shot some in Missouri, Indiana, Kentucky, Arkansas, and Mississippi" (Audubon, 1835a, p. 240). Nevertheless, in noting that "their flesh is by no means delicate... for it has usually a fishy taste, and is rarely tender, although many persons consider it good," Audubon admits that these birds just as often fall prey to humans who hunt them for food (Audubon, 1835a, p. 243). Rather than condemning this practice, he offers the reader detailed instructions on the best strategies for hunting curlews, and he observes that they "are in general easily shot, but take a good charge" (Audubon, 1835a, p. 243). His concluding paragraphs, in which he uses a page and a half to describe the physical characteristics of a typical Long-billed Curlew, are the only paragraphs in the entire entry where humans are not mentioned. As it would seem, where humans have completely settled within the physical landscape, they have also nearly lost the ability to conceptualize nature as something distinct or separate from humankind, resulting in almost all interactions between humans and nature being understood in terms of conflict.

Together, the dominant urban landscape and the narrative of violence against the curlews indicate that when large urban communities arise, human infringement upon nature reaches its zenith and forces wildlife into confinement. The same smooth textures Havell uses to paint the orderly, "tame" world of Charleston also characterize the clouds, the sky, the water, and the edge of Cole Island, almost to imply that the reach of humans has overridden all boundaries and now extends even into the last vestiges of the natural world. Hidden behind some unruly foliage, standing atop jagged rocks and gnarled roots, the two curlews in the foreground occupy the only truly 'wild' patch of nature in this image, and the physical location of this last wilderness, an island, reinforces the notion of the birds' imprisonment. Perhaps the most haunting feature of this subjugation is the curlews' silence; even as Audubon and his companions shoot the birds in their own habitat, "not a single note or cry [is] heard" (Audubon, 1835a, p. 242). "Remaining perfectly silent," the birds watch the hunters, breaking only to cry "a few loud whistling notes" when one of their companions is shot (Audubon, 1835a, p. 243). The repeated mention of silence evokes the unnerving idea that the curlews are aware of the irreversible damage being exacted upon their world, but they will not resist. Instead of flying to safety in the barely settled west, where Audubon knows they are capable of surviving, the curlews allow humans to have their way.

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Figure 4. J. T. Bowen after John James Audubon, Mink. 1844. Hand-colored lithograph, plate 33, from *The Viviparous Quadrupeds of North America*. Courtesy of the Lilly Library, Bloomington.

To interpret the three selected plates as a chronological documentation of human infringement upon nature would be to commit a serious logical error. Of the three images, the dense Charleston cityscape behind the Long-billed Curlew was actually the first plate engraved (Audubon, 1835a), while the pioneer setting given to the Glossy Ibis was the last (Audubon, 1838). Nevertheless, each image may still be understood by itself as representative of a particular stage in human settlement, as well as of the effects upon the natural environment that accompany each specific relationship. The relationship most recognizable to the modern reader is easily that of the curlew plate, wherein urbanization surrounds animals' natural habitats and confines threatened species to small areas of controlled "wilderness." Indeed, in the United States today, legal establishment of well-regulated nature preserves and parks is necessary for ensuring that the human desire to expand its territory is not fulfilled at any further cost to the animal habitats; thus, the suffocating dynamic evident in the curlew plate seems only a few steps removed from our present relationship to nature. The Snowy Heron plate, which prominently displays an exploitative, profit-driven relationship between humans and animals, might not immediately strike a chord of resonance within the modern Western reader, yet upon further reflection, it serves as a disturbing reminder of the harmful type of relationship that humans have had with animals the past. In doing so, the image functions as a warning of an ugly relationship with animals we never wish to revisit – a warning which still remains relevant within current debates regarding tests on laboratory animals, treatment of animals within the food industry, and many more public issues.

The temptation, then, might be to idealize the relationship portrayed by the Glossy Ibis plate as one of perfect coexistence between humans and nature, yet by itself the plate does not provide a perspective on frontier life comprehensive

enough to merit such blanket praise. On the whole, the images found in *Birds of America*, by the very nature of depicting animals that spend much of their time in the air above the human realm, cannot constitute an authoritative, complete perspective on the interactions between humans and animals. The consequences of humans' presence within agricultural and urban environments may be large enough to still manifest themselves even when viewed from the distance of the Snowy Egret or the Long-Billed Curlew, but for a nuanced understanding of human presence in "untamed" land, we must turn to the animals whose natural environment was the very ground trod by humans heading west. Audubon gives us these animals' viewpoints with a stunning degree of detail in his last project: *The Viviparous Quadrupeds of North America*, a collaboration with his son, John Woodhouse Audubon, the naturalist Reverend John Bachman from Charleston, SC, and the lithographer J.T. Bowen from Philadelphia. Compiled both from frequent expeditions through his "eastern haunts" of Kentucky forests and from a months-long journey westward to fulfill "a long-held dream… and explore the distant wilderness," these lithographs effectively capture the underbelly of the human-nature dynamic at work in the most "unsettled" areas of American land (Boehme, 2000, p. 35). More precisely, the images of the Mink, the Little Harvest Mouse, and the American Red Fox reveal information vital to interpreting humans' true relationship to their frontier cohabitants.

Though many images in the *Quadrupeds* collection depict a human presence in the animal world, the human-nature relationship displayed in the Mink lithograph (see Figure 4) bears the strongest resemblance to that of the Glossy Ibis plate. The obvious foundation for such a connection lies in the type of human dwelling common to both images: a small cabin, coarsely constructed from the materials of the land, rising from the natural landscape as if it were part of the land itself. Nonetheless, the similarity between the two scenes extends to their composition as well. For both the Ibis and the Mink, a body of water separates the animal presence in the foreground from the human presence in the background, and the strong diagonal created by the subject's body (and, in the particular case of the Mink, the log on which one animal stands) leads the viewer's eye directly to the cabin. Here, even more so than in the Ibis plate, the human domicile blends almost seamlessly into the natural world. The brown wood of the cabin walls perfectly matches the color of both the Minks' perches and the rocks bordering the river, while the light green vegetation on its roof complements the leaves in the trees and moss on the river's stones. The manner in which dense foliage envelops the cabin even evokes the way Audubon (especially in *Birds of America*) often surrounds his animals with thick undergrowth to designate them unquestionably as members of the non-human realm.

By positioning the human residence as he would one of his animal subjects, Audubon might seem to confirm that a healthy, non-contentious relationship exists between humans and animals within a frontier environment.

However, just as the Mink lithograph exaggerates the aspects of the Ibis plate that point to human-animal coexistence, it also amplifies the major problems that prevent either image from being neatly categorized as indicative of such a balanced relationship. Most significantly, the inclusion of two minks (as compared to one ibis) emphasizes the disparity between the prominence given to the animals in the foreground and the relegation of humans to the background. This unequal compositional weight works against the notion of "balance" existing between humans and nature, since Audubon asks the viewer to study the animal as the image's "most vital point" and perhaps consider the presence of humans only as an afterthought (Boehme, 2000, p. 40). Upon doing so, the viewer discovers another difficulty in classifying the Mink image on equal standing with humans: the mink closest to our vantage point is undoubtedly baring its teeth in a display of hostility toward the intrusion of observers. If the absence of a fence around the cabin suggests that this specific area remains in its earliest stages of settlement, the mink's snarl could just as easily be directed at the human newcomers in the background as it is toward us the observers. Either way, the aggression on display here complicates the so-called "peaceful" or "balanced" relationship of the frontier.

This paradox – the undercutting by subtle visual cues of what would otherwise appear a balanced relationship – turns out to be one not uncommon among *Quadrupeds*' other images of frontier America. Audubon, Bachman, &

Figure 5. J. T. Bowen, after John James Audubon, Little Harvest Mouse. Hand-colored lithograph, plate 65 from *The Viviparous Quadrupeds of North America.* Courtesy of the Lilly Library, Bloomington.

Bowen's (1845) lithograph of the Little Harvest Mouse, for example, might also seem to imply that human presence in the frontier can exist peacefully alongside the animal world (see Figure 5). After all, the two mice shown nibbling at the left-behind cob of corn are indirectly benefiting from the human activity of cultivating crops. Despite the scene's superficial harmony, though, the image's overall tone is anything but light or optimistic. Bleak grey, brown, and dark green colors overshadow the intimate composition, contrasting sharply with the bright, lush tones of broader landscapes, such as the Mink image. Critic Edmund Wilson has pointed out that some of bland coloring might simply be a result of the tendency of quadrupeds "not to meet the artist halfway by providing so much gay color" as their avian counterparts did, but the drabness of the Mouse lithograph is drawn more heavily from the humans' harvest than from the animals themselves (Wilson, 1962, p. 485). The corn cob, a supposed source of sustenance and strength for both humans and mice, appears as a dark yellow marked by shadow, while the severed stalks and trampled husks evoke the idea of life periodically being cut off by the human hand. Even up close, Audubon's portrayal of humans' relationship to nature still presents problems for anyone wishing to classify the frontier dynamic as perfectly sustainable or balanced.

With the remaining representations of humans scattered among *Quadrupeds of America*, Audubon goes beyond muted displays of tension between humans and nature, revealing explicit harm being exacted upon animals as a result of human presence in the western frontier. Most depictions of violence against animals within *Birds of America* remain confined to the accompanying text rather than represented in the plates, but the lithographs of *Quadrupeds* display no such segmentation. From Audubon's own likeness (drawn perhaps by John Woodhouse) shooting a Black-tailed Deer to a hunter's trap snaring a Canada Otter, many other illustrations of the frontier draw attention to "the violence and the drama of the hunted animal" (Boehme, 2000, p. 39). The American Red Fox lithograph (see Figure 6) quite effectively captures one such moment of predatory human action. Its legs extended as if still propelling the animal quickly through the underbrush, the fox seems to be registering for the first time that it has been trapped; the bright orange of its fur matches the fiery anger burning in its yellow eyes, as its head contorts backward in an attempt to discover the source of its pain. Observing the fierce line formed from the fox's tense ears to its wide, gaping jaw lined with sharp incisors, the viewer can almost hear the beast's ferocious growl, a sound which might have echoed throughout the quiet serenity of the valley and eventually reached the houses dotted in the distance. Audubon and Bachman's description of the fox's natural habitat ("the fur countries to the North… [and] the Russian settlements on the west of our continent") both confirms the fox's desirability for trappers and exposes a dangerous, growing sentiment (Audubon, 1835a, p. 271). Though far from being settled to the extent of the North (with its dense urban landscapes) or

Figure 6. J. T. Bowen after John James Audubon, Vulpes Fulves. American Red Fox. 1846. Hand-colored lithograph, Plate 87 from *Viviparous Quadrupeds of North America*. Courtesy of the Lilly Library, Bloomington.

the South (with its rural plantations), America's remaining unexplored land was already being conceptualized only in terms of what humans could derive from the environment. Such a relationship could hardly be considered 'balanced.'

The insights provided by the lithographs of *Viviparous Quadrupeds of America* thus effectively thwart any temptation to romanticize the frontier relationship between humans and nature, as represented by the Glossy Ibis plate. An idealized interpretation ignores the historical context of pioneer America, in which even the most harmless of settlements gradually grew to exploit the natural world. Whatever peaceful separation between humans and animals may appear in the Ibis plate is not only a consequence of the distance by which the Ibis is separated from the world of humans, but is also merely representative of a transient moment, a brief scene of quietude before the aggressive symptoms of human encroachment on wild spaces begin to surface. As Audubon's plates demonstrate, humans – whether congregating in frontier farms, agricultural plantations, or urban landscapes – cannot live among the wilderness for very long without exacting harm upon the environment. Reverend Bachman perfectly captures the inevitability of such conflict with an image quoted in Audubon's Long-billed Curlew essay: "it is almost impossible for a man to walk between [the birds and their nests], without injuring the eggs" (Audubon, 1835a, p. 241). This chilling metaphor, implying that the mere presence of humans is enough to cause damage to the environment, redefines the tales told in Audubon's plates, casting humanity as a force of darkness haunting the otherwise magnificent displays of both *Birds* and *Quadrupeds of America* with murky undertones of bared teeth, plucked feathers, and broken eggs.

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Becoming God: Cycles of Rebirth and Resurrection in *Their Eyes Were Watching God*

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ABSTRACT

This paper reexamines African-American writer and anthropologist Zora Neale Hurston's presentation of the self in *Their Eyes Were Watching God* (1937), generally considered one of the most important African-American novels of the twentieth century. Originally criticized by Hurston's contemporaries as a retrograde folk portrait of African-American life, *Their Eyes* presents the oral narrative of Hurston's protagonist, Janie, a woman surrounded by natural and social cycles. Building on the novel's allusive title and the convergent Biblical and folkloric frameworks of the work, I trace the evolving concept of "God" throughout the novel as external forces continually shape and reshape Janie's world for her, questioning whether she can retain any individual agency navigating through these cyclical, predetermined pathways. The redefined vision of the individual that emerges from this reading counters the criticism of Hurston's contemporaries, as Janie herself assumes the role of "God" at the novel's conclusion and gains the power to create her own cycles, free from external control. I thus argue that the novel transcends its supposed function as a depiction of the African-American self to make a broader, humanistic claim for the power of the individual, not contingent on social distinctions.

KEYWORDS: *Their Eyes Were Watching God*, African-American literature, cycles, God, folklore

Zora Neale Hurston, author of the canonical novel *Their Eyes Were Watching God* (1937), is a difficult figure to pin down, and her novel is no less problematic. A writer and anthropologist during the male-dominated Harlem Renaissance era, Hurston was foundational in establishing the female African-American voice in modernist literature, and *Their Eyes* represents, perhaps, the first modernist novel by an African-American woman to gain a place in the canon (Gates, 2006). But contradictions underlie these progressive achievements. Often dubbed a social conservative, Hurston controversially opposed the *Brown v. Board of Education* ruling, asserting that integration of schools would more directly implant racial stratification in the education system (Hurston, 1995). To add another layer of complication, Hurston generally turns away from explicitly addressing political issues in her writing, choosing to focus instead on African-American folk culture and tradition during an era of politically progressive artistic production.

As Henry Louis Gates, Jr. (2006) notes, "It is this complexity that refuses to lend itself to the glib categories of 'radical' or 'conservative,' 'black' or 'Negro,' 'revolutionary,' or 'Uncle Tom'" (p. 196). And it is this complexity that has puzzled critics since the first publication of *Their Eyes*, a novel that merges tradition with progressivism and questions what the "black novel" is or should be (Gates, 2006, p. 200). Nevertheless, I would suggest that the common thread that unites Hurston's contradictions is her belief in the individual. This essay is a fresh attempt to reframe the novel's polarities in the unified context of individualism, much in the same way the African-American folklore that Hurston so valued endeavored to do.

"Even the Bible was made over to suit our vivid imagination" (p. 19), muses Hurston (1935/1969) in the opening pages of her collection of African-American folklore, *Mules and Men*. Defining folklore as "the first thing that man makes out of the natural laws he finds around him" (p. 183), Hurston (1991) acknowledges African-Americans' skill at intricately interweaving folk elements into a Biblical framework to create an explanation of their world – a world formed not only by the governing laws of nature but also by the human-imposed construct of slavery.

Janie, Hurston's protagonist in *Their Eyes Were Watching God*, finds herself caught within a similar dualism, as layers of natural and social cycles envelop her life, ranging from the daily recurrence of sunrise and sunset to the generational inheritance of racial oppression and gender roles. The closed form of the cycle suggests the same sort of immutable "natural laws" that folklore and religion seek to explain, and Janie initially looks externally for an explanation of her world. However, she also comes to recognize the alternative possibility of the cycle as a form that allows new beginnings. In accordance with the dynamic role of God in African-American folklore, these interlinked and shifting concepts of external control and individual rebirth raise the question of who the elusive "God" of the title is, and I argue that as Janie finds the power to shape her own cycles, she becomes her own "God" and creates her own "natural laws."

Of course, not all readers have found the novel so empowering. Several of Hurston's contemporaries, notably Richard Wright and Alain Locke, whose works focus on socially-minded, often embittered, portrayals of racial injustice, saw *Their Eyes* as a step backward in the agenda for African-American social progress, rather than an assertion of individualism. Certainly, Hurston celebrates folk roots

and African-American community, which Wright criticizes as a continuation of the "minstrel technique that makes the 'white folks' laugh" (as cited in Beauchamp, 2014, p. 73). However, I contend that the folkloric cycles that Hurston presents in her novel in fact resemble the restrictive external forces that Wright and Locke fight to change. The fact that Janie is not able to alter these cycles and, instead, finds the internal agency to create her own cycles shows the power of the individual to transcend the constraints of social and cultural limitations. My reading, therefore, recasts *Their Eyes* as not merely a tale of the African-American self in the social world, but rather a broader, humanistic celebration of the individual, regardless of external influences at work.

FOLKLORIC VISIONS AND BIBLICAL CREATION

The scene Hurston paints in her opening pages effectively situates Janie's tale liminally between Biblical and cultural contexts as well as between social and natural spheres. As Janie walks through Eatonville, the townsfolk's eyes "watch" her in an ironic, even heretical, reprisal of the title, for the men marvel at Janie's sexuality and the women "hope that she might fall to their level some day" (Hurston, 1937/2006, p. 2). On the town's porch, a locus of folk expression, they "s[i]t in Judgment" (p. 1) and tell tales to explain Janie's empowerment, which remains beyond their understanding. Janie bypasses the front porch and progresses to her own back porch, a place Dale Pattison (2013) identifies as her individual "site of resistance" to social judgments. With her friend Pheoby as her sole companion, Janie begins her own tale, and, while "the kissing, young darkness [becomes] a monstropolous old thing" (Hurston, 1937/2006, p. 7), Janie takes us, her implicit listeners, back to the morning of her youth.

At the outset of what she terms her "conscious life" (Hurston, 1937/2006, p. 10), Janie's folkloric understanding defines her interaction with natural cycles as she embraces their influence on her life, believing a higher, omnipotent God to control them. With the coming of spring, the season of rebirth, Janie lingers beneath a blossoming pear tree and marvels at the heightened awareness that springtime stirs in her. Awakened by the new life flourishing around her and curious about her own budding existence, Janie searches the garden for "answers" and finds herself standing at her grandmother's gate, "waiting for the world to be made" (p. 11). Janie finds an explanation, if not an answer, through folktales, for young Janie knows "that God [tears] down the old world every evening and [builds] a new one by sun-up" (p. 25). Janie thus imputes to God the power of creation and rebirth through cycles, leaving her passively watching and waiting for God the Creator to "make" her world for her.

In this interval of hesitation, Janie's grandmother, Nanny, replaces Janie's folkloric vision of God and nature with one of social subjugation. Because of her past as a slave, a slave master, rather than springtime or sun-up or God, shaped Nanny's world for her. In consequence, Nanny has no tale of resplendent creation, but instead offers a repressive account of the social cycle in which the black woman is "de mule uh de world" (Hurston, 1937/2006, p. 14). She elucidates how the white man "throw down de load" (p. 14) and assigns the black man the labor of picking it up – only for him to dump it upon the black woman's back.

Nanny, therefore, arrogates the role of "God" as she summons Janie into the house and interferes with her springtime awakening, resolutely structuring Janie's new world according to her own social vision. She believes that a stable marriage to a small-time landowner, Logan Killicks, will elevate Janie above the social cycle and compels her into a union with him, "desecrating the pear tree" (Hurston, 1937/2006, p. 14) by forcing Janie to defy her springtime intuition. Ironically, by depriving Janie of her liberty, Nanny only thrusts Janie into the cycle of subservience; after they marry, Logan even buys a mule so that Janie can work the fields, an explicit imposition of her social role. Insensible to the inherent contradiction in her actions, Nanny arranges the wedding in the evening in her parlor. Thus, Nanny, as "God," tears down Janie's old world of pear trees and possibilities and constructs a new one of mules and monotony in its stead.

Janie remains static in her social role until the resurgence of natural cycles circumvents Nanny's claim to divinity and restores Janie to the realm of possibilities. As testament to her incomplete control over cycles, Nanny cannot evade the natural cycle of death and, before she dies, officially relinquishes her role as "God," telling God in prayer, "De rest is left to you" (Hurston, 1937/2006, p. 24). Free from the control of her first "God," Janie once again finds herself attuned to the springtime rebirth of the natural world and begins to "expect things" (p. 25).

Watching the road beyond the gate, Janie's eye catches on a "citified, stylish dressed man" (Hurston, 1937/2006, p. 27), Jody Starks, who speaks of possibilities beyond pear trees and garden gates. With his "big voice" (p. 28), Jody allures Janie with ambitious talk of "building" a new town. Although Janie admits to herself that Jody does "not represent sun-up and pollen and blooming trees" (p. 29), his prophetic speeches hold sway over her and carry her beyond both mules and springtime visions into grandiose images of the "far horizon" (p. 29). Abandoning Logan and his mule, Janie marries Jody at sunset, and they watch "the sun plunge into the same crack in the earth from which the night emerged" (p. 33). As nighttime ominously ascends, Jody now assumes the role of "God," this time rebuilding Janie's world in the form of a town: Eatonville.

In a fictional replication of the "burly, boiling, hard-hitting, rugged-individualistic setting" (p. 12) that Hurston (1942/1984) once called home, Eatonville alters the established social cycle of racial and gender subjugation. Because Eatonville historically was one of the first incorporated all-black towns, the issue of racial oppression disappears in the town, instead allowing for uninhibited African-American individualism and folk expression.

However, in the absence of racial strata, Jody adds an additional dimension of "upward mobility" (Gates, 2006, p. 197) by instituting a class system in the community. Jody proclaims himself the town's mayor and, through a linguistic nuance, explicitly elevates himself to the role of "God" with his frequent emphatic, "I god," instead of "my God" (King, 1990).

Through this dual authority as "God" and mayor, Jody seeks absolute dominion over the cycles within Eatonville. Endeavoring to control the rising and the setting of the sun – and, therefore the reconstruction of the world – Jody installs a street lamp outside his town store. Janie's life, in consequence, can never be rebuilt anew each day; rather, it becomes a cycle of tedious, mechanical repetitions, "as each morning the world [flings] itself over and expose[s] the town to the sun… and every day ha[s] a store in it, except Sundays" (Hurston, 1937/2006, p. 51). While Jody does not subject Janie to hard labor, he does not liberate her from her role as a mule either. Exemplifying Janie's modified social role, Jody at one point buys an overworked mule in the town and sets it free, only for it to die from "bare, bare fat" (p. 62) as the townsfolk spoil it. Jody likewise frees Janie from hard labor when he marries her; however, she, too "dies" from her listless life in the store.

Nevertheless, Jody's self-bestowed "divine right" to power in Eatonville turns out to be a deception as he, too, succumbs to the natural cycle of death, freeing Janie from another false "God." With Jody's death, Janie's springtime returns. Although she dresses in the "expensive black folds" of mourning, internally, she experiences "resurrection and life" (Hurston, 1937/2006, p. 88), and her personal visions can return in spite of external social distinctions. Having seen her world torn down and rebuilt with each of her two marriages – each beginning with a sunset and ending with a sunrise – Janie metaphorically rises again on the third day with the possibility to rebuild her own world. Her resurrection marks a convergence in the Biblical and folkloric frameworks of the narrative, for, as Eva Boesenberg (1999) observes, the traditional folktale follows a defined tripartite model, which takes shape through Janie's series of three marriages. The beginning of the third stage of Janie's "quest" (Boesenberg, 1999, p. 64) in the folktale structure therefore coincides with her resurrection in the Biblical realm. While in terms of folklore we would expect a forthcoming resolution at this point, the resurrection suggests an opposite trajectory, and this dichotomy anticipates the significantly more complicated third iteration in Janie's cycle of marriages.

QUESTIONING THE RESURRECTION

When Janie again enters into a relationship, it is with Tea Cake Woods, who embodies her long withheld springtime desires and further enables Janie to explore her independence as "God." At last Janie's "bee to a blossom – a pear tree in the spring" (Hurston, 1937/2006, p. 106), Tea Cake draws Janie into complete harmony with the natural cycles that she had previously maintained on the periphery and distances her from the control of social cycles. With disregard for such superficial social distinctions as age, status, and wealth, Tea Cake professes his love for Janie not only at nighttime before the world has been "torn down," but also in the morning after its reconstruction. Janie, now assured of his love, fully defies social expectations and runs off to marry Tea Cake. The two wed in the morning, signifying creation rather than destruction; becoming "God" in their union, Tea Cake and Janie together "make" their new world.

Now divorced from the rigid social construct of Eatonville, the couple chooses to exercise their "divine" power of creation among nature in "de muck" (Hurston, 1937/2006, p. 128) of the Everglades, where they establish their conjugal existence. They create a world that reflects young Janie's springtime awakening, in which mules disappear and nature becomes a reflection of the self. Manifesting this vision, Janie and Tea Cake pick beans together in the Everglades and share the load, rather than dumping it upon Janie's back, which allows Janie at last to transcend her status as a "mule." Even though others "work all day for money and fight all night for love" (p. 131), Tea Cake freely intermixes work and love as he spends his days laboring alongside Janie, not dividing his time based on human constructions of day and night. Similarly, Tea Cake and Janie stay for an entire cycle of seasons, waiting for the next harvest, whereas other workers adhere to social custom and leave the Everglades with the changing of the seasons. Tea Cake and Janie thus deepen their connection with the natural world as they live in harmony with natural cycles, while they choose to reject the constraints of the social sphere.

Arguably, this pastoral scene becomes too idealistic – and even deceptive – in its portrayal of Tea Cake and Janie's life in the Everglades. In reality, as Kathleen Davies (1992) points out, the plantation of the Everglades "is built on racism, white bosses' owning and running the fields" (p. 153). While Tea Cake and Janie insulate themselves from this apparent racial oppression, they have not truly escaped from social cycles; their perception has changed while reality has not. A similar shift in Janie's narrative perspective reveals how this insular view challenges Janie's female liberation as well. As Boesenberg (1999) emphasizes, Tea Cake is, in some ways, no less flawed than Janie's previous husbands. Tea Cake does beat Janie at one point, and her narrative voice becomes ostensibly silent during this chapter. Since, as readers, we do not hear Janie's thoughts on the beating, we do not view it as the same sort of atrocity that we do the abuses of her previous marriages. Yet, the reality of the situation suggests that Tea Cake and Janie's role as "God" is another false, if more felicitous, construction, made attractive by its connection with Janie's original springtime visions. The ambiguous dividing line between perception and reality questions whether their agency is merely an illusion, as they do not truly extricate themselves from the omnipresent cycles but simply refuse to see them.

As if answering this concern, a "senseless monster" (Hurston, 1937/2006, p. 158) – a hurricane – soon stirs

in its sleep and, in its mighty power, challenges Tea Cake and Janie's authority as "God." The storm, though a natural force, does not fit into Tea Cake and Janie's comprehension of cycles, but rather is a disruption in their world. Personified as a "monstropolous beast" (p. 161), the hurricane possesses its own will and, acting as an unpredictable, autonomous being, seizes control over the natural and social spheres of the world in one sweeping wave. Imposing a prolonged "night" (p. 158) on the world, the storm tears down the world in a literal sense and effaces all social and natural cycles in the process; not promising reconstruction with sun-up, the hurricane now becomes a corrupt embodiment of "God."

Initially reluctant to desert their idyllic existence in the Everglades, Tea Cake and Janie soon recognize that they have no control over the chaos of the "beast" and look to the existence of some higher power, leaving "their eyes… watching God" (Hurston, 1937/2006, p. 160) for an explanation of the uncontrollable. Tea Cake and Janie nevertheless resist passive resignation to the storm and flee the hurricane, wrestling for agency over their lives. Not even folklore can offer a rational explanation for the storm, for, as James Krasner (1989) states, "The chaos of nature cannot be made simplistically metaphorical" (p. 124). Indeed, Tea Cake and Janie witness animals being whipped around in a wild scene of folkloric disorder, and, in a culmination of chaos, Tea Cake fights a rabid dog in the middle of the storm to protect Janie from its savage violence. Physically struggling with a "beast," an animalistic embodiment of the storm, Tea Cake triumphs in his battle and kills the depraved dog, suffering only one seemingly insignificant bite. Tea Cake and Janie believe to have won their quarrel with control, and the storm soon abates as they reach safety in Palm Beach, where they arrive at sun-up, the destroyed world already being rebuilt.

Amidst all of the death and destruction of the hurricane, humans waste no time in reconstructing racial divisions. Even though "nobody can't tell nothin' 'bout some uh dese bodies, de shape dey's in. Can't tell whether dey's white or black" (Hurston, 1937/2006, p. 171), the white authorities of Palm Beach, playing the part of "God the Judge," dictate that only "white" people be buried in coffins. Anna Lillios (1993) comments that, while Hurston mythicizes her portrayal of the hurricane, it in fact accords with the historical facts of the 1928 Okeechobee Hurricane. Certainly, Hurston nods to the social injustice of the situation through her account of the corrupt burial process. Yet, what Lillios alludes to but does not critique is Hurston's decision to avoid mentioning the vast racial discrepancies in the death tolls: roughly three quarters of the victims were black migrant workers. Hurston's fragmentary depiction of reality mirrors Tea Cake and Janie's selective view of their situation in the Everglades and suggests an underlying desire to steer the novel away from social realism, a genre that Hurston terms "the sobbing school of Negrohood" (as cited in Gates, 2006, p. 199). Keeping the focus on the individual rather than on larger racial issues, Tea Cake and Janie avoid extensive social commentary and expeditiously leave the social cycles of Palm Beach to return to "de muck," where they arrive in the morning in an attempt to rebuild their lives.

However, the hurricane has already perverted the natural cycles of the Everglades and disillusioned Tea Cake and Janie to their limited agency, which poses a threat to their power as "God." Although they pass three weeks in relative normalcy, Tea Cake soon sickens, having contracted rabies from the dog in the hurricane. The bestial chaos of the storm passes on to Tea Cake, creating a new, corrupt cycle, and, helpless as she was in the face of the hurricane, Janie cannot avert Tea Cake's transformation into a savage beast. She can only observe as he walks with a "queer loping gait, swinging his head from side to side and his jaws clenched in a funny way" (Hurston, 1937/2006, p. 182-183). His animalistic descent nearly complete and his human consciousness absent, Tea Cake attempts to shoot Janie. In an assertion of her individual agency, Janie instead fires first and kills Tea Cake. In doing so, Janie not only wrests control over the uncontrollable, but she also tragically sacrifices a part of herself.

A trial for her rebellion against external control, Janie faces her Day of Judgment in court for killing Tea Cake, testing the integrity of her authority as "God." In front of a jury of twelve white men, she does not "plead to anybody," but rather "just [sits] there and [tells]" (Hurston, 1937/2006, p. 187). The jury, in their apostolic capacity, hears Janie's truth as if the "Word of God" and at last frees her fully, affirming her divine ascendancy in spite of the social tensions in the courtroom. "So the sun [goes] down" (p. 188) on Janie's judgment day, leaving her with complete agency in rebuilding her world and its cycles.

BECOMING GOD

As her own autonomous "God," Janie's reconstruction of the world after the chaos of Tea Cake's death takes on a radically different form from her attempted restoration following the hurricane. Perhaps desiring to forget her powerlessness in the face of the uncontrollable in the Everglades, Janie does not return to "de muck" as before but buries Tea Cake "out of the way of storms" (Hurston, 1937/2006, p. 189) in Palm Beach. Her resolution to bury him there in a "strong vault" (p. 189) reprises the earlier injustices in Palm Beach after the hurricane, and Janie defies social cycles on an individual level by giving Tea Cake the burial that other black people were denied. Nevertheless, Janie has realized that she has no power to control natural or social cycles in a larger context. With the hurricane and Tea Cake's subsequent death, her springtime visions of natural cycles in the Everglades failed to afford her any agency, and she at last discovers that she must construct her own cycles to find self-definition. Janie thus returns to Eatonville, the center of folklore, to reshape her folkloric visions of the world in accordance with her new individualistic comprehension of cycles.

Back in Eatonville, Janie's narrative to Pheoby comes full circle and, recognizing the renascent potential of cycles, Janie

now explores her ability as "God" to spark rebirth and even create. Gurleen Grewal (2010) remarks rather offhandedly how the beginning and the end of the novel display "a remarkable economy and unity of expression, much like that of a lyric poem" (p. 103), which raises a compelling point. Janie, by looking internally rather than externally for self-definition, actualizes her ability not only to explain her life through folklore, but to "make" her own world through poesis, the literal act of making. The final paragraphs contain a confluence of poetics, folklore, and spirituality as Janie merges her poetic ability to create with her folkloric views of the world and her agency as "God." With a poetic reading of the novel's end, the concluding scene gains a symbolic clarity that illustrates Janie's transcendent realization of selfhood.

As Pheoby leaves, Janie contemplates that "room upstairs," and with the doors "shut and fastened" (Hurston, 1937/2006, p. 192), she climbs the staircase as if ascending to heaven. With her ascension, Janie's "shadow [falls] black and headlong down the stairs" (p. 192) as she casts off racial distinctions. Then, in a Pentecostal scene, an image of the Spirit descends upon Janie in her locked house as lamplight "wash[es] her face in fire" (p. 192) and wind blows through her windows. With these metaphorical tongues of fire, the narration becomes increasingly poetic, and we hear the sound of the wind echoed in rich consonance: "commenced to sing, commenced to sob and sigh, singing and sobbing" (p. 192). The wind implicitly takes on the traditional birdlike form of the Spirit as the "song of the sigh [flies] out of the window and [lights] in the top of the pine trees" (p. 193).

Inundated with the creative power of the Spirit, Janie reshapes the natural cycles as she changes her adolescent vision of the transient, seasonal pear tree into one of evergreen pine trees. She redefines the cycle of sunrise and sunset as she resurrects Tea Cake, her sacrificial victim, through remembrance, wrapping him "with the sun for a shawl" (Hurston, 1937/2006, p. 193). Now, as a triune God, Janie transcends the limitations of her gender as we see Janie's womanhood alongside Tea Cake's masculinity and the Spirit's androgynous aesthetic, transforming Janie into a female form of God the Father. At last, in a cyclical motion of complete agency, Janie "pull[s] in her horizon. Pull[s] it from around the waist of the world and drape[s] it over her shoulder" (p. 193). As she encircles herself with the horizon, Janie herself becomes the world, at last realizing her capability to make her own world within herself.

Then Hurston herself becomes "God" in a sense as she shapes the novel itself into a cycle. Having commenced her work with an observation of "Watchers" (Hurston, 1937/2006, p. 1) who stare out at the horizon, searching for their dreams, Hurston concludes this thought in her final lines as Janie "call[s] in her soul to come and see" (p. 193). In ending the novel where it begins, we as readers perceive the transition between the passivity of "watching" and the insightful activity of "seeing." As we at last "see" the cycles set up in Janie's life, her tale can be retold through oral tradition, and the end becomes a new beginning. We then recognize perhaps the most important element of folklore in the novel – its demand to be repeated.

What intrigues me is how vehemently Hurston denied the presence of folklore in *Their Eyes*. In response to Alain Locke's criticism of her folk characters as "pseudo-primitives," Hurston asserted that "there is not a folk tale in the entire book," and threatened memorably, "I will send my toe-nails to debate him on what he knows about Negroes and Negro life – and I will come personally to debate him on what he knows about literature on the subject" (as cited in Hemenway, 1977, p. 241-242). Whether her toe-nails ever made their planned appointment with Locke is uncertain; what is less debatable is that folklore clearly forms an integral part of the novel, both thematically and structurally – through mules as well as three-part tales.

Ultimately, I think Hurston's ardent rejection of classification of her novel as a folktale reflects how she does not want her novel to turn into a didactic work or a piece of anthropology, and especially not a reductive social statement. Rather, in rejecting social realism, the novel becomes a humanistic celebration of the self and the God-like potential that each individual possesses, regardless of external distinctions. As Hurston (1942/1984) affirms in her autobiography, "We will go where the individual drive carries us... It is up to the individual... That is one of the strongest laws that God made" (Hurston, 1942/1984, p. 237). Janie, in the end, accepts this as her "natural law," too. Through Janie's life, Hurston presents the empowering idea that we as humans retain the agency to control the cycles within our lives and to choose how to define our relationship with those that lie outside our immediate reach. With all of our "watching" the horizon for our dreams, we find that it is within our grasp if we "see" inside and find the "God" within us.

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Propaganda and Artificial Glory: The Role of Propaganda and Political Rhetoric on the Decision to Volunteer for the Spanish-American War

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ABSTRACT

This project involves the analysis of both primary and secondary sources to investigate what caused men from three towns in Indiana to volunteer to fight in the Spanish-American War, a conflict that they had no personal reason to join. The predominantly-used primary sources were newspapers from the three towns in Indiana and speeches by politicians. These three towns were selected after careful analysis of demographic information including population and number of volunteers in the Spanish-American War from every major city in the state. To further expand on these ideas, political leanings and occupations were taken into account. Upon completing this study, it was discovered that both the rhetoric of pro-imperial politicians, the propaganda that filled the newspapers of the time, and the creation of the concept of glory and the valor that could be won through combat had an effect on the men's decision to register for a conflict in which the soldiers had no personal stake.

KEYWORDS: propaganda, war, memory, media, newspaper, Spanish-American War, Indiana

INTRODUCTION

On the morning of Thursday, April 21, 1898, Major Hathaway's 12th Regiment, en route from Fort Niobrara, Nebraska to New Orleans, passed through the town of Vincennes, Indiana. As readers of the *Vincennes Commercial* learned the following day, Major Hathaway had brought with him 86 horses, 530 men, and 30 officers across three different trains. Local women handed the troops flowers, while the troops returned in kind by giving them hardtack and buttons off their uniforms.

For Vincennes residents like Edward Thuis — a 19-year-old distillery employee — the reason for the 12th Regiment's arrival was no mystery. For months, American newspapers had reported the atrocities committed by Spain in Cuba, atrocities that culminated, for many readers, in the sinking of the USS *Maine* in Havana Harbor in February. Alongside crusading publishers like William Randolph Hearst (and their counterparts in small towns like Vincennes), American officials argued that the nation should spread its power across the world to free the Cubans and other subjugated people from the harshness of imperial monarchies like Spain's. In response to the growing clamor for war, men like the soldiers of the 12th Regiment — and, on April 26, 1898, in the town of Vincennes, Indiana, Edward Thuis himself — resolved to fight.

Why were Edward Thuis and other young men across the country — 280,564 in total (Livingston, 1998)— willing to fight in what amounted to a volunteer army in defense of the residents of Spain's colonies? Why would these young men choose to fight in a conflict in which they had no direct stake? What created the need or desire to participate in a war effort so far outside of communities in places like Nebraska or Indiana? Was it the infamous yellow journalism that, as many historians have claimed, fanned the flames of war in 1898?

Was it the language of particularly headstrong politicians such as Albert Beveridge? Or was it simply the pressure of an economy still recovering from the nationwide Depression of 1893? In order to analyze the effects of these events and ideas, I examined military volunteers from three sites in Thuis's home state of Indiana — a state that was in many ways typical in 1898, but that also included enough cultural divergence, from its northern to its southern end, to account for a range of American cultural and political traditions. In drawing a picture of the small-town Americans who became involved in the war, I hoped to discover a more universal truth about what motivated men to fight.

William Randolph Hearst's well-known command to his staff photographer at the *New York Journal*, "You provide the pictures, and I'll provide the war," may or may not reflect the power and prevalence of yellow journalism in the period surrounding the Spanish-American War. In either case, its continued familiarity, more than a century later, speaks to a larger truth about the American press in the late 1800s: that historians and scholars have maintained that it played a major role in the creation of the Spanish-American War (Campbell, 2001, p. 98). Hearst was more than happy to oblige this claim, asking his readers, "How do you like the *Journal's* War?" As historian W. Joseph Campbell has cautioned, it is impossible to prove these claims: Cuba fell off of the front page for months at a time; other conservative papers, such as the *New York Sun*, also called for war without resorting to the tactics of the yellow papers, and no direct evidence suggests that policymakers were affected by what they read in the yellow papers. "The newspapers of Hearst and Pulitzer may have mirrored, but they assuredly did not cause, the irreconcilable differences between the United States and Spain over Cuba," Campbell writes. Yet beyond the reach of big-city papers like Hearst's *Journal*, very little has been written

on how journalistic coverage of the buildup to war affected registration at a local level in small-town America (Campbell, 2001, p. 119).

Journalists were not alone in calling out for Americans to involve themselves in foreign wars. Politicians were also highly active in the promotion of becoming embroiled in conflict with foreign nations. One of the most ardent and well-known supporters of this was Albert Beveridge. Beveridge was the Republican Senator from Indiana from 1899-1911 who became the spokesperson for American Imperialism ("Albert J. Beveridge," 2007). Beveridge gave one of his most famous speeches even as the Spanish-American War raged. Historians later labeled this speech the March of the Flag, in which Americans and their imperialistic ideals spread across the world (Beveridge, 1898). Considering the fact that he won a senatorial seat after this speech, one cannot help but wonder whether his thoughts on Cuba and the war with Spain reflected the ideas and values of the people in Indiana at the time.

Another potential factor in determining the motivation of men to fight was the economic setback that came to be known as the Great Depression of 1893. The 1890's were a transformative period for the United States, as the nation occupied a larger role in the global stage — thus increasing both its vulnerability to international economic crisis and its opportunity for gaining greater economic power. Agriculture, while still a prominent feature of the economy, constituted only 19 percent of the gross national product (Witten, 2001). New forms of production and manufacturing helped American workers to "generate one of the highest levels of output per person in the world," but also led to catastrophic unemployment following the Depression of 1893. In 1894, nearly 12.3 percent of the workforce was unemployed (Witten, 2001). In 1898, when the war broke out, the situation was not much better: 11.6 percent of the workforce was unemployed (Witten, 2001). With these three factors in mind, I investigate how they played out on the ground in one state: Indiana.

Indiana was then, as it is now, a "crossroads of America" — a representation of rural and small-town America far from the traditional stomping grounds of yellow journalism and political rhetoric, such as New York and Washington, D.C. During the 1890's, many people in the state began to develop an idea of what being from Indiana truly meant (Madison, 2014, p. 190). This Hoosier identity was built on the fact that the majority of the state's people had similar roots and ideology. The other side of this character was Indiana's reputation for being stuck in its ways, and unwilling to change. This reputation included an emphasis on local over state or national governments. This was particularly influential in the development of a better educational system, which was put in place in the late nineteenth century. Citizens of Indiana did not want members of the larger governmental bodies getting themselves involved in issues they felt belonged to the jurisdiction of the local governmental establishments. These ideas can easily factor into the slow rate of development that occurred in the Hoosier State. But, by studying the makeup of war volunteers in an area about which little has been written

in this regard, we can try to see what motivated everyday Americans to fight in the Spanish-American War (Madison, 2014, p. 191-208).

BACKGROUND

Indiana divides roughly into three sections, North, Central, and South, which are distinguished by their geography and population. The state's large German population — by far the largest group of immigrants in the state — tended to settle in the central part of the state. The second wave of immigration, which included more immigrants of Eastern European or Slavic heritage, concentrated in cities like South Bend, in the northern part of the state. In the southern part of the state, despite the presence of some immigrants, there was a much greater native-born presence, with strong ties to the states of the upland South. For the purpose of this study, I have selected one town in each of these three regions that drew a high percentage of young men to enlist in the military in 1898. I investigated who were these men, how did they resemble or differ from their fellow townspeople or Hoosiers and more generally, what would they have read about the war in their local newspapers, or heard from prominent politicians? (Madison, 2014, p. 196-198).

In order to answer some of these questions, I chose three cities in Indiana and did an in-depth analysis of several factors that could have had an influence on the decision to go to war. First of all, I must explain how I picked the cities that I am analyzing. I looked at the Memorial Library site which contained a list of all of the soldiers from Indiana who fought in the war, or at least signed up for it (Memorial Library, 2011). I tallied the numbers of soldiers who volunteered from each city, picked the top seven to nine cities from each of the regiments, and created a list of 25 total cities to be included in the calculations. I then added the total number of white men, black men, foreign-born whites, and colored men, between the ages of 18-44 from each city for the denominator, and the total number of volunteers for the numerator (University of Virginia Libraries, 2007). All of this information comes from records of the University of Virginia, which are based on the 1900 census. This left me with a total of nine cities. I then picked the top three cities with the highest percentage of participation in the military. In choosing the cities, I wanted to make sure that I picked cities from the three different sections of Indiana: the north, the south, and the central regions, so that the data could be analyzed from a regional perspective. The cities with the highest percent of participants were Greencastle in the central part of the state with the highest rate of participation, the city of Knox in the north with the second highest rate of participation, and Vincennes in the south with the third. This allowed me to look at a difference in region and size of the towns rather than simply picking the three cities with the highest number of participants (*i.e.*, Indianapolis, Fort Wayne, and Evansville).

The following table (see Table 1) depicts the division of volunteers from the most commonly-cited cities in the state. Each column depicts a category that was divided in the original

Table 1. *Rates of Volunteering for the Spanish-American War*

County	City	Volunteers	White (18-44)	Black (18-44)	Foreign born white (18-44)	"Colored" (18-44)	Total county population (18-44)	%
Allen	Fort Wayne	308	14023	0	2009	15	16047	**1.919**
St. Joseph	South Bend	156	9717	200	3424	19	13360	**1.168**
Elkhart	Elkhart	108	9027	20	549	11	9607	**1.124**
Elkhart	Goshen	83	9027	20	549	11	9607	**0.864**
Noble	Ligonier	74	4573	0	212	0	4785	**1.546**
Steuben	Angola	74	3043	2	32	1	3078	**2.404**
DeKalb	Auburn	74	5243	3	293	0	5539	**1.336**
Wabash	N. Manchester	61	5533	3	293	0	5715	**1.067**
Starke	Knox	54	1630	0	350	0	1980	**2.727**
Marion	Indianapolis	743	37437	4384	4472	24	46317	**1.904**
Montgomery	Crawfordsville	96	5986	49	58	2	6095	**1.575**
Howard	Kokomo	93	5524	115	183	5	5825	**1.597**
Clinton	Frankfort	83	5644	21	59	1	5725	**1.45**
Randolph	Winchester	64	5543	68	44	1	5656	**1.131**
Morgan	Martinsville	76	4025	23	22	0	4070	**1.867**
Fulten	Rochester	58	3216	12	43	0	3271	**1.773**
Vanderburgh	Evansville	262	13301	2157	1109	3	16570	**1.702**
Knox	Vincennes	175	6718	136	215	2	7071	**2.475**
Vigo	Terra Haute	129	12339	546	879	6	13778	**0.936**
Floyd	New Albany	98	5465	431	247	0	6143	**1.595**
Monroe	Bloomington	97	4022	79	43	0	4144	**2.341**
Daviess	Washington	84	3691	77	114	0	3882	**2.164**
Putnam	Greencastle	148	4283	40	28	4	4355	**3.398**
Gibson	Princeton	21	5931	305	133	2	6371	**0.33**
Jefferson	Madison	73	4112	171	76	0	4359	**1.675**

source. They have been compiled here for ease of calculating percentages. As only men could fight in the war, each column only represents the male population of each city, broken down by racial category.

THE NORTH REGION: KNOX

The city of Knox, Indiana, was laid out in 1851 in Starke County, one of the northernmost counties in the state (McCormick, 1915, p. 54). Although it developed relatively late — the town did not have a railroad until 1882 — by 1928 it featured, in one observer's words, "two railroads running through the town, [and was] a handsome and pleasant town to live in, a town where we can purchase anything from a cambric needle to an automobile or threshing machine." The same writer praised Knox for its "fine buildings, dwellings, business houses, courthouse, jail, and sheriff's residence, churches and schools that are hard to beat in a town of its size," as well as its variety of Protestant and Catholic churches (McCormick, 1915, p. 54-58).

Knox was a small town of 1,466 in 1900 (Stats Indiana, 2015), while Starke County had a total of 10,431 people of whom 1,980 were men of military age. Fifty-four men in the city of Knox chose to volunteer to fight in the war in May 1898 (University of Virginia Libraries, 2007). Their average age — 24.75 years — was slightly higher than the men in other cities analyzed; all but two were in their early- to mid-twenties. More than half were born and raised in Indiana. All but one had American-born parents, though the majority of parents were not from Indiana. Instead, a large proportion of those parents had come to Indiana from Ohio. It is odd that there were not more men born outside of the United States in the sample, especially since Knox had one of the highest rates of foreign-born men between the ages of 18-44. However, the countywide percentage of foreign-born men was 17.67%, strongly suggesting that foreign-born men were less likely to volunteer for the Spanish-American War.

From an occupational standpoint, 63 percent of the Knox men who volunteered were farmers or day laborers on farms. Indiana has long been known for its farm production, and

Starke County is no different. Across the county, a total of 26,460 acres of corn, 2,736 acres of wheat, 7,022 acres of oats, 3,164 acres of rye, and 906 acres of potatoes were under cultivation in 1910 (Grimes, Barrett, & Bushnell, 1917, p. 10). In sum, 81 percent of the county's land was used for farming. Like many residents of northern Indiana, the majority of the county's farmers were people of northern or central European descent: Scandinavian, Bohemian, German, Russian, and in particular, Austrian. They arrived in a county eager for "satisfactory farm labor," and apparently full of work for farm laborers (Grimes et al., 1917, p. 7-17). Another possible reason why these men were less likely to volunteer for a war was because they may have been fleeing from increasingly militaristic European states.

All of the men in the sample were literate, whether or not they were formally educated. With this in mind, it is impossible to rule out the role of newspapers in their decision to go to war. There were several newspapers that were active in the Starke County area during this time period: the *Starke County Democrat*, the *Starke County Republican*, and the *Starke County Ledger*. The *Republican* reportedly had "a large patronage" among local readers (McCormick, 1915, p. 58). If the men in my study were reading a newspaper, it would have likely been one of these three. As a result, I wanted to analyze the newspapers' use of propaganda or other techniques typical of the infamous yellow journalism of publishers like William Randolph Hearst.

One of the key events that framed the Spanish-American war was the Cuban War for Independence from Spain. All of the papers in Knox carefully recorded the plight of the Cuban people. The *Starke County Republican* portrayed the Cubans as sympathetic, mentioning their cheering for the United States, and their struggles in their fight against the Spanish. The paper's features described the Cubans as starving and ill-equipped to deal with their fight against the Spanish (*Starke County Republican*, 1898a).

The destruction of the USS *Maine* on February 16, 1898 in Havana Harbor (Public Broadcasting Service, 1999), was a key provocation to the Spanish-American War. The *Starke County Republican,* like other papers of the time, believed that the *Maine* was destroyed by the Spanish. The newspaper's editors went so far as to claim that they had definitive proof that the ship's destruction was no mere accident: a "shattered section of a submarine cable." Whether or not the *Maine* was destroyed by Spanish forces, Americans believed that it had been, and that belief — encapsulated in the phrase, "Remember the *Maine*" — had power to forge action. To strengthen its point, the *Republican* included a detailed explanation of how submarine mines work (*Starke County Republican*, 1898b). Such details presumed Spanish blame without suggesting other options — such as mechanical failure — for what could have caused the *Maine*'s destruction and the subsequent death of so many American sailors.

The *Republican* reflected an appreciation, if not an obsession, with war. The paper dedicated considerable space to describing the power of the ships that the United States would use in the event of war. In other sections, the paper focused on details of the American Civil War, including short anecdotes of events, often portrayed in a positive light. By showing the buildup to a war with Spain alongside stories on the nation's last major war, the newspaper emphasized the comparisons between them (*Starke County Republican*, 1898b).

The *Republican* consistently portrayed the Spanish from the perspective of the Cubans, emphasizing for American readers the empire's similarity to Great Britain at the time of the American Revolutionary War. In their paper on March 24, they showed a map of the world demonstrating what Spain had controlled more than 100 years earlier (*Starke County Republican*, 1898b). In addition to allowing the paper's audience to see the areas that were currently in contention, the map showed how much territory — including large sections of the United States — the Spaniards had already lost. In addition to showing Spain as a decrepit empire, the image seems calculated to instill fear that the Spaniards could try to take their land back. By playing on these ideas and fears, the paper educated its readers even as it allowed its own slant to shine through.

The conflict continued to occupy a major portion of the *Republican'*s pages even after Knox men had enlisted for service in May. On June 9, the paper described the American military's success after one month of combat: "We have demonstrated to the world that our war vessels are second to none that float, that our gunners fire to hit, and not simply to make a noise." Such descriptions treated American victories not simply as a path to defeat the Spanish, but also as a demonstration of American power and confirmation that fighting against the United States would be tantamount to suicide. Just over 30 years since the nation's own civil war, the editors seemed determined to prove the power of the United States and readiness to defend itself and its interests. They referred to the fights between Spain and the United States as "not unlike those of a pygmy measuring strength with a giant." Not satisfied with building up the United States, they continued to tear Spain down to make the Spanish enemy appear weak. This focus extended to other issues that Spain was facing: the collapse of the Spanish bank and the Spanish monetary system as well as Spain's "crushing defeat" in the Philippines. Such detail seemed designed to humiliate Spain even further in an attempt to consolidate belief in the power of the United States (*Starke County Republican*, 1898e).

The Starke County Democrat, despite its contrasting party affiliation, was similar to the *Republican* in its war coverage. The *Democrat* did, however, devote more attention to Don Carlos, the Spanish Pretender to the throne. By portraying an illegitimate heir, they emphasized the regime's corruption (Starke County Democrat, 1898c).

The *Democrat* spent a lot of its time describing the process of declaring war. President McKinley drafted an ultimatum saying that he wanted no war with Spain, but firmly asked that the Cubans be given food and other necessities, and that the Cuban government be acknowledged (Olcott, 1916, p.

20-21). The document implied that if the Spanish did not respond to these demands, the United States would declare war on Spain. In great detail, the paper described the process by which the ultimatum was written and passed through both the Senate and the House of Representatives (*Starke County Democrat*, 1898c). This account of the protracted, thoughtful process leading to Congress's declaration of war contrasts with the newspaper's account of Spain's simple declaration that "a state of war exists" (*Starke County Democrat*, 1898d), implying that either the Spanish did not plan as carefully as the Americans did, or that Spain was simply more warlike than the United States. Either interpretation implies an insult to the carefully-laid plans of the United States government, in contrast to the Americans' respect for Spain.

While both the *Republican* and the *Democrat* were indeed party papers, at their cores they viewed the war in similar ways. Both attempted to portray the Spaniards as weak, while demonstrating how the powerful United States would easily defeat them. The *Republican* presented in greater detail the glory that war could confer. The *Democrat* focused more on the troops who volunteered to fight in the war, relating them to the people who had fought in the Civil War and thus further extolling the glory of fighting in a justified war. Whether they were Republican or Democrat, the Knox men who chose to volunteer heard what amounted to the same story on both sides of the political spectrum.

The people of Knox prided themselves on their participation in the military. "Many mothers wept and sisters shed tears," wrote one Starke County historian "as those boys marched to the front, ready to do their duty like all patriotic citizens have always done when our country needs their service." McCormick's (1915) report suggests that the men who volunteered to fight in the conflict did so not out of a desire to help the Cubans in their fight with the Spanish, but because the Spanish had disrespected the values that the citizens of Knox held dear:

> Many no doubt felt a longing for the old home, for father, for mother, for sister or brother, and for his sweetheart he left behind, but there is a disposition and a desire as well as a duty to his country that spurs us on, that fills the heart of man to ever be ready and willing to tread the battlefield to meet the hardships of war that our country might be saved and our laws respected and obeyed, maintaining the integrity of our nation, assuring peace and happiness to all its citizens. (McCormick, 1915, p. 146-147)

Based on this evidence (though it was published in 1915, 20 years after the war), the men who chose to fight were inspired to protect their country. The local newspapers' efforts to instill fear that the United States had been slighted by Spain possibly played on and compounded that desire. This also echoes the Hoosier localism that was considered typical of the time period (McCormick, 1915, p. 146-147).

THE CENTRAL REGION: GREENCASTLE

The second city I analyzed was Greencastle, located in Putnam County, in the central portion of the state. Like Knox,

Greencastle was a young town when the Spanish-American War broke out, having only been established as a city in the 1860's (Weik, 1910, p. 235-236). Still, the town grew quickly; a January 1868 edition of the *Banner* newspaper stated that it already contained:

> one iron, one nail factory, one foundry, and machine shop, two flouring mills, one pump factory, one carriage factory, four wagon shops, seven blacksmith shops, six saloons, eight churches, thirty-five clergymen, one college, one high school, one young ladies' school, a number of other schools with efficient teachers, ten physicians, twenty-four lawyers, a population of five thousand, and more handsome ladies than any other town in Indiana. (Weik, 1910, p. 242)

Despite this passage's focus on industry, the town's most prominent feature was its access to farmland.

Greencastle, and Putnam County more generally, boasted a robust farming industry with fertile agricultural land, particularly in the northern part of the county (Barrett, 1912, p. 185). In 1900, the county's 2,883 farms (Barrett, 1912, p. 184) made up 301,039 total acres (U.S. Census of Agriculture, 1999). Of that acreage, 61,808 acres were in corn, 15,772 in oats, 18,599 in wheat, 3,978 in clover, and 18,117 in timothy-grass (Barrett, 1912, p. 184). Despite what these numbers suggest about the county's economic base, the majority of the volunteers from Greencastle had occupations outside of the farming industry.

In the 1900 census, 4,355 of Putnam County's 21,478 people were men between the ages of 18-44. Of this number, 148 volunteered to fight in 1898 (University of Virginia Libraries, 2007) Despite Putnam County's reliance on farming, only 14 percent of the men in my sample worked as farmers, and nearly half of that number were laborers who worked on other people's farms. The other 86 percent of the volunteer sample group worked in a variety of careers that included clerks, merchants, a night watchman, a painter, and an auditor, among many others. Their average age was 24.14 years, although this group included James F. Fee, a 51-year-old major. With this outlier removed, the average age of Greencastle's volunteers becomes 21.6 years, making this group the youngest of the three groups analyzed (this difference may have reflected the presence of DePauw University in the town). More than three-quarters of the men in the Greencastle sample were born in Indiana, and only two had foreign-born parents, in both cases only one parent each. Despite central Indiana's generally higher percentage of German immigrants, none of the men that I analyzed seemed to be of German descent, though one had a parent from Ireland in Knox. All of the men — formally educated or not — were literate, and more than likely read the local newspapers.

Neither the *Greencastle Banner Times* nor the *Greencastle Star Press* seemed to have an obvious party bias, but both included the journalistic propaganda that was prevalent during this time. While most of the newspapers in the three cities focused on the conflict in Cuba, the *Banner Times* took this a step further, devoting nearly all of its coverage to Cuba. The paper's editors framed the conflict in Cuba in terms of how the war would affect Americans, describing the conflict

as "a constant menace to our peace." They played on readers' emotions as well, describing Spanish acts as "extermination not warfare" (*Greencastle Banner Times*, 1898a).

The ever-present issue of the *Maine* also found its way into the Greencastle newspapers' discussion of Cuba. Instead of blaming the Spanish for destroying the vessel, the editors criticized them for being unable to protect outside ships or foreign interests. They chose to publish McKinley's famous ultimatum in its entirety, including the president's statement that "Spain cannot protect visiting vessels in the Havana Harbor" (*Greencastle Banner Times*, 1898a). While McKinley was clearly present in the pages of the *Banner Times*, Spanish leaders were rarely, if ever, mentioned. The only mention of Don Carlos occurs in an explanation of his attempt to preserve the honor of his country following the loss of their once-glorious Empire. The other prominent Spaniard mentioned is Enrique Dupuy de Lôme, Spain's Minister to the United States (Library of Congress, 2011). On April 22, seeing that war was inevitable, de Lôme withdrew from his position in Washington and fled to Canada to escape the increasingly anti-Spanish fervor of the United States. While more than likely a wise decision, the minister's actions had the unintended side effect of seeming cowardly. By portraying his flight in a manner intended to lower respect for the Spanish, the newspaper continued to fuel the fire of patriotism, convincing Americans that "the most improved engines of war ever invented" would lead the Spanish enemy to find that "her ships would be sunk before they could throw a shell" (*Greencastle Banner Times*, 1898b).

The newspaper's anti-Spanish rhetoric was at times quite direct:

> Spain's fleet swears by the Virgin Mary that they will not return to their native land without victory. That seems quite useless in view of the probability that there will be nothing left of it to return. Victory has long ago ceased to perch on Spanish banners. (*Greencastle Banner Times*, 1898b)

As the war drew ever closer, the writers at the *Banner Times* started to focus on what Spain would lose if it continued to fight. There is also a description of how the Spanish had been funding the war, through "patriotic" bullfights. Bullfighting is a time-honored tradition in Spain, but to the citizens of the United States, it was a foreign concept. By mentioning it, the papers are able to portray the Spanish as something fundamentally different from America (*Greencastle Banner Times*, 1898a).

The *Greencastle Star Press* reiterated many of these ideas, but also discussed the appeal of Cuba: "With good government and proper sanitary arrangements well enforced, the island of Cuba would make a good place to live, and get rich" (*Greencastle Star Press*, 1898a). By contrasting Cuba as it is with how it could be, the editors allowed the citizens of small-town America to see Spain's misrule in Cuba, and to imagine that the people of the island would be better off under the oversight of the United States. While this aspect of war would logically be a part of any discussion of imperialism at the time, only the *Star Press* seems to be willing to take

that step.

THE SOUTH REGION: VINCENNES

The final city in my sample is Vincennes, located in Knox County, in the southwestern portion of the state. Some 7,071 of Knox County's 32,746 residents in 1900 were draft-aged men (ages 18-44). Of that number, 175 volunteered for combat in the Spanish-American War (University of Virginia Libraries, 2007). Vincennes was home to Vincennes University and the Vincennes University Cadets, who were reported to be "the only full company of cadets sent by any state educational institution in the country to engage in the Spanish War." In addition to the university, the small city was known as a center for manufacturing (and included four flour mills): "The wage scalp of all manufacturing establishments is high and the mills and factories run on full time," reported historian George E. Green in 1911. Green (1911) further stated that, "This state of affairs is not only a boon to the laborer, but it is a condition which the merchant thoroughly appreciates." Despite these claims, the city, like most of the cities in Indiana, put the majority of its focus on farming (Green, 1911, p. 461-512).

In 1900, there were 305,966 acres of farmland in the county (U.S. Census of Agriculture, 1999). The city boasted that it was "in the midst of one of the finest agricultural sections in the world with other natural advantages that few localities possess" (Green, 1911, p. 526-527). The majority of the area's volunteers, however, were not farmers. Only 28 percent of the men in the sample worked as farm laborers. The other 72 percent held a wide variety of jobs, and included architects, carpenters, and express agents. Only one was born outside of Indiana, and he was born in neighboring Illinois. Twenty-one percent of the men had at least one foreign parent, with over half of that number being from Germany. Thirty-six percent of the men had at least one parent who was not from Indiana, while only one of those had parents who were both from Illinois. This makes him the only volunteer of non-foreign descent who did not have at least one parent from Indiana. The average age of the men in the sample is 23.21, which places the average right around the age of a college student. This finding makes sense due to the presence of Vincennes University. Much like the other two cities, whether or not they were formally educated or whether or not they were farmers, all of the men in the sample were literate and more than likely read one of the newspapers which were published in the town of Vincennes.

Vincennes's principal newspaper in 1898 was the daily *Vincennes Commercial*. Additionally, at least two German papers catered to the city's sizable German population (Green, 1911, p. 475). Much like Greencastle's newspapers, the *Commercial* lacked an outright political bias, but the paper's obvious support for the war shone through in its articles, including its considerable buildup to the April 26, 1898 muster. The editors described on multiple occasions the government's plan to request as many as 200,000 troops prior to the official declaration of war (*Vincennes Commercial*, 1898a).

On April 21, 1898, the *Commercial* featured its coverage of the arrival of Major Hathaway's regiment on their way to New Orleans. In addition to describing the grand procession, complete with its bugles, wagons, and 86 horses, the paper dwelled on the reception that soldiers received from "our maidens who are famous for their beauty." The newspaper's reporter focused on the flowers that the troops received in exchange for buttons off their uniforms. One man promised to bring back the scalp of General Weyler, the Spanish General, in exchange for a bouquet. Such stories romanticized the life of a soldier, suggesting that the women of Vincennes would pay more attention to men who were in the military. Coming only a few days before men volunteered for the war, this article could have provided additional incentive for why they were willing to get involved, though the newspaper described the volunteers as being "all moved by a single impulse, patriotism." With this in mind, it makes sense to shift to the role of propaganda in the newspaper in Vincennes (*Vincennes Commercial*, 1898c).

The *Vincennes Commercial* employed similar language to the *Greencastle Banner Times* when describing the Spaniards' warlike ways, noting the "great enthusiasm reported through Spain at the prospect of war." At the same time, the editors stressed Spain's lack of preparation, mentioning that the Spanish were running short on food in Cuba (*Vincennes Commercial*, 1898b) or that a Spanish vessel had sunk in the Irish Sea (*Vincennes Commercial*, 1898e). Such efforts to show the enemy as weak boosted the morale of prospective soldiers, making the fight seem easily winnable.

The editors' language further expanded on the Spaniards' warlike character. Describing Spain's simple response to McKinley's ultimatum, the *Commercial* stated that "Spain considers the ultimatum a declaration and will make no reply - her fleet is on the move" (*Vincennes Commercial*, 1898c). The newspaper juxtaposed Spain's eager response with the United States government's carefully-thought-out ultimatum (*Vincennes Commercial*, 1898a). By making the Americans seem like the passive party in the conflict, the paper showed the American war fervor as simply a response to the actions of the Spanish as its large headline exclaimed on April 22, "War! Ready to fight! The hour has come" (*Vincennes Commercial*, 1898c).

More than the other papers examined here, the *Commercial* focuses on the role that allies would play in the coming conflict. The core ally in their narrative was the British. The nation that had once put the United States in a similar situation was, according to the newspaper, willing to help the United States. Britain volunteered to protect American interests in Spain (*Vincennes Commercial*, 1898b) and to "guard the United States against a European Coalition" (*Vincennes Commercial*, 1898d). The reminder that Britain would defend the United States' European interests made Spain seem more dangerous even as it made the United States seem better protected and, once more, allowed volunteers to imagine that the war was winnable.

The *Commercial* described the leave-taking of Vincennes's volunteers in great detail. There was a large banquet and all of the troops attended, including the University Cadets (*Vincennes Commercial*, 1898f). Lieutenant C.D. McCoy thanked everyone for choosing to join the conflict and for getting involved in the city's affairs. The paper described the young men who, for all they knew, were going to fight and possibly die in the conflict, as being happy and excited, in contrast to the older soldiers, who had known of war (*Vincennes Commercial*, 1898f). The banquet was also attended by female students at Vincennes University who presented a flag to the volunteers. At the heart of this article, the editors published a sketch that read "Remember the *Maine*," reminding Americans of their fears and also their hopes for what the war would accomplish. Had the Vincennes men joined hoping that they would get the glory given the soldiers from Nebraska, they would have been overjoyed. They were made to seem as heroes, before they had ever set foot on a battlefield (*Vincennes Commercial*, 1898f).

In addition to the likely influence of local journalist description of the time upon their decision to enlist, the political rhetoric of the time, too, had a particularly local cast. Albert J. Beveridge, as mentioned earlier, was one of the foremost supporters of American Imperialism, and often spoke about America's claims to the world ("Albert J. Beveridge," 2007). His most famous speech, given later in 1898, came to be known as the March of the Flag speech. In it, he continued to construct the terms of America's Manifest Destiny. Like others defending the same principle, Beveridge insisted that it was Americans' "liberty" that empowered them, and that they needed to spread throughout the world, for it was their right. With the Spanish-American War about to end, he reminded his listeners that "Hawaii is ours, Porto [sic] Rico is ours, at the prayer of her people, Cuba will finally be ours" (Beveridge, 1898).

To further his agenda for an American Empire, Beveridge compared the United States and Germany: "If Germany can govern foreign lands, so can America." By doing this, he was creating a model and an example of how the American Empire should look, while at the same time promoting his expansionist agenda. He put emphasis on the role that the military would play in this endeavor, particularly the Navy: "The oceans make them (Cuba, Puerto Rico, and Hawaii) contiguous. And our navy will make them contiguous" (Beveridge, 1898). Using military strength to unite the world is often key for the creation of an empire, and knowing that the United States was often separated from the rest of the world, it would make sense for there to be more emphasis placed on the role, and the power, of the military (Beveridge, 1898).

Beveridge's prescription for empire included a large dose of racism. Beveridge noted that it was reasonable to take land from Native Americans because they lacked the ability to govern themselves, and through extension, neither understood nor properly used the resources available on their land. The same principles applied, Beveridge believed, in other places such as Cuba, whose people were unable to take full advantage of their resources. Arguing that the United States must "find new markets for our produce," he argued that "every other

nation on Earth must pay our tariff before they can compete with us" (Beveridge, 1898). By using military power to create economic power, the United States would gain more influence in a global market.

For Beveridge, the need for global lands followed naturally from historical precedent. The flag, in his speech, had been carried, along with American identity, to places on the continent that had not been part of the United States, such as Mississippi, Florida, and others. Just as earlier Americans had bought such large chunks of land, as the Louisiana Purchase, without specific plans for what they wanted to do with it, the acquisition of Cuba and other lands abroad would prove useful once it was completed.

The men who volunteered to fight would not have heard or even read about Beveridge's speech, which was published months after they enlisted. But even without directly affecting their decision, the speech's contribution to an existing discussion of the continuation and further construction of the American Empire makes it impossible for us to say that the men would not have heard or been exposed to similar ideas. Beveridge himself had attended DePauw University in Greencastle (Weik, 1910, p. 242-245), and his ideas may have been shaped in the town in ways that influenced the Greencastle men who volunteered for the War.

DISCUSSION

A few interesting comparisons emerge when considering the three cities examined in this study. Despite the fact that all three were heavily reliant on agriculture, only Knox saw a majority of volunteers with farming backgrounds. The relative scarcity of farmers or farm laborers could be explained by the year-round need for farmers to take care of the crops, and Knox in particular seems to have had a high demand for farm workers (Grimes, 1917, p. 17). Men who worked in the service or manufacturing industries seem to have been more inclined to volunteer for the war. Jobs in manufacturing were easier to replace. So if a worker decided to join the war for the two-year period that the government required, someone else would be able to fill in for them. Then when the war ended, it would be easier to get their old job back, or a job in a similar field. Since they did not have that year-round commitment that farmers had, it would be easier for them to go off to war, come back to their jobs, and continue from where they left off prior to volunteering. If they knew this was a possibility, it would make sense for them to be able to fight and make some extra money, and then come back home to start again. Farmers during this time did not have this luxury because there would always be a need for food that could be grown and distributed.

Despite Indiana's population of immigrants, of the men that were sampled from the three cities, none were born outside of the country. There were certainly men who were born outside of Indiana, and men with foreign-born parents, but the vast majority had lived out the entirety of their existence on American soil. This might have been one of the reasons why they were prone to choosing to fight in the conflict, and also prone to falling for the propaganda that occurred in the newspapers, particularly to the rhetoric of fear. Many of the newspapers used the idea of fear to their advantage by stating that the Spanish might attack the coast — they were able to appeal to the desire of the American men to protect their livelihoods and the land that they came to cherish (*Greencastle Banner Times*, 1898b). By concentrating on the ever-present fear of the Spanish, the newspapers sought to unite the people of the United States behind a common banner, a banner that more often than not bore the phrase, "Remember the *Maine*."

Both Vincennes and Greencastle, as college towns, present common demographic information worth analyzing. When compared to towns like Knox — which lacked a university — the average age of the men who volunteered to go to war was much younger. This would seem to make sense given the average age for college attendance. However, the majority, despite being in the age range to attend their respective university, were not enrolled in classes. Most of the men who volunteered from Greencastle and Vincennes were born in those respective cities, and seem not to have traveled to the city to attend college. Working-class men who were not attending the university were more likely to enroll than their college-bound brethren.

While local Indiana newspapers did indeed use propaganda to their advantage, it is difficult to define whether or not their contents would have met the definition of yellow journalism, which was often considered to be a requirement of propaganda in journalism given the vagueness of that term. In 1900, Delos Wilcox set out to define yellow journalism, and his definition of "an above average emphasis on news of crime, or vice, use of illustrations, the publication of want ads, and medical advertising, and a tendency to advertise or call attention to its accomplishments" has remained current to this day. Under Wilcox's definition, the Indiana papers that I analyzed would not be considered "yellow." While crime was covered in the papers, it was not present to the detriment of other subjects. All of the papers used illustrations, but never to the excessive amount seen in papers such as Hearst's *New York Journal - American*. To my knowledge, none of the papers drew excessive attention to their own achievements. For the most part, the paper seemed like it was created solely to dictate facts, even if the facts were shaped into propaganda, and did not play an active role in creating the news itself. Not even such familiar stylistic elements as the banner headlines could be seen in the Indiana papers. Yet without serving as classic examples of yellow journalism, they still served a patriotic agenda through their use of wartime rhetoric (Campbell, 2001, p. 5-6).

A plethora of reasons could have inspired small-town Hoosiers to volunteer for the Spanish-American War: jobs and economic concerns like the Depression of 1893, propaganda dispensed through local media, and political rhetoric coming from nearby legislators. It is difficult to come up with a single reason as to why these men registered, or why the men of these three cities registered for the war at a higher rate than the men of any other city in the state. All of the men in the

sample were surprisingly literate, and thus likely to have read their local newspapers, which presented information that was largely accurate but was presented with the obvious agenda of justifying the war. Anyone reading these publications would have seen a portrayal of a decadent, warlike Spain attempting to enforce its claims upon its weak Cuban colony. For anyone with some knowledge of the American Revolution, the parallel between France's assistance to the new nation seeking its independence, and the potential American role in the Cuban conflict seemed obvious.

However, even those recruits who were unaware of their history could be motivated by fear. By preying upon American fears of invasion, newspapers created an added justification for war. Whether or not the papers were telling the truth, the emotional response to such threats was powerful. While not fitting the strict definition of yellow journalism, Indiana's small-town newspapers actively advocated for the conflict. It cannot be said that such papers caused local men to enlist, but they did keep people informed in a way that played on their emotions and sense of patriotic justice.

CONCLUSION

The men themselves were often as varied a group that could be found in Indiana during this period. However, they all had one thing in common: a desire to fight in the Spanish-American War. That desire might have come from a sense of boredom in a dead-end job as much as it did from the quest for glory. In comparison to this, the governmental figures of this time period, particularly Albert J. Beveridge, were pro-American Imperialism, and while he did not give any of his major speeches before the war broke out, the fact that he won a senatorial seat shortly after his famous March of the Flag speech indicates that there were some people in the state who were sympathetic to his views, views which could have been shaped by his time spent in Greencastle, one of the three cities in the sample. It is difficult to ascertain exactly the role that he, or his ideas would have played in the men's decision to join the war, but he was a creature of the times, and was constructed by the structures of feeling that were in the air in the late-nineteenth century.

Through the newspapers' creation of the concept of glory, many of the men would have found an opportunity to achieve a sense of agency by fighting in the war that they would not have previously been able to acquire working in a grocery store. But in order to have the necessary emotional response, it would have taken the work of both the papers and the rhetoric of politicians to convince the men that fighting in the conflict would be considered a "right" and "justified" response to the emotional swelling that they were experiencing. Political and journalistic propaganda and rhetoric would have been the determining factor in not only dictating how the men would feel about the war, but also how much they would know about it. News was limited to what was printed locally, and those who printed the papers could choose how much they told, and how they presented that information. However, the people who were most likely to be affected

by the propaganda were the same men who volunteered in such large numbers for the Spanish-American War: native-born men who were normally employed in careers outside of the farming industry, which was, and is, so prevalent in Indiana. It is in this manner that they effectively constructed the war — not in the sense of determining the government's decision to go to war (an accusation that historians such as Campbell have already shown to be false), but at the ground-level, among the men who would choose to fight in the war. Without soldiers, there would not have been a war, so the role that propaganda played in convincing men to fight in the war should not be overlooked. Ultimately, the story of the war that was constructed through propaganda became the story that they believed, which allowed them to decide to fight for America, for Cuba, and to Remember the *Maine*.

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Tracks in the Snow

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ABSTRACT

In 2000, Subhankar Banerjee set out for the Arctic National Wildlife Refuge to photograph polar bears in a "place untrammeled by tourism or industry" (Banerjee, 2008). This paper explores a number of threads regarding Banerjee's artistic journey from descriptive to interpretive work, including the role of politics in Banerjee's evolution as an artist and environmental activist and comparisons of his different publications over time. Along with providing context for Banerjee's work, this paper investigates the unique avenues through which Banerjee's photography challenges the traditional paradigm of a pristine wilderness by reconceiving its spacial representations in exhibitions and books highlighting the presence of humans in the Arctic. Research was primarily conducted through an analysis of both photographic and textual elements of Banerjee's publications and a conversation with Banerjee.

KEYWORDS: environmental photography, art activism, wilderness paradigm, environmentalism

INTRODUCTION

The sun beams on the yellow-white fur of a polar bear as it lumbers towards the leftover bones of a whale, mouth slightly open in anticipation of its meal (see Figure 1). Between patches of half-melting ice, water reflects the bright blue of the sky and a perfect mirror image of the bear. You might recognize this photograph—it has been wielded by scores of environmentalists, politicians, and journalists decrying global warming. Ironically, its photographer, Subhankar Banerjee (b. 1967), did not have political intentions when he first set out to photograph the Arctic; back then, his main motivation was to seek inspiration in "a place untrammeled by tourism or industry, a place untouched by man, pristine wilderness, so called 'the last frontier'" (Banerjee, 2008). However, this view of the Arctic would come to change as Banerjee immersed himself in Arctic life, producing art that, both intrinsically and through its special presentations, conveys a narrative of ecological richness that deconstructs the wilderness paradigm of classic American conservationism. In addition to his venture north, Banerjee underwent a political journey, transforming the way he would view and approach art as a vehicle for change.

SEASONS OF LIFE AND LAND

Before becoming a professional photographer, Banerjee was an engineer for Boeing and backpacking enthusiast, and before that, he was a boy growing up in Calcutta, drawn to images in the form of painting and the cinema. Coming from a middle-income family, however, he decided to take the "practical" route and pursue a career in the sciences. After his graduate studies brought him to New Mexico State University, Banerjee fell in love with the wide-open spaces of the American southwest. He joined the Sierra Club, where he became interested in the restoration of natural spaces, and would often go backpacking, taking photographs along the way. It was in part this passion for photographing the wild that led him to take his career to Seattle, where he

Figure 1. *Banerjee,* Polar Bear on Bernard Harbor (2001). Reproduced with permission by S. Banerjee.

joined a mountaineering club. In 2000, Banerjee ventured to Manitoba, a popular destination for people seeking to photograph polar bears, but was dissatisfied with his experience of commercialized tourism and industry. Craving a more authentic exposure to the wilderness, Banerjee left his job at Boeing and headed for the Arctic National Wildlife Refuge (Banerjee, 2012b).

Once in the Arctic, Banerjee's romantic notions of a journey through the wilderness were quickly dispelled by weather that was so brutal his camera lens shattered from the cold. "There were times I was sure I would freeze to death until another cup of hot coffee revived me, times when there was no money and only the richness of fellowship could buy us sufficient hope for another day's work," he recalled (Banerjee, 2003, p. 17).

Yet he also found the land to be beautiful and nurturing, bursting with rich, ecological vitality four seasons a year. Banerjee's first book, *Arctic National Wildlife Refuge: Seasons of Life and Land* (2003), reflects this realization, bringing the Arctic back to the traveler at home. Filled with

14 months worth of evocative photographs, entries from his diary, and essays from prominent environmentalist writers, the book journalistically recounts Banerjee's first Arctic experience.

One of the most artistically powerful aspects of this first book, however, lies in its presentation of wildlife photography in clusters, implying a temporal continuity that reminds the viewer that the Arctic is a living place. For example, two photographs displayed one above the other show a moose feeding on vegetation. The top photograph shows the moose with its head raised, eating from an upper branch. The photograph directly underneath is nearly identical, but the moose has lowered its neck and is now feeding on a lower branch (Banerjee, 2003, p. 20). By evoking a sense of motion, this simple difference—a lowered neck—transcends the frozen stillness of photography. The Arctic, to the viewer, is no longer a two-dimensional slice of Banerjee's journey; it is a land that exists in time and space, constantly moving and changing—a land with which one can actually interact.

ROLE OF SPATIAL PRESENTATION

Many of Banerjee's later images also reinforce an ecological narrative through the way they are presented in Banerjee's publications, often conveying the interconnectedness of the Arctic life and land. The aerial photographs in Banerjee's book *Resource Wars* (2008) do this especially well in two predominant styles. For the first, Banerjee sequentially presents two images that are identical except for a change in scale. For example, a photograph titled "Caribou Crossing the Utukok River" (Banerjee, 2008, p. 18) depicts a vast landscape in which green vegetation takes up the majority of the page and patches of snow delineate a silt-grey river bend. To the right is the same image, but expanded to three pages and magnified so that one can almost see the individual parts of the caribou. It's as if the first image says, "Here is an Arctic landscape," while the second demands, "Look closer. Here is a living ecosystem." The combination of the two is a powerful reminder not to dismiss the landscape as only an expanse of land; it is also a habitat filled with life and motion.

Less commonly, Banerjee will reveal a closer shot of a view first and then zoom out in the following page, such as with "Brant and Snow Geese with Chicks" (Banerjee, 2008, p. 41). By showing the geese on a more individual level first and then in a broader scope, Banerjee seems to comment that one must not see them as restricted to the area in view. In other words, Banerjee does not let his audience get away with viewing one part of nature without the whole context. There are the geese, yes, but then there is the land, and to look at the geese, one must look at the land as well.

The second ecologically evocative layout Banerjee employs in *Resource Wars* is the placement of two images side by side that are distinct but similar in color and texture. A two-page spread containing "Sheenjek River II: A Gwich'in Homeland" (Banerjee, 2008, p. 66) and "Caribou Migration II" (Banerjee, 2008, p. 67) demonstrates this technique. Both images depict vast landscapes of white snow and blue

ice, and a mountain line from the former seems to continue smoothly into the latter. The long lines of caribou treading across the ice in the latter image do not explicitly pass through the former, but the combination of the two creates a sense of the extensive distance the caribou must travel. The two pictures seem to be extensions of each other, reminding the audience that the landscape exists beyond the end of the page.

PEOPLE OF THE LAND AND THE WILDERNESS PARADIGM

The first photograph in that same spread also makes another more indirect, but perhaps even more important point; to notice it, the viewer must look not to the image itself, but its caption, "Sheenjek River II: A Gwich'in Homeland." Paradoxically, the image itself contains no visible signs of human presence; yet that is precisely what makes it so important. Taken at face value, the landscape shown reinforces the pre-existing beliefs of many American conservationists: that the Arctic is an empty and pristine wilderness, an untouched land. The title, however, points out what the viewer missed by just gazing at the surface. Despite what the viewer thinks or how nature is presented, the Arctic is the homeland to a group of people and the viewer must learn to reframe it as such.

In the foreword of Banerjee's collection *Arctic Voices* (2012), the artist recounts an instance in which, after viewing Banerjee's work, a young environmentalist asked, "How could there be a hunting camp in a pristine wilderness?" (Banerjee, 2012, p. 15). The environmentalist's confusion, while not ill-intended, is indicative of a dangerous and prevalent mentality in classic American conservationism, which is based largely on the idea that wilderness and humans are completely separate. This notion is not only idealistic and false, but also severely detrimental. During the conception of Yellowstone and Yosemite National Parks, conservationists would completely ignore the clear presence
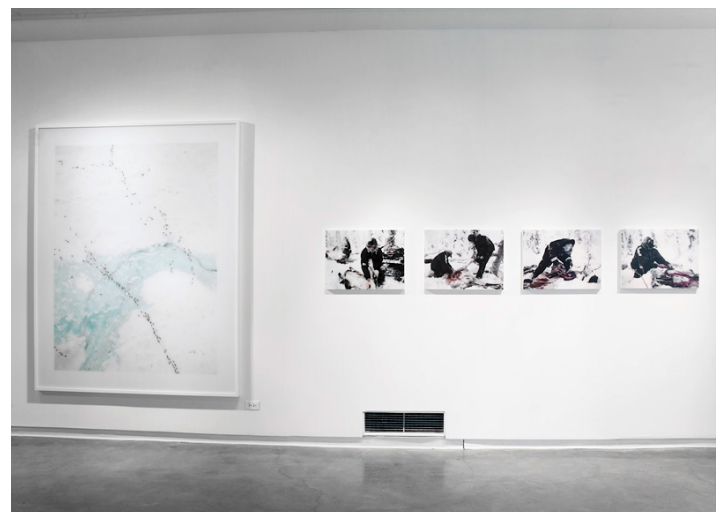

Figure 2. Banerjee, Installation View (2009). Reproduced with permission by S. Banerjee.

of at least five tribes in the area, reporting lands they deemed conservation worthy as empty, untrodden, and pristine. Native Americans and rural, white subsistence-hunters would be labeled "thieves," "poachers," and "squatters," and would forcibly be moved from their own homelands to preserve the conservationists' ideal. For 32 years, the U.S. military ran Yellowstone, effectively enforcing cultural eradication (Banerjee, 2012a, p. 9).

While Banerjee may have embarked for the Arctic with the ideal of a pristine landscape in mind, his interactions with the Gwich'in and Inupiat people ran completely counter to the classic wilderness paradigm. Banerjee's guide on his first trip to the wilderness was an Inupiat hunter named Robert Thompson, who, along with his wife Jane, taught Banerjee how to survive in the Arctic. In an immersive experience, Banerjee learned about Inupiat culture and documented the sacred whale hunt. He also lived with the Gwich'in people for a time, going on caribou hunts and learning the importance of the caribou to Gwich'in culture and life. Consequently, Banerjee's work in the Arctic breaks the wilderness paradigm not only by including native Inupiat and Gwich'in people in his photography, but by depicting them as having an established place in the ecology of the Arctic and a culture tethered to the land.

One such example of human-Arctic interrelations comes from a group of Banerjee's photographs in an exhibit (2009) in Jaffe-Friede Gallery in the Hopkins Center for the Arts, which elevates the narrative of humans as a part of Arctic ecology by simply having the images share a wall (see Figure 2). On the left is an 86 x 68" aerial shot of long lines of migrating caribou taken at such a distance that the caribou look no larger than ants, the white ice beneath them divided by a spread of blue. The image is juxtaposed to the right with a significantly smaller five photo series of Gwich'in hunters butchering the very same species of animal seen trekking over ice on the left (Banerjee, 2009). Blood-dark in the snow, there is no glorification of the hunter or hunted; these photographs are close and confrontational, and, compounded with the caribou migration image, force the audience to recognize both the reality of nature and the essential connection between land, animal, and human. This point is bolstered by the fact that, in the two images, the smears of red caribou blood and flesh and the blue of the ice supporting the caribou from underneath are the only colors present. The blood of the caribou (its death and flesh) is necessary for the survival of the Gwich'in people, and the ice (the land of the Arctic coast) is necessary for the survival of the caribou.

Banerjee's famous photograph of a polar bear lumbering across melting ice towards whale bones (see Figure 1) also exemplifies the interdependence of people and Arctic wildlife. The caption tells what the photograph on its own cannot: that the whale bones were leftover by the Inupiat from the previous year's hunt; the polar bear and other scavenging animals now benefit from the presence of humans.

A more solemn image highlighting human-Arctic involvement shows an Inupiat cemetery. Two massive jawbones of a bowhead whale arch out of the snow and into the sky in the form of a cemetery gateway, illustrating how the relationship the Inupiat people have with the bowhead whales is so deep that they are together even in their final resting places. Towards the back of the image, Christian crosses made of whalebone mark each grave. Together, the familiar (though perhaps unexpected) Western and unfamiliar tribal symbols evoke empathy in the viewer. Despite the solemnity of the image, the cemetery is not an inherently sad place; the sadness arises from the scene of past generations of Inupiat people buried in their land, the very land that the wilderness paradigm of Western civilization denies has even been trodden on by human feet. This denial is worse than ignorance; it is cruel cultural erasure.

THE TIPPING POINT

In an even graver depiction of human involvement in the Arctic, an exposed coffin by the shore takes the foreground (see Figure 3). The coffin, originally buried in permafrost, now only has a thin layer of dirt to cover it (Banerjee, 2006). Unlike the photograph of the Inupiat cemetery, this image points less to the people who buried the coffin than to the people thousands of miles away who are unknowingly responsible for exhuming it. Banerjee took this photograph in 2006, six years after his initial trip to the Arctic. In the span of those years, so much had changed so quickly. Banerjee saw scenes of the Arctic he had never seen before: "a drunken forest in Siberia, trees leaning at odd angles from softening of the permafrost; and the skeleton of caribou that had died from starvation due to winter icing on the tundra" (Banerjee, 2012a, p. 2). In addition, whereas there was little talk about global warming in the Arctic communities the first time he visited, though oil development was frequently discussed, climate change was on everyone's tongue five, six, or seven years later—how it was affecting the animals, communities, and Arctic ecology.

Figure 3. Banerjee, Exposed Coffin (2006). Reproduced with permission by S. Banerjee.

While Banerjee was noticing changes in the Arctic firsthand, a political war was raging back in Washington D.C. regarding whether or not companies should have the right to drill in the Arctic National Wildlife Refuge. Prominent Republicans and the Bush administration certainly thought so; the Secretary of the Interior at the time, Gail Norton, characterized the Arctic as lifeless, a "flat, white, nothingness." One Republican senator from Alaska held up a blank poster board and said, "This is a picture of Arctic National Wildlife Refuge as it exists for about nine months of the year." In March 2003, Senator Barbara Boxer of California challenged that view of the Arctic. "Cast your eyes on this," she said on the Senate floor, displaying the very image of a polar bear lumbering across ice mentioned earlier along with many of Banerjee's other photographs from *Seasons of Life and Land*. Her amendment that would prevent (or at least delay) drilling in the Arctic National Wildlife Refuge passed, 52-48 (Dunaway, 2009).

This use of Banerjee's work in a high-profile political setting catalyzed a turning point in his career. Banerjee had originally intended for his work to be educational and stayed mostly away from political focus groups. After Senator Boxer's use of his photography, however, Banerjee realized the impact his work could have and how photography could be used as a vehicle for change (S. Banerjee, personal communication, December 8, 2015). Much more so than for other art forms, people believe what nature photography shows them. Every image implies reality; the photographer must have been a firsthand witness of the scene—touched by the light, nose in the flowers, cheeks stung from the cold—to have brought the experience back for viewers to share.

As Banerjee's aims turned political, many aspects of his work began to change. While his earlier photography aimed to show a descriptive picture of the Arctic, his focus shifted to a more interpretive view, polished and pointed like a weapon. In the first sentence of *Resource Wars*, Kelley Wilder proclaims that aerial photography, the style Banerjee predominantly employs in the book, "is the language of war" (Banerjee, 2008, p. 11). Indeed, looking through *Seasons of Life and Land*, viewers mostly see the Arctic with their feet on the ground, as they would were they actually there. By contrast, viewers see the striking aerial landscapes in *Resource Wars* from the sky, page after page after page. Banerjee's photographs acknowledge the physical space that separates the viewer from the landscape. Yet they also compel them to understand how connected they are to the land. The difference is clear: the first style focuses on the individual; the second, by showing the literal big picture, demands that the viewer recognize the figurative big picture of global connectivity and how our decisions at home have a real effect on places far away.

SHIFT TO WRITING

In 2007, Banerjee began drawing back from pure photography, instead placing a greater emphasis on writing, both in essays and as an accompaniment to his art (S.

Banerjee, personal communication, December 8, 2015). This transition is reflected in the different ways in which Banerjee describes the same pieces of his own work in *Seasons of Life and Land* (2003), and then again in *Arctic Voices* (2012a). In the former, four photographs depict a polar bear mother and her two cubs as they tread through the snow then rest, the mother stationary while the cubs bound around her, each vying for her attention (Banerjee, 2003, p. 24). The image is sympathetic, and the two-line caption informs the reader about the general timeline of polar bear motherhood. When Banerjee writes again about these photographs, in his collection *Arctic Voices* (2012), his tone is drastically different:

> This isn't an adventure story, as you might think, but instead, as you'll see later in this volume, we ask such questions as, "Can you imagine the oil companies cleaning up a BP-like spill in the frozen Arctic Ocean in such a blizzard? (Banerjee, 2012a, p. 6)

This new commentary effectively shifts the topic of conversation away from being contained within the Arctic, instead pointing to a specific political issue and even naming an associated corporation that readers will undoubtedly recognize.

A 2001 photograph of musk oxen serves as another example of this change in intention (Banerjee, 2012a, p. 1). Located in one of the first few pages of *Seasons of Life and Land*, the oxen are silhouetted against a completely orange sky, the tops of their backs appearing almost to dissolve into the orange fog. Beneath them, the snow is such a deep blue that it could almost pass for the sea. In this book, the image is caption-less, but in *Arctic Voices* (2012), Banerjee provides sharp commentary:

> I began to wonder how could there be such vibrant colors in an environment that is supposed to be free of pollution? I remember from my childhood many colorful sunrises and sunsets in Kolkata, where pollution in the air was all around us; it still is. There had to be particulates in the air to create those deep red-orange colors in the musk oxen photo. (Banerjee, 2012a, p. 8)

Again, Banerjee now chooses to focus less on the subject than on the environmentalist implications of the image.

Gone was Banerjee's previous, more journalistic treatment of the Arctic. Each photograph in his later collections is imbued with purpose, bolstered by pointed textual commentary that explicitly and specifically conveys the urgency of environmentalism. In *Resource Wars* (2008), with a leaflet tucked into the front cover that serves as a complement to the images, Banerjee informs the reader not only about the detrimental effects of climate change on the native population and entire Arctic ecosystem, but he also makes sure that it is very clear that the fight is right at the reader's doorstep, instilling them with responsibility—compelling them to recognize their own personal stake in what happens in the Arctic.

CONCLUSION

While the politics in many of Banerjee's works directly involve the Arctic, an underlying theme of global connectivity

is always present. After all, if this far-away place often conceptualized as the last pristine wilderness is so affected by the decisions we make at home, how can we consider ourselves and our actions isolated from the rest of the world? It is not enough to prevent industrialization in the Arctic; our choices at home matter as well. Arctic ecology is world ecology. It affects the ecology of the spaces we choose to inhabit and we are constantly and personally engaging with all of it. "It may be just a square inch of space," Banerjee told me, "but square inches make up cities" (S. Banerjee, personal communication, December 8, 2015).

Recently appointed a Cambridge Fellow, Banerjee has spent a great deal of time reconsidering the concept of wilderness. When I asked him what wilderness means to him now, he replied, "sustenance: spiritually, culturally, and nutritionally" (S. Banerjee, personal communication, December 8, 2015). This new view of the wilderness places an emphasis on inclusion—of the feeling that originally drew him and other conservationists to nature, of the people who call it their homeland, and of all the living things that make up its vibrant ecology. Banerjee's work is an attempt at reconciliation, acknowledging the history of the outdated wilderness paradigm while bringing back the unfiltered voices of the Arctic.

If we now return to what has perhaps become Banerjee's most famous photograph, we see, once again, the sun beaming on the yellow-white fur of a polar bear lumbering towards its meal, left over from an Inupiat hunt. We see, between patches of half-melting ice, a crisp reflection of the bear and the bright sky. But now we see it differently. Banerjee might have gone to the Arctic to capture precisely this moment, but we know he gained so much more—the impetus to work towards change in the world.

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NATURAL SCIENCES

Construction of Generalized Integral Formulas By Means of Laplace Transformations

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ABSTRACT

We present a method for the construction of integral identities that contain an undetermined function. Except for mild restrictions, this function can be chosen arbitrarily. Our method is illustrated by several examples leading to new integral identities.

KEYWORDS: generalized integral formula, Laplace transform, definite integral

1. INTRODUCTION

The closed-form resolution of integrals is one of the standing issues in calculus. Integrals appear in many areas of mathematics and in the natural sciences, particularly in physics and engineering. Existing resources for integral tables, such as the monographs (Abramowitz & Stegun, 1964; Brychkov, 2008; Gradshtevn & Ryzhik, 2015) or online data bases (Shapiro, 2015; Wolfram Alpha, 2016), are continuously extended as new methods for the resolution of integrals are discovered. An example for such a new method is presented in the recent work by Glasser (2013). Starting from a known identity, the Laplace transform is used to construct the following integral formula:

$$\int_{-\infty}^{\infty} \frac{F(x^2 + i\pi x) \, \cosh(x)}{2 + 2\cosh(2x)} \, dx \;=\; \frac{\pi}{4} \, F\!\left(\frac{\pi^2}{4}\right). \tag{1}$$

In contrast to the vast majority of identities involving integrals, (1) contains a function F that can be chosen arbitrarily with only slight restrictions. As a result, formula (1) can be used to generate an infinite number of integrals, together with their closed-form resolution. Consequently, generalized integral formulas like (1) are much more versatile than their standard counterparts, such that it is desirable to determine methods for obtaining them. The purpose of the present research is to develop an approach for constructing a class of generalized integral formulas. We start out by considering a group of functions that have a common class of indefinite integrals. By imposing condition on the latter indefinite integrals, we can build integral identities that allow for the construction of generalized integral formulas (Section 2). As a result, in Section 3 we obtain several of such formulas, each of which produces new integral identities.

2. GENERALIZED INTEGRAL FORMULAS

In what follows we will first present an example of a *generalized integral formula* and how to obtain it from an identity that can be found in standard tables. Afterwards, we extend the example, leading to a scheme of construction for generalized integral formulas.

2.1. GENERALIZED INTEGRAL FORMULAS

For $t > 0$ we consider the following identity (Gradshtevn & Ryzhik, 2014):

$$\int_{0}^{\infty} \frac{\exp\left[-t\exp(x)\right]}{1 - \exp(-x)} - \frac{2\exp\left[-t\exp(2x)\right]}{1 - \exp(-2x)} \, dx \;=\; \log(2)\,\exp(-t). \tag{2}$$

We will now multiply both sides by a continuous function f in the variable t. Further restrictions on the properties of f will be developed as our calculation proceeds. After multiplication by f and reordering terms, we obtain:

$$\int_{0}^{\infty} \frac{1}{1 - \exp(-x)}\,\exp\left[-t\exp(x)\right]f(t) - \frac{2}{1 - \exp(-2x)}\,\exp\left[-t\exp(2x)\right]f(t)\,dx \;=$$
$$= \log(2)\,\exp(-t)\,f(t). \tag{3}$$

In the next step we integrate this relation with respect to the variable t over the interval $(0, \infty)$. Furthermore, we require f to be such that the order of integration can be exchanged. This leads to the result:

$$\int_{0}^{\infty} \frac{1}{1 - \exp(-x)}\left\{\int_{0}^{\infty}\exp\left[-t\exp(x)\right]f(t)\,dt\right\} - \tag{4}$$
$$- \frac{2}{1 - \exp(-2x)}\left\{\int_{0}^{\infty}\exp\left[-t\exp(2x)\right]f(t)\,dt\right\}dx = \log(2)\int_{0}^{\infty}\exp(-t)\,f(t)\,dt.$$

The terms in curly brackets can be interpreted as Laplace transforms of the function f. Assuming that f admits such a transform F, we can rewrite (4) as follows:

$$\int_{0}^{\infty} \frac{F\left[\exp(x)\right]}{1 - \exp(-x)} - \frac{2F\left[\exp(2x)\right]}{1 - \exp(-2x)} \, dx \;=\; \log(2)\,F(1). \tag{5}$$

We refer to this identity as a generalized integral formula because it contains a function F that can be chosen arbitrarily, as long as it admits an inverse Laplace transform such that the order of integration in (4) is interchangeable and the integral exists.

2.2. GENERALIZATION AND METHOD OF CONSTRUCTION

Before we proceed, let us formulate four standing assumptions that we will make throughout this work. While these assumptions will be illustrated using our example in Section 2.1, they extend to subsequent considerations in a straightforward manner. First, it is assumed that the function *f*, as it appears in the role of a function that is to be integrated in (3), is continuous. Second, it is assumed that double integrals that arise during the scheme in (4) allow to change their order of integration. Third, it is assumed that all integrals converge, in particular sums or differences of integrals such as in (4). Last, it is assumed that the function *F* contained in the final result (5) admits an inverse Laplace Transform.

The construction of our integral formula (5) is possible solely due to a particular structure of our initial identity (2). In general, the latter identity must be of the form:

$$\int_0^\infty \sum_{j=1}^n A_j(x) \, \exp\left[-t B_j(x)\right] dx \;=\; C \, \exp(-Dt), \tag{6}$$

where *n* is a natural number, A_j, B_j, $j = 1, ..., n$, are functions and *C*, *D* denote constants. However, for several reasons relation (6) cannot serve as a starting point when it comes to the practical construction of formulas like (5). This is so because only very particular choices of functions A_j, B_j, $j = 1, ..., n$, will permit a closed-form resolution of the integral on the left side of (6). In addition, even if such a resolution is possible, the integral does not necessarily take the form shown on the right side of (6). In order to overcome these issues and construct integral formulas like (5), we will focus on the function that results from indefinite integration on the left side of (6).

For the sake of simplicity let us revisit and analyze our example (2). Indefinite integration gives:

$$\int^x \frac{\exp\left[-t\exp(y)\right]}{1-\exp(-y)} - \frac{2\exp\left[-t\exp(2y)\right]}{1-\exp(-2y)} \, dy \;=$$
$$= \; \exp(-t)\left\{\mathrm{Ei}\left[t - t\exp(x)\right] - \mathrm{Ei}\left[t - t\exp(2x)\right]\right\}, \tag{7}$$

where Ei stands for the exponential integral (Abramowitz & Stegun, 1964) and a constant of integration was set to zero. Next, we must substitute the integration limits. Starting out with infinity, we make use of the limit relation:

$$\lim_{x \to \infty} \mathrm{Ei}(-x) \;=\; 0. \tag{8}$$

Applying this to the right side of (7) while taking the limit gives:

$$\lim_{x \to \infty} \exp(-t)\left\{\mathrm{Ei}\left[t - t\exp(x)\right] - \mathrm{Ei}\left[t - t\exp(2x)\right]\right\} \;=$$
$$= \; 0, \quad t > 0. \tag{9}$$

It remains to evaluate the right side of (7) at x = 0. Since Ei tends to infinity as its argument approaches zero, we recall the following series expansion:

$$\mathrm{Ei}(x) \;=\; \log(x) + \gamma + x + O\!\left(x^2\right), \tag{10}$$

where γ stands for the Euler-Mascheroni constant. On substituting the arguments of the exponential integral given in (9), we obtain:

$$\mathrm{Ei}\left[t - t\exp(x)\right] - \mathrm{Ei}\left[t - t\exp(2x)\right] \;=$$
$$= \; \log(tx) - \log(2tx) + O\!\left(x^2\right) = -\log(2) + O\!\left(x^2\right).$$

Consequently, we arrive at the expected result:

$$\lim_{x \to 0} \exp(-t)\left\{\mathrm{Ei}\left[t - t\exp(x)\right] - \mathrm{Ei}\left[t - t\exp(2x)\right]\right\} \;=$$
$$= \; \log(2) \, \exp(-t).$$

Let us now consider the following function A that generalizes the right side of (7):

$$A(x,t) \;=\; a_1(t) \, \mathrm{Ei}\left[b(x,t)\right] - a_2(t) \, \mathrm{Ei}\left[c(x,t)\right], \tag{11}$$

where a_1, a_2, *b* and *c* are functions that are to be determined. We have:

$$\frac{\partial}{\partial x} A(x,t) \;=\; a_1(t) \, \frac{\exp\left[b(x,t)\right]}{b(x,t)} \, \frac{\partial}{\partial x} b(x,t) - a_2(t) \, \frac{\exp\left[c(x,t)\right]}{c(x,t)} \, \frac{\partial}{\partial x} c(x,t).$$

Now, according to the left side of (6), we want each of the terms in curly brackets to be a product of an exponential and a factor that is independent of the variable *t*. Since we already have an exponential in both terms, it is reasonable to require:

$$\frac{\partial}{\partial t} \frac{1}{b(x,t)} \frac{\partial}{\partial x} b(x,t) \;=\; 0 \qquad\qquad \frac{\partial}{\partial t} \frac{1}{c(x,t)} \frac{\partial}{\partial x} c(x,t) \;=\; 0.$$

These conditions are fulfilled if the following choice for *b* and *c* is employed:

$$b(x,t) \;=\; b_1(t) \, b_2(x) \qquad\qquad c(x,t) \;=\; c_1(t) \, c_2(x), \tag{12}$$

where b_j and c_j, $j = 1, 2$, are functions depending on a single variable that will be determined further. Upon substituting (12) into (11), we obtain:

$$A(x,t) \;=\; a_1(t) \, \mathrm{Ei}\left[b_1(t) \, b_2(x)\right] - a_2(t) \, \mathrm{Ei}\left[c_1(t) \, c_2(x)\right], \tag{13}$$

and:

$$\frac{\partial}{\partial x} A(x,t) \;=$$
$$= \; a_1(t) \, \exp\left[b_1(t) \, b_2(x)\right] \frac{b_2'(x)}{b_2(x)} - a_2(t) \, \exp\left[c_1(t) \, c_2(x)\right] \frac{c_2'(x)}{c_2(x)}. \tag{14}$$

Comparison of this expression with the integrand on the left side of (6) shows that the functions a_1, a_2, can be chosen as follows:

$$a_1(t) = \exp(-k_1 t) \qquad a_2(t) = \exp(-k_2 t)$$
$$b_1(t) = k_3 t \qquad c_1(t) = k_4 t,$$

where k_j, $j = 1, ..., 4$, are constants. These settings render (13) in the form:

$$A(x,t) = \exp(-k_1 t)\ \mathrm{Ei}\,[k_3 t b_2(x)] -$$
$$- \exp(-k_2 t)\ \mathrm{Ei}\,[k_4 t c_2(x)]\,, \tag{15}$$

while for its partial derivative (14) we find:

$$\frac{\partial}{\partial x}\,A(x,t) = \exp[(k_3 - k_1)t b_2(x)]\frac{b_2'(x)}{b_2(x)} - \exp\{(k_4 - k_2)t c_2(x)\}\frac{c_2'(x)}{c_2(x)}.$$

In the next step we will substitute the limits of integration into (15). Starting out with infinity, we take our identity (8) into account. This gives the constraints:

$$\lim_{x \to \infty} k_3 b_2(x) = -\infty \qquad \lim_{x \to \infty} k_4 c_2(x) = -\infty. \tag{16}$$

Taking the limit of (15) at zero is more complicated because the behavior of the functions b_2 and c_2 at zero is not known. While we are unable to give a general criterion for the limit to exist, in the example section we will discuss typical scenarios that lead to a finite limit.

3. APPLICATIONS

We will first take our previous formula (2) and evaluate it for several particular cases. Afterwards, we construct a new generalized integral formula (15). In our final example we show that the latter indefinite integral can also be used to build formulas involving complex functions.

3.1. EXPONENTIAL AND HYPERBOLIC INTEGRANDS

We revisit our integral formula (2), which can be obtained by comparison of the indefinite integrals (7) and (15). Both coincide if the following settings are employed:

$$k_1 = k_2 = k_3 = k_4 = 1$$
$$b_2(x) = 1 - \exp(x) \qquad c_2(x) = 1 - \exp(2x). \tag{17}$$

Let us now state a few particular cases of the generalized integral formula (5) resulting from (15) with the settings (17). Recall that we must choose the function F such that it admits an inverse Laplace transform and such that the resulting integral exists. Starting out with a simple example, we plug F(x) = 1/x into (5), which gives:

$$\int_0^\infty \frac{1}{1 + \exp(x)}\,dx = \log(2).$$

Another simple example is generated if we choose F(x) = 1/(x + 1). We obtain after conversion of exponentials to hyperbolic functions:

$$\int_0^\infty \mathrm{sech}(x)\tanh\left(\frac{x}{2}\right)\,dx = \log(2).$$

Let us now generate a less elementary integral relation. Upon setting F(x) = erf(1/x), where erf denotes the error function (Abramowitz & Stegun, 1964), we get from (5):

$$\int_0^\infty \frac{\exp(x)}{\exp(2x) - 1}\ \{[\exp(x) + 1]\mathrm{erf}\,[\exp(-x)] - 2\exp(x)\mathrm{erf}\,[\exp(-2x)]\}\,dx = \log(2)\,\mathrm{erf}(1).$$

Before we conclude this example, let us remark that our integral formula (2) can be generalized further if we leave the constants k_j, $j = 1, ...4$, arbitrary.

3.2. LOGARITHMIC INTEGRANDS

Let us now make the following settings in (15):

$$k_2 = k_1 \qquad b_2(x) = -x$$
$$c_2(x) = -\log(x + 1),$$

where we further assume that k_1, k_3, $k_4 > 0$. After substitution, (15) takes the form:

$$A(x,t) = \exp(-k_1 t)\{\mathrm{Ei}\,(-k_3 t x) - \mathrm{Ei}\,[-k_4 t \log(x+1)]\} \tag{18}$$

The partial derivative (14) of this function is given by:

$$\frac{\partial}{\partial x}\,A(x,t) = \frac{1}{x}\ \exp[-t(k_1 + k_3 x)] - \frac{\exp(-k_1 t)}{(x+1)^{k_4 t + 1}\log(x+1)}. \tag{19}$$

Keeping this in mind, in the next step we substitute the limits of integration into the function (18). Starting with infinity, we make use of (16) in order to obtain:

$$\lim_{x \to \infty} A(x,t) = 0, \quad t > 0.$$

Next, we observe that the arguments of both exponential integrals in (18) vanish as x tends to zero, such that (10) becomes applicable. We get after some simplification:

$$\lim_{x \to 0} A(x,t) = \log\left(\frac{k_4}{k_3}\right)\exp(-k_1 t), \quad t > 0. \tag{20}$$

Now, combination of (19) and (20) gives the following identity for $t > 0$:

$$\int_0^\infty \frac{1}{x}\ \exp[-t(k_1 + k_3 x)] - \frac{\exp(-k_1 t)}{(x+1)^{k_4 t + 1}\log(x+1)}\,dx = \log\left(\frac{k_4}{k_3}\right)\exp(-k_1 t). \tag{21}$$

We can now apply the same procedure as in our first example, that is, multiply (21) by a function f depending on the variable t, and integrate over the interval $(0, \infty)$. Assuming that f is such as to allow an exchange of the integration order and to admit a Laplace transform, we arrive at the generalized integral formula:

$$\int_0^\infty \frac{F(k_1 + k_3 x)}{x} - \frac{F[k_1 + k_4 \log(x+1)]}{(x+1)\log(x+1)} \, dx = \log\left(\frac{k_4}{k_3}\right) F(k_1). \tag{21}$$

Recall that this relation holds as long as F has an inverse Laplace transform. Let us now present a few particular cases of (22) for different choices of the function F. For the sake of brevity, we first apply the overall settings $k_1 = 4$, $k_3 = 1$ and $k_4 = 2$. Picking $F(x) = 1/x$ renders (22) in the form:

$$\int_0^\infty \frac{F(k_1 + k_3 x)}{x} - \frac{F[k_1 + k_4 \log(x+1)]}{(x+1)\log(x+1)} \, dx = \log\left(\frac{k_4}{k_3}\right) F(k_1). \tag{22}$$

Next, we plug $F(x) = \exp(4 - x)$ into our formula (22). We obtain:

$$\int_0^\infty \frac{1}{x^2 + 4x} - \frac{1}{2(x+1)\log(x+1)\left[\log(x+1) + 2\right]} \, dx = \frac{\log(2)}{4}.$$

Note that the right side does not change because we did not modify the constants k_1, k_3 and k_4.

3.3. COMPLEX INTEGRANDS

Except for the introductory formula (1), throughout the preceding considerations we assumed that the indefinite integral (15) and the function it contains are real. In particular, our calculations of the integration limits are based on real-valued functions. In this section we will show that choosing complex functions b_2 and c_2 in (15) can lead to integral formulas that extend those previously studied here. It is important to point out that our criterion (16) for determining the limit of A at infinity does not hold anymore if b_2 and c_2 are complex-valued. While a general analysis of this case is beyond the scope of this note, we will present an example. Starting out from the indefinite integral (15), making the following settings:

$$k_1 = k_3 = k_4 = 1 \qquad k_2 = -1$$
$$b_2 = 1 - ix \qquad c_2 = -1 - ix.$$

This renders our function (15) in the form:

$$A(x,t) = \exp(-t)\mathrm{Ei}\left[-t(-1 + ix)\right] - \exp(t)\mathrm{Ei}\left[-t(1 + ix)\right]. \tag{23}$$

Its partial derivative (14) becomes:

$$\frac{\partial}{\partial x} A(x,t) = -2i\,\frac{\exp(-itx)}{x^2 + 1}. \tag{24}$$

We now evaluate the limit of (23) if x tends to infinity. We obtain:

$$\lim_{x \to \infty} A(x,t) = -\frac{i\pi}{2}\left[\exp(-t) + \exp(t)\right]. \tag{25}$$

Instead of taking zero as the lower limit of integration, this time we will use negative infinity:

$$\lim_{x \to -\infty} A(x,t) = -\frac{i\pi}{2}\left[-3\exp(-t) + \exp(t)\right]. \tag{26}$$

Upon combining (24) and (25), (26) we get after multiplication by $i/2$ the relation:

$$\int_{-\infty}^\infty \frac{\exp(-itx)}{x^2 + 1} \, dx = \pi \exp(-t).$$

The form of this identity is suitable for the construction of a generalized integral formula. Multiplication of both sides by a function f that has a two-sided Laplace transform F and exchanging the order of integration yields:

$$\int_{-\infty}^\infty \frac{F(ix)}{x^2 + 1} \, dx = \pi F(1). \tag{27}$$

Before we state particular cases of this identity, let us remark that due to the complex argument of F and the domain of integration being the whole real line, the choices for F are much more restricted than in the previous examples. As mentioned above, we will not go into details, but just evaluate (27) for a few cases. The simple setting $F(x) = 1$ gives the known relation:

$$\int_{-\infty}^\infty \frac{1}{x^2 + 1} \, dx = \pi.$$

Next, we choose $F(x) = x^2/(x + 1)^2$, which renders (27) in the form:

$$\int_{-\infty}^\infty \frac{x^2}{(x - i)^3(x + i)} \, dx = \frac{\pi}{4}.$$

Finally, let us substitute $F(x) = \arctan(x^4)$ into (27). We obtain the result:

$$\int_{-\infty}^\infty \frac{\arctan(x^4)}{x^2 + 1} \, dx = \frac{\pi^2}{4}.$$

As mentioned above, we restrict ourselves to the complex integral formula (27) because the criteria for choosing the function F become much more complicated than in the real case.

4. CONCLUDING REMARKS

In this note we have presented a simple method for the construction of generalized integral formulas containing an almost arbitrary function rather than numerical parameters.

It should be stressed that our method can be generalized by replacing the Laplace transform through a different integral transform, such as the bilateral Laplace transform or the Fourier transform. This broadens the choice of functions in the resulting generalized integral formula and it also allows to modify the domain of integration.

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Endosymbiont Bacteria *Holospora undulata* Confers Oxidative Tolerance in Host *Paramecium caudatum*

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ABSTRACT

Paramecium is a genus of ciliated protozoan that, while unicellular, has a complex intracellular structure, comparable to Metazoan cells, which has made them excellent models for the study of genetics and cellular functions. *Holospora undulata* is a bacterial endosymbiont specific to the species *Paramecium caudatum*; they are unable to grow outside of *P. caudatum*. The presence of this endosymbiont has proven to have an effect on the subsequent gene expression and cellular maintenance of its host cells. Recent studies have demonstrated that infection by *H. obtusa* increases the expression of host heat-shock genes and leads to both resistance at normally-lethal high temperatures and heat resistance in ciliary movement (Fujishima, Kawai, & Yamamoto, 2005; Hori & Fujishima, 2003). Heat-shock resistance occurs because bacterial DNA triggers the upregulation of its *P. caudatum* host's heat-shock genes (*i.e.*, hsp60 and hsp70), although the mechanisms are not known (Hori & Fujishima, 2003). These studies demonstrate that infection of *P. caudatum* by *H. undulata* (a closely-related species to *H. obtusa*) induces heat-shock resistance, but fail to address whether *H. undulata* protects against other common environmental stressors such as oxidative damage. To determine if infection by *H. undulata* has the ability to induce additional tolerances, we examined differences in oxidative tolerance, based on percent survival, between *P. caudatum* with and without *H. undulata* infection. Samples of both lines were treated with increasing concentrations of hydrogen peroxide, the number of surviving cells were counted, and the percent survivability of each sample was calculated. There was an approximate 20% increase in survival when *P. caudautum* was infected with *H. undulata*—thus *H. undulata* infections confer oxidative tolerance. Further studies will be conducted to determine if an increase in survivability occurs in response to other damaging mechanisms. Future work will also investigate if the genes responsible for oxidative damage repair are upregulated, in addition to the already characterized heat-shock genes.

KEYWORDS: *Paramecium caudatum*, oxidative tolerance, endosymbiont, host, heat-shock

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PROFESSIONAL SCHOOLS

Effects of Filament Diameter Tolerances in Fused Filament Fabrication

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ABSTRACT

Fused filament fabrication (FFF) is one of the most popular additive manufacturing (3D printing) technologies due to the growing availability of low-cost desktop 3D printers and the relatively low cost of the thermoplastic filament used in the 3D printing process. Commercial filament suppliers, 3D printer manufacturers, and end-users regard filament diameter tolerance as an important indicator of the 3D printing quality. Irregular filament diameter affects the flow rate during the filament extrusion, which causes poor surface quality, extruder jams, irregular gaps in-between individual extrusions, and/or excessive overlap, which eventually results in failed 3D prints. Despite the important role of the diameter consistency in the FFF process, few studies have addressed the required tolerance level to achieve highest 3D printing quality. The objective of this work is to develop the testing methods to measure the filament tolerance and control the filament fabrication process. A pellet-based extruder is utilized to fabricate acrylonitrile butadiene styrene (ABS) filament using a nozzle of 1.75 mm in diameter. Temperature and extrusion rate are controlled parameters. An optical comparator and an array of digital calipers are used to measure the filament diameter. The results demonstrate that it is possible to achieve high diameter consistency and low tolerances (0.01mm) at low extrusion temperature (180 °C) and low extrusion rate (10 in/min).

KEYWORDS: acrylonitrile butadiene styrene, RepRap printers, fused filament fabrication, fused deposition modeling, inconsistent extrusion, Raster

INTRODUCTION

Fused deposition modeling is a type of additive manufacturing. According to Griffey (2014), "fused deposition modeling is what most people understand to be 3-D printing, as this technology is by far the most common and in many ways the simplest of the possibilities [of additive manufacturing]." Fused filament fabrication (FFF) works the same way as fused deposition modeling; by laying down molten strings of plastic (in our case ABS) from the nozzle of the printer's hot end onto each other, the molten plastic fuses together to build parts. Parts begin as computer models, which are converted into stereolithography files for printing. When using a RepRap printer, the layers are laid down according to the Cartesian coordinates (x, y, z) and the print head is programmed to move with relation to the build plate where the flat surface layers of the object are deposited on. The RepRap Prusa models used in this project print layers from the build plate vertically upwards. An advantage of using a RepRap printer is that a user can control more variables and that these printers can reproduce the parts for themselves by printing them.

With custom programming, users can control certain variables that affect the overall print. One such variable is the layer height. Layer height is the FFF equivalent of a printed page's dots per inch as it determines the resolution of the print; a smaller layer height creates a smoother finished product but it also takes a significant amount of time longer to print such high resolution objects (Griffey, 2014). A common theme in the variables users try to control is one that allows for higher quality prints. 3D printer users have to adjust to a number of

issues that can cause prints to be incorrect, or fail. An aim of this research is to determine what makes a print of quality and if the filament's geometric and dimensional tolerances have a part in affecting the quality of finished prints.

Hernandez (2015) suggests that "differences in material properties across manufacturers and even across different material lots from the same manufacturer can result in very different printing results, requiring user intervention to refine several printer parameters until usable prints are achieved." 3D printing software will extrude a certain volume based on the filament diameter, diameter of extrusion nozzle, and the extrusion flow rate. When printing, an extruder wheel turns and pushes some selected volume of plastic down the hot end. If there are any irregularities in the filament being fed to the nozzle, the printer will not compensate for the difference and will continue printing. This is what is referred to as "inconsistent extrusion." The printer is extruding based on a certain theoretical amount already determined in the file and will not adjust the extrusion to fix any unexpected variations of the filament during printing. "Once a given layer is printed, the build platform lowers by the distance equal to the slice layer thickness. With the lowered build platform, the next layer is built on top of the previous layer. This process continues until the build is complete" (Rishi, 2013). This distance does not undergo any automatic adjustments if any imperfections were to occur with the amount of material flowing out of the nozzle.

A filament diameter that is inconsistent can cause serious complications during extrusion. An unexpected small diameter will cause the mechanism to not be able to grip the filament because of the lack of tension, causing extruder

failure since no plastic will melt for impression. Conversely, if the filament has a sudden increase in diameter, the plastic will not be able to fit in the opening of the nozzle and melt properly. The gold standard across the industry for filament tolerance is +/- 0.05mm (or acceptable deviation of 0.1mm) and a typical spool of 1 kg ABS is approximately 1350 ft. Maintaining a tolerance lower than the current industry standard with consistency throughout the entire length of the filament would be challenging during manufacturing, which is why there is grounds for more research in this area.

It remains debatable if minor changes within tolerance can affect an extrusion. During extrusion, as explained previously, the filament is heated and melted for impression. The imperfections of the filament that can affect printing are those that occur right when the material is being discharged from the nozzle. Roundness, as a matter of fact, is not even a major factor considered. The only importance of it is that any angle printed is within diameter tolerance. Roundness is not used as a key evaluation in our project. Consistency is more important for our research, and tolerances will become our main priority when evaluating filaments.

METHODOLOGY

Ong (1994) finds that "conventional tolerances allow the designer to specify the desirable surface condition and size of a part feature within an upper and a lower limit. The advantages of this tolerancing method are that it is simple to use and part conformance can be easily verified using direct measurement tools such as a caliper and a surface indicator." For our project we have designed the following objectives and outlined how we will address them.

1.1 Filament Analysis

Firstly, we need to specifically understand the filament. We will need to approach the outcomes of filament extrusion, like filament differences, or "air pockets" shown in the Results section. The purpose of this is to identify causes of variations in the material and prevent imperfections during extrusion. Controlled parameters, such as feed rate and temperature, will be studied as possible causes. Distinct adjustments of these parameters should be analyzed to determine the optimum settings for the filament to obtain the consistency desired. Thus, we will improve the potential of our extrusion and eventually narrow tolerance values.

1.2 Optimization of Extruding Process

Optimizations will include the improvements in the feed rate, pressure, and temperature during extrusion, following the conclusions obtained from the filament analysis portion. Differences in sizes matter when purchasing a filament and this should be addressed to optimize the accuracy of the filament quality when selecting dimensions. Deciding optimal processing parameters is the basis of this objective. We will have to manipulate controlled parameters to identify their effects and select ideal settings for consistent filament. Control variables will be selected for comparison. Prints with common

criteria for printing with selected values in the chosen aspect will be compared to prints made with our adjustments to determine the difference in quality, accuracy, and raster air gap.

The feed rate threshold will be observed in addition to this process. Research has shown that manipulating feed rate and nozzle height can impact volumetric flow rate. This involves affecting surface quality, layer height, and bead width. What this means is if the 3D printer is "aware" of the geometrical and dimensional properties of filament before the filament enters the heated nozzle, past research has shown it is possible to adjust parameters to compensate for these irregularities (Rishi, 2013). However, future research will be needed to determine the significance of a closed loop feedback system on surface quality and part accuracy (Rishi, 2013).

1.3 Final Adjustments

If we were to come across the situation where the manipulation of aspects within the printer may not be sufficient to obtain the quality of print desired, we will then add an additional process after extrusion, referring to techniques like cooling down the filament faster, setting the product in a "bath" of water, or adding a chemical to allow the filament material to set. This serves to correct imperfections still present after extrusion.
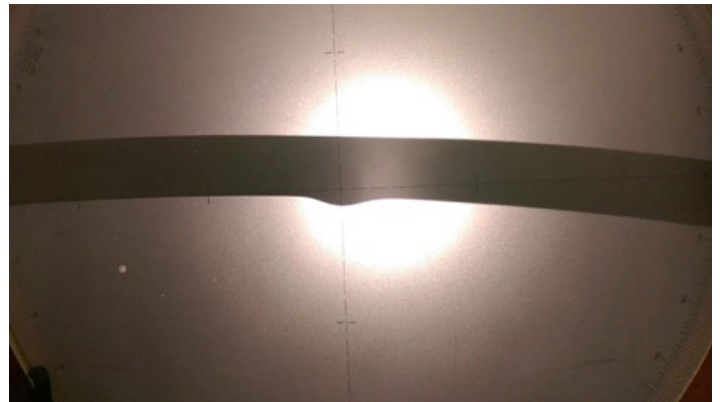

Figure 1. Optical Comparator - Air bubble in purchased filament.

RESULTS

During the process of evaluating filament, imperfections (see Figure 1) were found that prove the need of 3-axis to monitor filament diameter. It is necessary to develop a way to detect imperfections beyond filament diameter tolerances to maintain the filament within the acceptable ranges. This is necessary to maintain the quality of the print and prevent unwanted results, previously identified as inconsistent extrusions.

Without any measuring instrument, imperfections (see Figure 2) can be difficult to identify. Also, without 3-axis monitoring, any differences that are one-sided can be out of sight once the filament is rotated. Ideally, filament should maintain a consistent diameter throughout the entire spool. In reality, during manufacturing, an absolutely consistent diameter value throughout an entire filament is not achievable, which is why a tolerance has to be defined. Diameter can be

changed by altering temperature, nozzle diameter, or by pulling the filament as it is extruded.

The orientation of the extrusion device also affects the resulting filament. When the filament does not cool quickly enough, it is still malleable enough to misshape or curl back on itself. Those who extrude filament have documented a preference for angled extrusion, vertically mounted extrusion, and horizontal extrusion with the use of a pulley to pull the filament into a spool. Preferences though, do not provide enough evidence to support whether all methods are acceptable or whether some are more beneficial to end product quality.

A pellet-based extruder is utilized to fabricate acrylonitrile butadiene styrene (ABS) filament using a nozzle of 1.75 mm in diameter. This nozzle diameter has remained the same throughout this project. Temperature and extrusion rate are other controlled parameters. In our testing of different temperatures, we determined that 174 °C up to 180 °C, depending on room temperature, successfully extruded filament of the desired diameter. An optical comparator and an array of digital calipers are used to measure the filament diameter currently. The results demonstrate that it is possible to achieve high diameter consistency and low tolerances (0.01mm) at low extrusion temperature (180 °C) and low extrusion rate (10 in/min).

CONCLUSION

Our significant findings have been building a filament extruder and categorizing the differences between manufactured, mass-produced filament, and filament we have extruded from ABS pellets. As presented by the objectives and results, the project is still in process of collecting significant evidence for future research routes to be determined. This project's experience with filament extrusion has shown a need for possibly producing a second extruder to modify for use in the continuation of the project. With the manipulation of certain variables (thus far temperature and orientation of the extruder), we have already seen the effect variable control has on final filament diameter. As stated in the results, there is a varying temperature at which to extrude and this affects the resulting diameter for those producing filament. The understanding of the filament extrusion process is key to manipulating such variables and producing results. There are a great number of components to define in this continuing process. Some of these components are how to specifically characterize a good quality filament, how to achieve and produce good quality filament with consistency, and whether a quality filament improves the quality of a print. In many cases the materials in production do affect resulting products, but as far as 3D printing there is more complete evidence to be found to prove or to disprove this idea. With filament quality there are a multitude of characteristics (*i.e.*, tensile strength) that have the potential to affect the overall quality but which ones do with significance is to be determined still. These are all fields with a necessity of further investigation and a process to follow. It requires us to understand filament to a certain extent in order to be able to quantify the quality of it. Research has shown that manipulating feed rate and nozzle
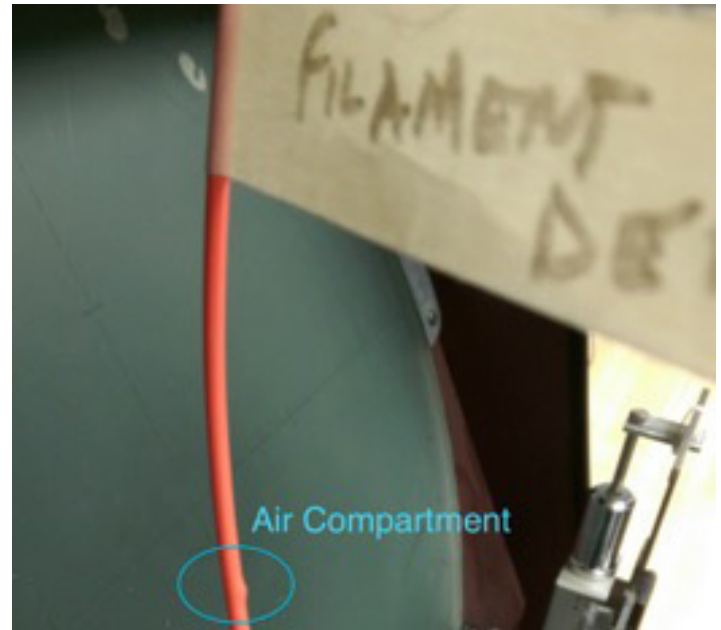

Figure 2. Filament imperfection.

height can impact volumetric flow rate. Parameters will further be established by this project to fulfill these goals.

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The Motivations Behind Child Welfare Work

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ABSTRACT

This report seeks to explore the findings of a qualitative research study concerning the motivations behind child welfare work. Child welfare is a major field within the social work profession that demands a great deal of expertise and effort from workers. Professionals employed as case managers within the child welfare field are held accountable for a wide variety of social work roles, often placing these individuals at risk of emotional trauma and high levels of work-related stress. Due to this, workers who remain in the field for extensive periods of time often experience strong sensations of purpose relative to their work. Our study found that child welfare caseworkers were motivated by altruism and a deep desire to improve the lives of their clients. They were also kept motivated by the successes that came from time to time. While trials seem to be experienced on a regular basis, child welfare caseworkers generally found their work to be a positive presence within the families they serve. Further research is needed to expound upon the findings of this study.

KEYWORDS: child welfare, motivation, altruism, case manager, secondary trauma

INTRODUCTION

Child welfare work is a uniquely sensitive area of the social work profession. Families who come into a state's child welfare system often present a variety of underlying needs and are accompanied by complex layers of trauma. Workers in this field are held to a high standard of professionalism and are often entrusted with life-and-death responsibility. Prior to conducting this study, we hypothesized that individuals attracted to child welfare work are often motivated by deeply-held altruistic beliefs; to continue to serve clients with the sort of passion and dedication that speaks to the core of quality client engagement, it is imperative that workers remember their original sources of motivation.

The discipline of social work is widely seen as one that is best suited to educating and training child welfare workers (Folaron & Hostetter, 2006). Therefore, social work educators are particularly interested in understanding who is drawn to child welfare work. Understanding the motivation of child welfare workers also helps recruit and retain excellent people for the field.

This study seeks to offer an explanation as to what motivates contemporary child welfare workers. By inviting participants to share their experiences of both arriving to and remaining in the field, they may be reminded of the personal reasons with which they began this chapter of their careers. In turn, all social workers and other professionals with an interest in the child welfare field will have the opportunity to expand their understanding of the realities current child welfare workers face.

BACKGROUND

Child welfare workers have garnered an increased amount of interest in recent years. Policy reformations across the county have made an effort to recruit, train, and keep quality workers who can perform to a new standard of care. While obtaining statistics from server databases and surveys is a feasible task, solid qualitative data is difficult to collect due to the overscheduled and busy nature of child welfare workers.

Barth, Lloyd, Christ, Chapman, & Dickinson (2008) provided the field with a variety of in-depth, contemporary, and reasonably-generalizable data about the characteristics of child welfare workers. The researchers took multiple factors into account. In addition to worker satisfaction, home life, and income, the backgrounds and training of workers were analyzed as well. By utilizing data gathered from 92 clustered primary sampling units, the researchers were able to collect regionally-sensitive data from across the United States. Job satisfaction, urban status, gender, race, experience, supervision, social work degrees, roles of the worker, and income were each assessed in detail.

Barth et al. (2008) found the child welfare field to be lacking in worker diversity. Case managers are still overwhelmingly female and white. Additionally, a case was made for demographic stability as this trend does not appear to be significantly different amongst recently-hired workers. Quality supervision was found to be the strongest predictor of satisfaction among child welfare workers, making an argument for the importance of strong and thorough advising and emotional support. Social workers were found to remain in the field the longest and to earn more money on average than their non-social work colleagues.

Jayaratne, Chess, and Kunkel (1986) utilized surveys to gather information from 75 female workers and their male spouses. Due to the demographic context of the state the researchers were analyzing, only 14 male-and-married workers were present, thus prompting the researchers to restrict their inquiries to female workers. Burnout, anxiety, depression, irritability, self-esteem, physical health, emotional support, and job satisfaction were assessed by the survey.

Jayaratne et al. (1986) concluded that female workers experiencing high levels of work-related anxiety and stress felt compelled to conceal their struggles. Workers lacking in access to or the knowledge of good support systems and supervision were the most likely to suffer from burnout and other risk factors. The researchers found a vicious cycle of job-related issues affecting marital satisfaction, resulting in

marital conflicts negatively impacting job satisfaction.

The Social Work Policy Institute (2011) found supervision to be a key element in both the success and retention of workers. A variety of high expectations are placed upon supervisors, such as culturally-competent practice, the transmission of evidence-based practices, and addressing staff retention. However, fulfilling all of these roles simultaneously in real-world practice appears to be difficult and perhaps unfeasible. Therefore, if a supervisor is unable to fulfill these roles, the case managers beneath them will likely struggle to deliver quality services and ultimately remain in the field.

Unfortunately, the literature concerning the motivations behind child welfare work cannot be deemed extensive or exhaustive. The realities workers are experiencing will likely continue to receive more attention as an increasing emphasis is placed upon methods to recruit and keep workers. To reiterate the goal of this study, there is a need for an increased awareness as to why workers are both drawn to and remain within the child welfare field. In doing so, outside workers may be inspired to investigate a career in child welfare, while more awareness may be raised concerning the realities contemporary workers are facing. Agencies also may use the information to reach out to new workers and help retain ongoing workers. Perhaps most importantly, current workers may be encouraged to reflect upon the deeper reasons for which they entered the field.

METHODS

Participants

The present study used a convenience sample of child welfare workers ($N = 6$). To be eligible for participation, workers had to be currently employed as a case manager for their state's respective child welfare department. Study participants were not offered incentives for participating. The research was approved by the university's Institutional Review Board. Participants' gender is not disclosed so as to further protect their anonymity.

All workers who agreed to participate in this study were interviewed. Participants represent work on both the assessment and ongoing phases of child welfare case management. All individuals invited to participate were employed as Family Case Managers within a central region in the state of Indiana.

Measures

The instrument used to collect data for the present study was a seven-point questionnaire. This questionnaire was used by the researcher to interview study participants. The questionnaire was designed with the specific intention of protecting both worker and client confidentiality.

Procedures

Participants were interviewed by the researcher via the use of the instrument. Following an invitation to participate in the study, consenting participants scheduled a time to speak with the researcher that would be most convenient for the participant's schedule. Participants were offered the opportunity to participate through either a phone or face-to-face interview.

While conducting the interviews, the researcher reaffirmed the importance of confidentiality and asked participants to state whether or not they felt comfortable speaking in confidence in their current situation. Interviews began after each participant had given verbal consent. Participants were free to stop the interview at any point during the process.

RESULTS

1) How did you first come to learn of the child welfare field?

Participants' responses primarily centered on having some sort of prior contact with a child welfare worker. Some participants came to learn of the field via personal experiences as a child, while others came to know of child welfare work due to the issues experienced by their adult siblings. Participants also learned of case management opportunities in child welfare through engagement with other professions in a previous job setting. Workers may have been service providers or played a different role in the system, leading them to either be intrigued by or recommended to the child welfare field. One participant stated: "I was a service provider prior to coming to the state. I didn't know much about [the agency]. I purposefully went after my bachelor's so I could be a family case manager with [the agency]."

2) Was there a specific moment that caused you to feel "drawn" to the child welfare field? If not, was there some culmination of moments or experiences?

Participants mainly focused on their experiences as new workers in the child welfare field. A challenging moment during training, the first engagement with a family, or the first successful closure of a case seemed to give the participants inspiration to reaffirm their decision to work in child welfare. The participants described moments of clarity that validated the time, effort, and emotion they had invested in the job. Childhood experiences were also named as a compelling force to enter the child welfare field. Stated one participant: "Since I was a kid I've been interested in social work, although of course I didn't know what it was called back then. My dad is a drug addict, and so there were a lot of experiences and traumas that drew me to the field. My mom was a victim of domestic violence, so that's how I made it here." Participants seemed inspired to take action due to their personal experiences with neglect and abuse.

3) What has been your proudest moment as a Family Case Manager?

Participants exhibited two main sets of responses to this question. Some participants spoke of cherishing small victories, as they are often the only visible changes workers can witness in the field. This seemed to be especially the case for assessment-oriented workers, as they are only with families for a brief window of time as they determine whether the families need to be involved with the agency or not. One assessment worker described this, saying: "Celebrating the

small stuff; seeing growth and small changes within parents, kids making improvements. Since I'm at the assessment phase I unfortunately don't get to see a lot of the happy endings; so holding onto the small things."

On the other hand, participants also shared stories of proud moments where they were able to witness a family truly overcoming their various challenges and issues. One participant stated: "When I did my first removal, the mom had hit rock-bottom; she was heavily addicted, very sick, and her life was falling apart. Little by little, I watched her put her life back together. The day the court reunified that family was one of the best days of my life." Participants were honored to play a role in these individuals' triumphs and at times were sincerely thanked by their clients. Still other participants were proud to have a sense of "saving" a child or adult family member from an abusive situation. Instances of domestic violence and sexual abuse were described as being particularly difficult to overcome, with witnesses and survivors often being very hesitant to reveal any information concerning their abuser. In these instances, participants were particularly proud of situations where they were able to help an individual or family "escape" an abuser.

4) What has been your most trying experience as a Family Case Manager?

Participants named a number of frustrations centering on a lack of time, resources, and client motivation. Several stated they felt the demands of the job, including extensive paperwork, constant yet brief meetings with clients, and massive caseloads, were seemingly impossible to meet within the standard timeframes governed by respective department policies. This was a major source of frustration for several participants, as they felt their potential impact for change within families was diminished by these administrative tasks.

One participant went into great detail about the struggle to balance their home and professional lives. "The most trying part of child welfare would be the secondary trauma and the burnout. There's no ability to turn it off. Even the individuals with the best boundaries still have trouble turning it off. When you're at home on the weekends or on vacation, the phone always rings, and I feel guilty about turning my phone off. If you have a worker that isn't wondering if someone might need something, I feel like I would be questioning why they aren't doing those things." This participant hinted at the guilt workers may face if they take time off, even for the brief period of one afternoon. Additionally, workers often struggle to process the sort of difficult life experiences their clients are going through. In turn, workers may begin to assume the burdens their clients face as their own.

Concerning client engagement, participants described the challenge of working with unmotivated clients. A child welfare department's involvement in a family's life is always time-limited, and for true client buy-in to take place the individuals must be open to making major life changes. Workers seemed to feel guilty for times they were unable

to properly engage with a family as there are a variety of drastic consequences that may result. Participants stated the department may be pushed at times to either pursue a termination of parental rights or to list abuse or neglect as unsubstantiated, thus choosing between the "lesser of two evils." Workers often seem to be rushed by department policies to make concrete decisions on very limited information.

Participants also voiced serious challenges relating to secondary trauma and burnout. They seemed to be greatly distressed by serious instances they had witnessed while on the job, particularly in relation to child fatalities. One participant detailed his/her experiences with child fatalities: "The child had been left in a car and had passed; it was difficult because when I arrived the parents were still trying to process that their child was deceased, let alone handling the agency's involvement. There was another fatality that was a child that I had worked with previously; this one is difficult because I knew her when she was alive. They were difficult for different reasons; seeing the death of a three-year-old that was close to the age of my own child, versus the death of a child I had known before. It was so important for me to draw upon the support of my office family." Participants described how they processed events differently based upon their relation to the situation; meaning, whether or not they had a child at home of a similar age, had known the deceased child through a previous work-related relationship, and other personal reasons.

5) Keeping proper observation of professional confidentiality in mind, what family provided you with the most growth as a worker?

Participants were quick to point to a family that was either very challenging or particularly inspiring to work with. They described situations where a parent had reached a very low point in life, held fast by addictions or other issues, only to later rise above their life challenges and be reunited with their families. One participant described how they were inspired to take initiative: "There was a sex abuse case with three young girls, and I think it really opened my eyes to a lot of things. The things I took the liberty to learn on my own far surmounted anything I had done up to that point. I think it's important to understand what our families are going through. Sometimes I ask myself why- why would anyone do that? I think you have to dig deeper." This participant calls our attention to the need for continuous growth and increases in competency within workers.

Some participants also described families that were particularly challenging to engage in the case process. The workers attempted a variety of different intervention and interviewing strategies, but still struggled to connect with the individuals. In the end, the participants had to come to terms with the reality of these clients' situations and how they likely would struggle to cooperate with services from any worker.

6) How has your view of child welfare work changed over time?

Some participants were hesitant to provide a detailed response to this question, citing their feeling of having only worked a brief time within the field as the primary reason.

Other participants spoke candidly about both the positives and negatives of how their time within the child welfare field has impacted their view of the profession. Some participants felt the work had hardened them; whereas they initially were very sympathetic toward the parents they worked with, they now found themselves expecting more accountability from clients. This was explained by one participant as "I have hardened, and now have a less emotional reaction; I'm more empathic with the children but have a higher expectation of parents. I used to really feel bad for the parents, but now I see that they have played a big role in the situation; they need to take responsibility and really prove their ability to improve to me."

Some participants spoke of their frustrations concerning child welfare work's failure to meet their original expectations. One participant stated: "Prior to starting with [the agency] it was all rainbows and butterflies; everything was going to be wonderful, their goal is to provide permanency and safety and wellbeing for children, it's great." They went on to say: "Our cases have become numbers on a to-do list. They're not humans anymore, they're not people; they don't have real needs and real strengths because there's not time to spend with them to treat them the way they need to be treated to actually see the successes. And I would say that 100 percent of the families that succeed are doing so because they want to succeed – not because we're doing something positive for them." The participants hoped to be spending a great deal of time working one-on-one with families and playing a major role in their progress, but instead they found themselves spending most of their energy meeting requirements, completing reports, and struggling to handle their over-sized caseloads.

Nevertheless, there was a pervasive optimism present when the participants spoke of the field. Participants continue to believe they are making some sort of positive impact upon the lives of their clients. Despite concerns with the department's general structure, participants are hopeful regarding the opportunity to help children and families.

7) What aspect or aspects of child welfare work give you the greatest sensations of purpose?

Participants were virtually unanimous in their appreciation of the opportunity to play a part in the improvement of a family's well-being. Workers seem to be touched deeply by witnessing their clients' triumph over the barriers in their lives, namely in overcoming whatever obstacles they may have been facing and eventually being reunified with their families. One participant described a couple of his/her most inspiring engagements: "One of my cases that I've had during my entire time with [the agency] we filed for termination, and I really had to fight for her. When I looked at the mother I saw a young version of myself, and I always made sure to let her know that I believed in her and I believed that she could do it. We made it to reunification for trial home visit, and that was a very profound moment for me. My purpose was to see that happen- to never quit, never give up, never lose hope. I had a little gal tell me when I was a service provider that I was the first person to ever say they believed in her; and I think that's really important, because a lot of the families we work with have low self-esteem, and much of their involvement is generational and it's all they've ever known. To have someone from the outside tell them they can do it and they believe in them is so important." Participants stated that although they often struggle with the more difficult aspects of child welfare work, focusing on positive moments is key to remaining driven and invested in the work. Participants seemed to imply that a purpose-driven worker will find the most success in child welfare work.

DISCUSSION

Motivations and Barriers

After gathering and analyzing each participant's responses, it is reasonable to suggest that child welfare workers are fueled by primarily altruistic motivations. This altruism seems to be rooted in a desire to be a part of actionable change efforts to improve the lives of children and families. Workers may be inspired by the opportunity to play a significant role in improving the wellbeing of children and families. Participants were also motivated by their childhood experiences, with some having endured trauma from a young age; still others had been moved by the positive influence a caring adult had been in their young lives, seeming to encourage them to pursue a reprisal of that role for other children.

On the other hand, participants also seemed to be experiencing a great deal of pressure from their work environments. Participants repeatedly voiced concerns relative to the lack of available time they have to spend with families. Weighed-down by large caseloads and expected to complete subsequent paperwork in a timely fashion, participants seemed to feel limited.

Institutional Constraints

In addition to responding to the researcher's questioning concerning their motivations, some participants offered explanations of their struggles with the climate of their respective agencies. Participants seemed to be stressed by administrative duties, such as completing paperwork and meeting requirements while following a strict time table. Workers also voiced difficulties concerning the implementation of quality client engagement in the context of contemporary policies. Responses regarding policy could be interpreted to be the workers feeling more obligated to serve by policy than by the actual needs exhibited by their clients. Workers may feel pressured to perform "by the numbers" and potentially jeopardize client successes.

Implications and Applications to Social Work Practice
Child welfare workers must perform a variety of social work roles, and participant responses seem to highlight some of the pressures that can come from juggling a variety of roles. The risks of secondary trauma and burnout appear to have serious implications, as some participants planned to soon leave their area of the child welfare field due to the severity of these stressors. Child welfare is known as a field with particularly high burn-out and lack of retention (Sprang, Craig, & Clark, 2011). Participants felt their ability to implement social work roles was restricted by the policies and administrative requirements of their respective agencies. Based upon the responses of these participants, one could argue for a need to assess possible options for decreasing the time workers spend on administrative tasks with the goal of increasing client engagement. Such an exploration could increase the amount and quality of social work practice within the child welfare field while also speaking to the motivations present within the participants of this study.

Limitations of the Research
Although participants were able to offer in-depth responses to the questionnaire, this study is limited in generalizability. Due to the low amount of responses, this study cannot be used to speak for a broad range of workers. Additionally, participants primarily identified as female and white, limiting this study's potential application to those of other backgrounds.

Future Research
Future research on the motivations behind child welfare work could provide more breadth, depth, and support to the findings of this study. Further qualitative research with more participants could allow researchers to better-assess commonalities and recurring themes; additionally, since this study only included workers employed by the state of Indiana, future research could expand to other states and child welfare systems. Future research on this subject should also make a conscious effort to include participants of diverse backgrounds so as to take their unique experiences into account.

APPENDIX A

Research Instrument For Interviews on the Motivations behind Child Welfare Work
1. How did you first come to learn of the child welfare field?
2. Was there a specific moment that caused you to feel "drawn" to the child welfare field? If not, was there some culmination of moments or experiences?
3. What has been your proudest moment as a Family Case Manager?
4. What has been your most trying experience as a Family Case Manager?
5. Keeping proper observation of professional confidentiality in mind, what family provided you with the most growth as a worker?
6. How has your view of child welfare work changed over time?
7. What aspect or aspects of child welfare work give you the greatest sensations of purpose?

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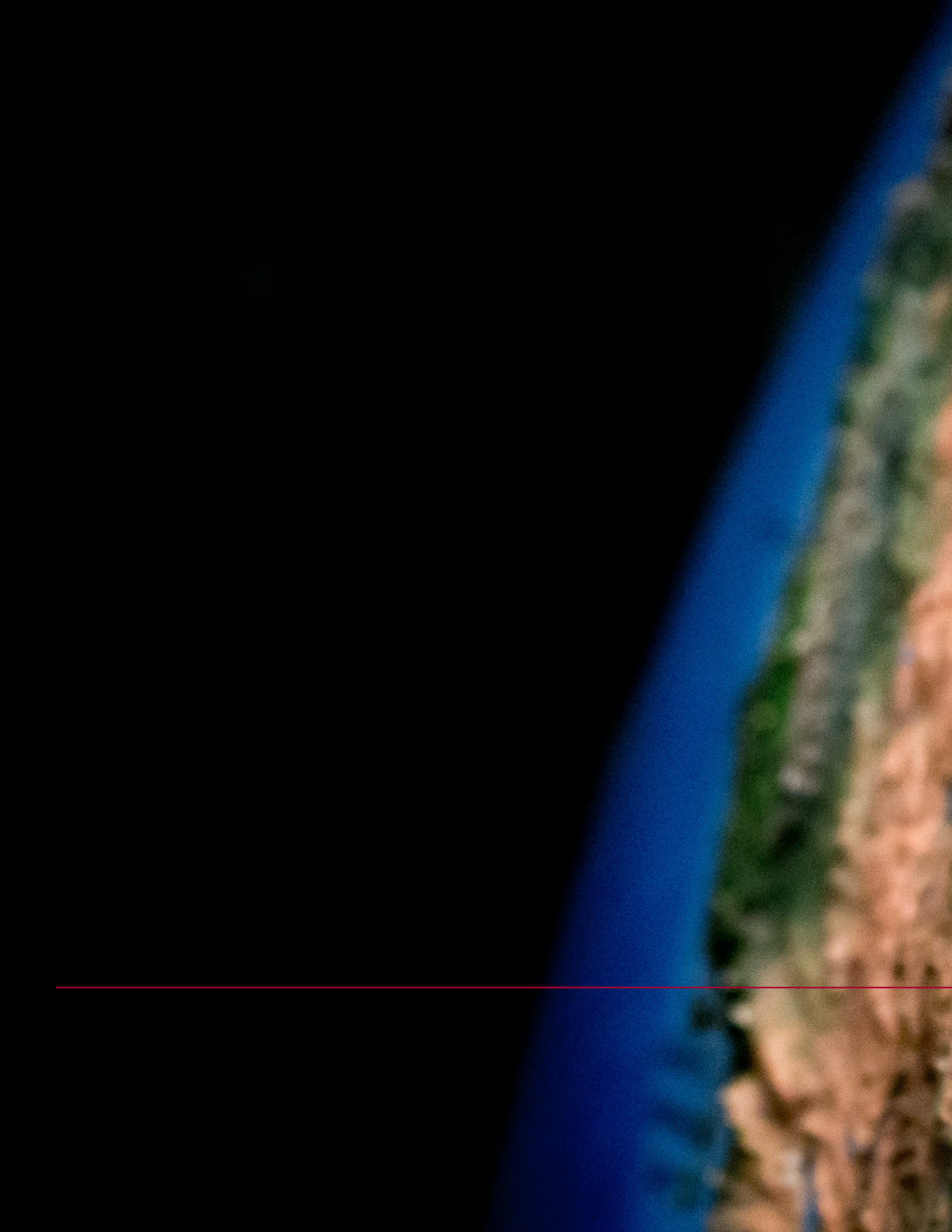
SOCIAL SCIENCES

Learning About Letters through Handwriting Practice

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ABSTRACT

The influence of visual-motor experiences with written symbols on pre-reading abilities, such as letter knowledge, have been shown to be facilitatory in both correlational studies on very young children and in experimental studies on older children. However, it is not known whether any fine-motor practice will create this benefit, whether it is specific to writing letters, or whether certain ages would benefit most from handwriting practice. Here, we hypothesized that immature fine-motor skill that produces variable forms may be crucial to the beneficial effects of handwriting training – predicting the younger children would benefit more from the training than older children. Preschool-aged children, ages three to five years, were divided into two experimental groups (letter-writing, digit-writing) in a 2x2x2 design: TIME (pre, post), AGE (younger, older), and CONDITION (letter-writing, digit-writing). Each group received six weeks of training. The letter-writing and digit-writing groups practiced writing letters (A-Z) or single digits (0-9), respectively, four times per week. Before and after the training period, each group received assessments targeting letter knowledge directly. We predicted that the younger age group, compared to the older age group, in the letter-writing condition would score significantly higher on the letter knowledge tasks at post-test than at pre-test and that this effect would not occur in the digit-writing group. Results demonstrated that the younger children did show a significantly greater improvement in letter recognition skills than the older age group, but this effect held for both the letter-and digit- writing groups. These results suggest, therefore, that any fine-motor practice at a young age can facilitate letter knowledge.

KEYWORDS: handwriting, variable exemplars, letters, symbols, perception, motor development

BACKGROUND

The ability to quickly and accurately recognize individual letters lies at the base of fluent reading ability, and fluent reading ability is foundational to academic success. However, 65 percent of U.S. children remain unable to read at a proficient level by the fourth grade, 16 percent of whom will fail to graduate high school (Hernandez, 2012; National Assessment of Educational Progress, 2013). Of all pre-reading skills, letter recognition is the strongest predictor of successful reading acquisition in fourth grade and is facilitated by experience hand-printing individual letters (James, 2010; James & Engelhardt, 2012; Longcamp, Zerbato-Poudou, & Velay, 2005; Scanlon & Vellutino, 1996; Snow, Burns, & Griffin, 1998). Surprisingly, preliterate children in typical U.S. schools spend less than twenty minutes each day on activities targeting pre-reading skills, only one minute of which is spent on handwriting activities (Pelatti, Piasta, Justice & O'Connell, 2014). Increasing the prevalence of handwriting practice in preschool curriculums may lead to earlier attainment of pre-reading skills and, in turn, facilitate successful reading acquisition.

Although we have some evidence that early handwriting facilitates pre-literacy skill, we don't know why this may occur. There are several possibilities. We have proposed two possible alternatives. The first is the possibility that the visual output of letter production when motor skills are poor results in variable instances of a named letter - the child sees their own 'messy' productions and categorizes them into a forming category (Li & James, in press). Another possibility is that the actual fine-motor skill of producing letters may serve to augment a visual representation of letters and, by virtue of efferent copies, may facilitate letter knowledge (James, 2010; James & Engelhardt, 2012; Longcamp et al., 2005).

The first idea that the variable perceptual output facilitates category learning and letter knowledge is supported by a study that showed children retain significantly more object names for a given category of objects (*e.g.*, cups) when they have experience with a variety of exemplars from that category. This indicates that experiencing within category variability (variability in exemplars) is important for children to recognize particular instances of that object category (*e.g.*, recognizing a coffee cup and a teacup as cups; Horst, Twomey & Ranson, 2013). As experience with the category increases, within-category differences become more distinct (Goldstone, 1994). So when children write letters in a different way each time, they are pairing a variety of exemplars to the presented stereotypical letter, and this pairing should increase their ability to recognize instances of that letter category over time.

Recognizing letters is a perceptual task that requires an ability to discriminate between perceptually similar letter categories (*e.g.*, T vs. P). Writing and viewing a variety of symbols within a category has been shown to increase recognition. Visually studying examples of a target symbol category in variable fonts (*e.g.*, Ψ) has been shown to improve recognition more than visually studying a target symbol category in only one stereotypical font (Li & James, in press). In this study, across six conditions, only the participants in conditions that practice variable fonts showed improvement, regardless of whether they practiced motor productions or visual perception. This suggests that the variable output produced during early handwriting may be the key to the facilitatory effects that this manual skill has on letter knowledge.

The second idea that any task that involves visual and motor systems will facilitate learning is supported by research suggesting that manual manipulation may be a particularly

effective pathway to object knowledge (James & Gauthier, 2006; Longcamp et al., 2005; Longcamp, Anton, Roth & Velay, 2003; Molfese, Beswick, Molnar & Jacobi-Vessels, 2006). Symbols (*e.g.*, letters or digits) are a unique object type that are very rarely manipulated manually, except in the specific case of handwriting when symbols are formed feature-by-feature. Studies have also shown that letter perception tasks activate brain regions that are also known to be activated in letter-writing tasks, suggesting that practicing with visuo-motor integration, such as handwriting, can later activate both visual and motor systems when only visual stimuli is present. This is potentially because the information was encoded and retrieved through two modes (James & Gauthier, 2006; Longcamp et al., 2003). Furthermore, Molfese, Beswick, Molnar, & Jacobi-Vessels (2006) found a correlation between quality of produced letters during early printing and letter naming scores in preschool children who were just learning to understand letters.

In an experimental study, Longcamp, Zerbato-Poudou, & Velay (2005) investigated how motor practice affected letter learning and found that handwriting practice led to a greater increase in letter recognition ability over typing practice. Children were divided into three experimental groups: letter-writing, letter-typing and letter-visual. Note that typing letters restricts the visual experience of the letter category to the single exemplar on the keypad, whereas printing offers children the perception of variable category exemplars (*i.e.*, messy letters). Children were also divided into three age groups from three to five years: older, middle, and younger. After three weeks of training, the older letter-writing group improved the most in letter recognition compared to the typing or visual training groups. The authors suggested that the younger children did not have enough motor development to copy the letters accurately enough to benefit recognition.

This interpretation presents a conundrum: if variability is good for category learning and if the younger children produced more variable instances of letters due to their immature motor systems, then why did only the older children benefit from the training? One hypothesis is that the younger age group required more practice during training: perhaps the benefit of learning variable exemplars of a category requires that the learner view a wide variety of exemplars during learning. An alternate explanation is that the younger children's productions were simply too variable for them to extract commonalities among their productions. The category learning literature supports this interpretation as too much variability is not helpful if the learner cannot extract common features (Horst et al., 2013; Goldston, Medin & Gentner, 1991; Twomey & Horst, 2011; Twomey, Ranson & Horst, 2013).

Therefore, although letter writing facilitates letter knowledge in older children, we do not know whether this effect is due to younger children producing too much variability in their letter productions due to their immature motor control or whether the younger age group simply requires additional training. This study sought to address this issue by increasing the training time in younger and older children to determine whether the additional training would facilitate letter recognition in the younger children.

We tested the two ideas presented above by having younger and older children learn letters and digits through handwriting practice. We address the idea that variable output may be crucial for younger children by testing both younger (messier productions) and older (neater productions) children. We also test the idea that any fine-motor skill coupled with visual perception during learning will facilitate the learning by comparing letter recognition ability in two motor training groups. This is an indirect measure of the hypothesis that stated perhaps increased fine-motor skill itself would facilitate recognition ability (Longcamp et al., 2005), and this could be achieved by digit writing as well as letter writing.

METHODS
Participants
Thirty-two children, 18 girls and 14 boys, with a mean age of 4.57 years (*SD* = 0.70) and an age range from 3.14 to 5.75 years, practiced letter-writing and digit-writing weekly for a total of six weeks. Two schools participated in this study; both are private preschools located in Bloomington, IN in which six children came from one school and 26 from the other. Both schools draw from similar, middle-to high-income households. All testing and training were conducted in the participants' schools after receiving informed consent from parents in cooperation with school administrators. All procedures were approved by the IRB at Indiana University.

Procedure
The procedure consisted of a pre-test, a training period, and a post-test. The pre-test was administered during the first week. The training period lasted from week two through week seven. During the training period, participants practiced writing 26 symbols, either letters or digits, four times per week. The post-test was given during the eighth week.

Pre-test. The pre-test consisted of three categories - letter naming, letter recognition, and letter categorization - to be used together as a composite baseline score of letter knowledge and a suite of standardized assessments to be used as descriptive measures of the motor ability and pre-literacy level in our sample. The pre-test assessments were given in two sessions: the Symbol Knowledge Testing Session and the Standardized Testing Session, each lasting 25 to 45 minutes.

Standardized testing session. Visual perception, motor coordination, visual-motor integration, phonological processing skills, and pre-literacy levels were assessed using nine standardized assessments. Three Beery-Buktenica developmental tests to assess visual-motor integration, visual perception, and motor coordination; the La Rue Reading Skills Assessment to assess letter and digit knowledge; Rhyme Awareness and Sound Awareness sub-tests of the PiPA to assess phonological skills; and the Visual Discrimination sub-test of the Bader Reading & Language Inventory to assess letter and word recognition (Bader, 1983; Beery, Buktenica, & Beery, 2010; Dodd, 2008; LaRue, 2014). The tests in this

session were not analyzed in the current study but will be used to determine the distribution of the data at the pre-test.

Letter Knowledge testing session. Four additional assessments measured letter and knowledge: letter naming, letter copying, letter recognition, and letter categorization tasks.

Letter Naming task. Participants named 26 letters in Zaner-Bloser typed font from 2.25 x 2.75 inch cards presented in a pseudo-randomized order.

Letter Recognition task. Participants performed a four-alternative forced-choice (4-AFC) task in which they were required to select a stereotypical typed letter exemplar from three other choices when presented with a variable handwritten letter exemplar. This method has been used in previous studies (James, 2010; James & Engelhardt, 2012; Longcamp, Zerbato-Poudou, & Velay, 2005). Twenty-six handwritten letters from 4.25 x 5.5 inch index cards were presented one at a time. Children were required to match the letter to one of four presented options: (1) the correct choice, which was a typed letter in Zaner-Bloser font; (2) the false choice, which was a typed pseudo-letter created by rearranging the features of the target letter; (3) another typed letter similar in shape to the correct choice; and (4) a typed mirror reversal of the correct choice. For the 11 letters that cannot be reversed (*e.g.*, M), a "matched" false choice option that was created using the same method as (2) was presented;
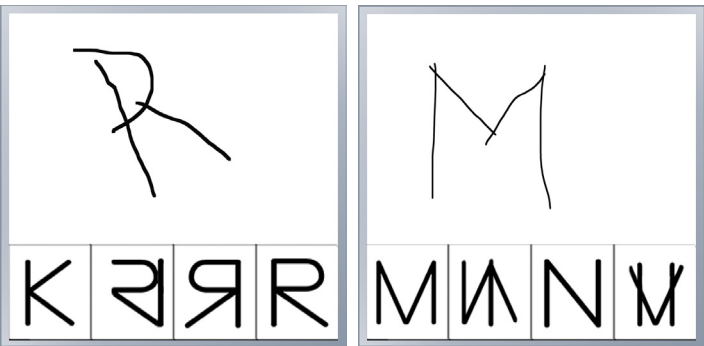

Figure 1. Sample Letter Recognition task trials. On the left is an example of a trial in the Letter Recognition task in which a reversal is included. On the right is an example of a trial in the Letter Recognition task in which a letter cannot be reversed and a "matched" false choice option is presented instead (the fourth choice).
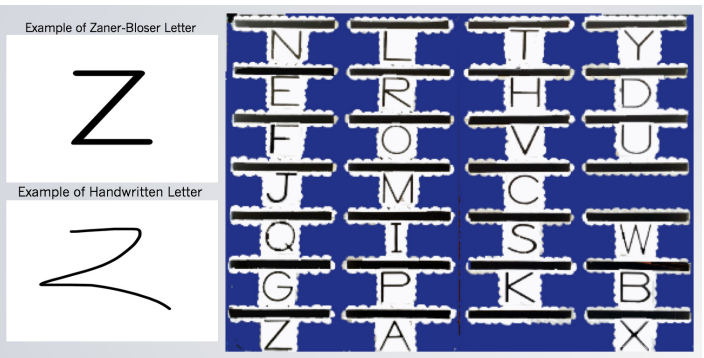

Figure 2. Depiction of the Letter Categorization task. This figure illustrates the Letter Categorization task and the two types of sorting cards: typed and handwritten.

however, the results more closely resembled the correct choice, just as the reversal would bear a closer resemblance to the correct choice than a false choice (see Figure 1).

Letter Categorization tasks. Participants sorted 26 4.25 x 5.5 inch cards, 17 with handwritten letter examples and nine with Zaner-Bloser typed letters, into a "mailbox" with 28 slots, of which 26 were labeled with letter cards in Zaner-Bloser font measuring 2.25 x 2.75 inches (see Figure 2). The extra two slots were left blank. Participants were allowed to "deliver" to those slots if they didn't know where else to place them.

The handwritten samples used in both the Letter Recognition and Letter Categorization tasks were taken from an ongoing study collecting handwriting samples from subjects ages three to five years. The quality of the handwritten sample was determined by consensus of two experimenters with an agreement of 96 percent. No subject was given the same set of handwritten samples twice and the ordering of the samples within the sets was counterbalanced between subjects.

Training. The training period began on week two and ended at week seven, lasting for a total of six weeks. To decrease experimenter time, participants completed training sessions in groups of two or three. Participants were randomly assigned to one of two experimental groups and never practiced with participants from the other experimental group.

Experimental groups. Participants were randomly assigned to one of two groups: letter-writing and digit-writing. Both training conditions wrote either single letters (A-Z) or single digits (0-9) four times each week in workbooks. Digits were repeated so that each group practiced with 26 symbols each week.

Letter-writing. Twenty-six letters were randomly divided into two sets of 13 each. Those sets were then each ordered three different ways to make three different orders for the first 13 letters (1.1, 1.2, 1.3) and three different orders for the last 13 letters (2.1, 2.2, 2.3) (see Figure 3).

Digit-writing. Each of the worksheet sets had 13 digits each. Those sets were then each ordered three different ways to make three different orders for the first 13 letters (1.1, 1.2, 1.3) and three different orders for the last 13 letters (2.1, 2.2, 2.3). All 10 digits appear once in every worksheet, and three digits were repeated (see Figure 3).

Workbooks. Symbols were presented in Zaner-Bloser typed

Set 1.1	Set 1.2	Set 1.3	Set 2.1	Set 2.2	Set 2.3	Set 1.1	Set 1.2	Set 1.3	Set 2.1	Set 2.2	Set 2.3
L	K	E	D	Q	T	8	4	7	8	1	0
A	I	P	O	R	C	2	6	3	1	0	7
M	N	U	Y	D	R	9	1	4	0	6	6
I	P	A	W	T	W	1	2	9	7	5	8
X	H	N	B	W	O	7	0	5	4	9	9
K	A	L	T	Z	S	4	5	7	6	1	2
U	X	M	Q	O	F	0	7	6	2	8	3
G	G	H	V	S	Q	6	8	1	5	2	8
N	E	K	F	B	B	3	2	8	0	7	1
O	L	J	Z	C	D	7	8	0	9	3	6
H	J	I	C	V	V	5	4	2	3	5	4
E	M	X	S	Y	Z	1	3	9	5	4	2
J	U	G	R	F	Y	3	9	3	4	6	5

Figure 3. Set orders by Set (1 or 2) and Sub-set (0.1, 0.2, 0.3) for letters and digits.
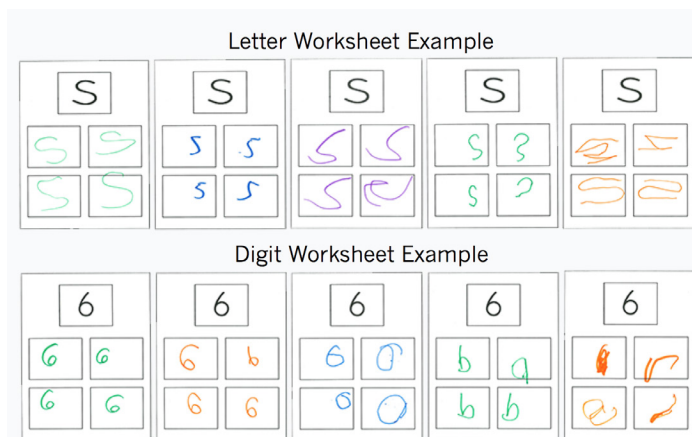
Figure 4. Examples of letter- and digit-writing worksheets.

font centered within a 3.25 x 2.75 inch box located centrally in the upper third of 8x10 inch workbook pages. Four blank 3.25 x 2.75 inch boxes were located below the typed letter, and children were asked to copy the typed exemplar above into them (see Figure 4). Each child practiced 13 symbols at each training session two times per week, so they did not become overwhelmed in a single session. There were six sets of worksheets each for the letter-writing and the digit-writing groups, two sets (set1, set2) of 13, rearranged three different ways (0.1, 0.2, 0.3) so that each child was given a different order of symbols each week (see Figure 3). Participants completed 12 worksheets (two per week) throughout the six-week training, cycling through the six sets twice throughout the training period. The worksheets were given in the same order to each subject, and the two sets were given in reverse order for the second three weeks (weeks 4-6) to avoid order effects (week 1: 1.1, 2.1; week 2: 1.2, 2.2; week 3: 1.3, 2.3; week 4: 2.1, 1.1; week 5: 2.2, 1.2; week 6: 2.3, 1.3). The experimenter pointed to the top of each worksheet and then pointed to the boxes below saying, "Make this letter (or number) in the boxes below." The experimenter never named the letters or digits.

Post-test. During the eighth week, all participants completed both the Standardized Testing Session and the Symbol Knowledge Testing Sessions again. The only difference between pre-testing and post-testing procedures is the categorization task for the letter-writing group. In the pre-test, both letter- and digit-writing groups sorted nine Zaner-Bloser typed letters and 17 handwritten letters. In the post-test, the letter-writing group sorted nine Zaner-Bloser typed letters, nine handwritten letters, and eight of their own handwritten letters produced in their last training session.

ANALYSIS

All analyses were performed with SPSS statistics® software.

Description of Sample

Sample characteristics were determined by examining the distribution of the standardized assessments and letter knowledge test scores from the pre-test session. All test scores are reported as percent correct. Scores from the Letter
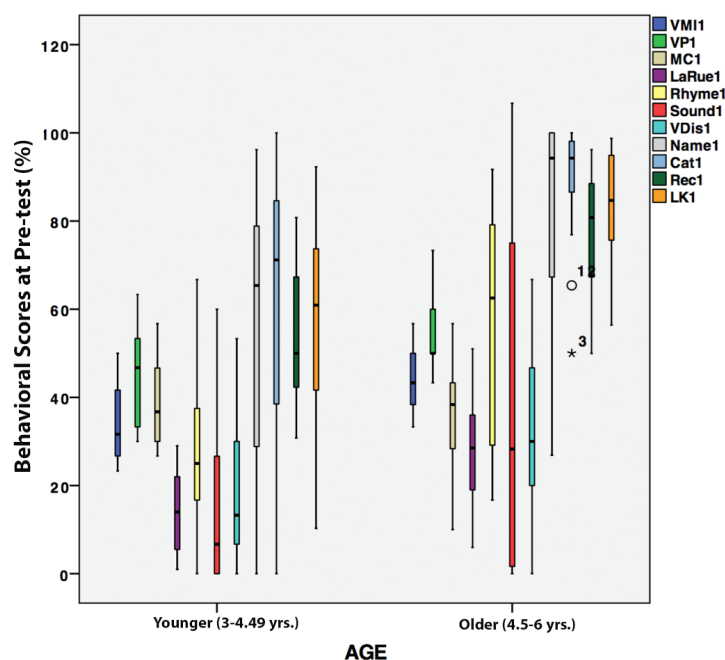

Figure 5. Box plots showing the distribution of the data in behavioral scores at pre-test by age.
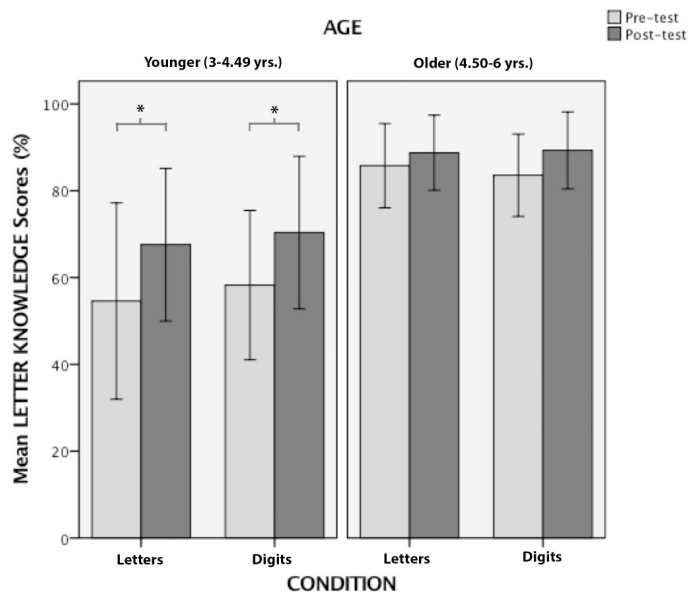

Figure 6. Bar graph showing mean letter knowledge by age and condition. Error bars indicate 95% confidence interval, and * indicates significant effect.

Naming, Letter Recognition, and Letter Categorization tasks were averaged to create the letter knowledge composite score.

We also screened for outliers by examining the spread of each of the pre-test scores about the median. Outliers were defined as data points that lie outside of the extreme bounds of the scores sampled, which was quantified as 1.5 times the inter-quartile range. This method was chosen because no assumptions are made about the distribution of the data.

Box plots were constructed for visualization purposes (see Figure 5).

Analysis of Training Effects on Letter Knowledge

We performed a 2x2x2 repeated measures ANOVA with letter knowledge as the dependent variable. Factors included TIME (pre, post), AGE (younger: 3-4.49 yrs., older: 4.5-6 yrs.), and CONDITION (letter-writing, digit-writing). Post hoc paired t-tests were performed to look into interaction effects revealed by the omnibus ANOVA. This analysis excluded any outliers found in the above outlier analysis. Bar plots were constructed for visualization purposes (see Figure 6).

RESULTS

Sample Characteristics

The younger group ($M = 3.98$, $SD = .40$) and the older group ($M = 5.16$, $SD = .41$) both included 16 participants. The letter-writing group included 17 participants ($M = 4.66$ yrs., $SD = .76$), and digit-writing group included 15 participants ($M = 4.46$ yrs., $SD = .68$). Pre-test data indicated that our sample was normally developing based on visual perception, motor coordination, visual-motor integration, phonological processing skills, and pre-literacy level. One outlier was identified in the older group. Because the outlier did not affect the results when the ANOVA was reanalyzed, we excluded it from the results reported below.

Analysis of Training Effects on Letter Knowledge

The omnibus ANOVA revealed a significant main effect for TIME, $F(1,27) = 22.80$, $p < .05$. All participants displayed greater letter knowledge at post-test ($M = 78\%$, $SD = 19\%$) than at pre-test ($M = 70\%$, $SD = 23\%$). There was a significant TIME x AGE interaction, $F(1,27) = 5.36$, $p < .05$. The younger group showed a significant increase, 13% on average, in letter knowledge over the pre-post testing periods than the older group, 4% on average (see Figure 6). There was not a significant TIME x CONDITION interaction, $F(1,27) = .071$, $p = .79$. Neither group, letter-writing nor digit-writing, improved significantly more than the other. There was no significant three-way interaction, $F(2, 21) = .27$, $p = .61$. There was also no ceiling effect in the older group because their average pre-test letter knowledge score was 84%.

DISCUSSION

We found that younger children showed a significantly higher increase in letter knowledge than older children over the course of a six-week training period, suggesting that if given more training time, younger children can benefit from fine-motor practice with symbols. However, this result was independent of the type of symbol practice (letters or digits), suggesting that any motor practice during this time period increases letter recognition.

Longcamp et al. (2005) demonstrated that practice printing letters improves letter recognition abilities more than practice typing letters in preschool-aged children; however, their results indicate that printing practice is most effective for five-year-old children with no significant improvements in the three- and four year-old children (Longcamp et al., 2005). We have suggested that practice printing letters provides children with variable exemplars of each letter category and facilitates letter recognition. In writing a letter multiple times, children create for themselves varying examples of each letter category, the variability of which narrows with experience. By this hypothesis, given enough practice, younger children should show an increase in letter recognition ability more than older children (who produce less variable forms); this idea was supported by the current study.

Importantly, experience with a narrow range of variable exemplars is different than experience with a wide range of variable exemplars, indicating that the range of variability experienced may have different effects on subsequent recognition. Narrow-range experience improves recognition and retention, whereas wide-range experience improves generalization (Twomey & Horst, 2011; Twomey et al., 2013). Object recognition is the identification of an object and is distinct from object naming, which is the ability to assign a label to an object; object retention is the ability to recognize a previously learned object after a delay period. Object generalization is the ability to identify an object as belonging to a particular object category despite deviations from the category stereotype and is typically thought to be a task requiring a more experienced perceptual system than object recognition and retention. For example, cups vary greatly in their size, shape, texture, weight, and color. Nonetheless, humans can easily tell, despite these variations, that the object is still a cup. Just as children recognize and retain more object categories after experience with variable exemplars of common handheld objects, children recognize and retain more written symbol categories after experience with variable exemplars of those symbol categories (Li & James, in press). Therefore, preschool children with little to no experience with letters should show a similar pattern in learning to recognize letters after experience with narrow-range and wide-range variable exemplars: narrow variability early on should aid recognition and retention, whereas widely varying exemplars should hamper recognition and retention in preschool children. However, the developmental progress of handwriting is such that widely varying exemplars are encountered first, the range of which decreases with experience, rendering the beneficial effect of handwriting more apparent in younger children.

Pre-literate children with immature fine motor skills produce highly variable exemplars, beyond the bounds of the narrow variability required for the acquisition and retention of categories (Twomey & Horst, 2011; Twomey et al., 2013). However, preschoolers' productions of diagnostic features are within the range of narrow variability (Beery et al., 2010). Symbols within an orthography's writing

system make use of recurrent features, such as curve, rotation, reversal, and perspective (E. Gibson, J. Gibson, Pick, & Osser, 1962). Thus, we suspect that symbol recognition is facilitated by perceptual gains for recurrent features because symbol recognition should be hampered if children are focusing on the entire symbol-form due to the extreme variability but should be facilitated if children are focusing on diagnostic features. Perhaps, the variability inherent in the experience of copying symbol forms, such as letters or digits, improves the recognition of forms within that symbol category or whether the experience improves written form recognition more broadly within that writing system.

Our finding that both letter-writing and digit-writing groups improved with training suggests that the benefit for letter recognition is not specific to the form being practiced. We consider three, not mutually exclusive, reasons for this result. First, any fine-motor practice may help children learn letters. Second, any training at all over the six-week period would facilitate letter learning. Third, recurrent features that are apparent in both digits and letters facilitate category understanding of letters. Fine-motor practice has been shown to help children better recognize letters. But will any type of fine motor practice improve letter leaning? Practice handwriting a letter has been shown to increase letter recognition in children over the more gross motor function of typing, and letter-writing has been correlated with letter naming (Longcamp, et al., 2005; Molfese et al., 2006). The current study found that digit-writing can be just as beneficial to letter knowledge as letter-writing. Would other forms of fine -motor control, other than writing symbols, aid in a similar increase in letter knowledge? Further research is required to answer this question. Perhaps the increase in letter knowledge simply stems from the duration of practice. The current study found that younger children benefit more from symbol-writing over the course of six weeks. It might be that any symbol training over six weeks of practice would yield a similar result. We are currently testing if symbol-viewing will have the same effects. The children in the symbol-viewing condition are exposed to letters or digits for the same amount of time on average so that we can compare the letter-writing, letter-viewing, digit-writing, and digit-viewing conditions to examine if any symbol practice would improve letter knowledge over six weeks.

The younger children might have outperformed the older children because the older children had no room for improvement from pre-test to post-test. However, the mean scores of the older children indicate an average of 84 percent on the pre-test, suggesting that both the younger and older groups had the capability for improvement in letter knowledge from pre-test to post-test. Another limitation of these findings is the lack of control over effort. That is, the worksheets might not have been exciting enough to maintain attention to the task. For example, children chose to scribble when they determined they did not know how to reproduce a letter. This would happen in the younger children more than the older children. If there was an effect of effort, the younger children would show less improvement than the older children; but

because we found the opposite effect, effort most likely did not affect these results. It was also difficult to control for outside practice of letters. Preschool-aged old children are constantly surrounded by letters and digits both at school and at home. We suggest that this outside practice would be distributed among all participants and would therefore not show an overall effect on the data. It should also be noted that the data analyzed here is a subset of a larger study focusing on how fine-motor practice affects letter knowledge, within which correlations among our standardized tests and results from the complete design will be assessed.

CONCLUSION AND IMPLICATIONS

This study suggests that having pre-literate children practice copying symbols before the age of four and a half will significantly improve letter knowledge. Perhaps this increased letter knowledge will aid in learning phonological sounds and future reading ability.

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Forest Economies: A Remedy to Amazonian Deforestation?

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ABSTRACT

Commonly described as the "lungs of the planet," the Amazon rainforest represents over half of the remaining rainforest in the world, constituting an important global carbon sink and one of the most culturally- and biologically-diverse regions of the world. The past half-century has seen a worrisome amount of deforestation in this rainforest, but different regions within the Amazon, however, compare differently in terms of deforestation trajectories. What has been the role of products obtained from managing forests, such as the now globally-consumed açaí palm fruit, in reverting deforestation trends? My hypothesis is that there is a statistically significant negative correlation between such forest products and extent of deforestation. This study examines, within the historical and social context of the Amazon Delta and Estuary, the relationship between açaí agroforestry and deforestation. The focus units are the *municípios* (roughly equivalent to counties) that constitute the Amazon Delta and Estuary, all located in the northern Brazilian states of Amapá and Pará. Statistical data for deforestation obtained from PRODES, a Brazilian governmental project, which monitors deforestation via satellite, is used to ascertain deforestation in the region. This dataset is then correlated with census-based production data for each município for the period from 2002 to 2012. Mapping these variables onto municípios does visually demonstrate a contrast between areas of high deforestation and high açaí production; however, the relationship is not statistically significant.

KEYWORDS: Amazon, deforestation, agroforesty, açai

Just like a mosaic, which can seem a monolithic entity when viewed from afar, but increasingly diverse when examined more closely, so too can large ecosystems house surprising diversity invisible unless studied closely. Surpassed by few in this regard is the Amazon Basin, home to a wide array of not only species, but also landscapes, cultures, and contemporary issues. Well-known and highly-publicized in association with the Amazon is its widespread deforestation: a social, environmental, and developmental concern at local, regional, and global levels. Less well-known is the extent to which deforestation differs across regions within the Amazon. In an area as vast as the Amazon, covering over 6,915,000 square kilometers (*i.e.*, the size of the continental U.S.), deforestation and conservation can and do occur simultaneously.

Deforestation trends actually vary greatly in the region, and their variability increases as the area of analysis becomes smaller (Brondízio & Moran, 2012). However, noticeable regional trends do exist. Most significant is the so-called "Arc of Deforestation" running through the eastern and southern portions of the Amazon Rainforest, where deforestation rates are at some of their highest. This phenomenon is largely due to construction of road networks that have facilitated large scale agriculture, pasture expansion, and migration to new settlements near or within the territory of the forest. Other regions, however, manifest quite different trends, demonstrating, in some cases, the potential for sustainable forest and agroforestry management. One such region is the Amazon Delta and Estuary, which enjoys a strong forest-based economy. This economy is largely based on cultivation of the açaí fruit, but also involves a variety of other forest products.

Due to this divergence from trends elsewhere in the Amazon, this study investigates the relationship between açaí fruit production in agroforestry systems and deforestation in the Amazon Delta and Estuary. Previous research demonstrates an inverse relationship between deforestation and açaí cultivation in parts of the delta-estuary (Brondízio, 2008). This study seeks to examine the presence of such a relationship at a delta-wide level. The data used is obtained from IBGE, the Brazilian Institute of Geography and Statistics, and PRODES, a Brazilian federal project monitoring deforestation via remote sensing (satellite imagery).

This article is organized in the following manner: a background section describing the geographic location of the study is followed by a review of the social and economic context of açaí cultivation. The statement of the hypothesis and an explanation of the methodology appear next, followed by the actual results and their explanation. Finally, a discussion section examines the meaning and implications of the results.

THE AMAZON RAINFOREST

The Amazon is a vast area, with territory distributed across nine countries, and one of the world's most diverse areas, not only biologically but also culturally. The Amazon Basin (*i.e.*, the total area drained by the Amazon River) covers nearly seven million square kilometers and encompasses various types of ecosystems, including savannahs, swamps, and flooded forests. The predominant ecosystem, however, in terms of territory, is rainforest, covering 5.5 million square kilometers within the basin and representing approximately half of the total rainforests remaining on Earth. Due to this fact, its existence is crucial to regulating carbon at a global level and it has historically been called the "Lungs of the Planet" ("Amazon: Lungs of the planet," 2014).

The Amazon Rainforest has been inhabited for millennia, and much evidence indicates, contrary to widespread preconceptions, that there actually existed significant human modification (or management) of the forest environment dating back far before European settlement (Balée, 2013).

In fact, the Western/modern dichotomy of "pristine" environments versus "modified," "touched," or "degraded" ones does not hold much ground here; even areas deep within the forest display signs of significant modification by indigenous populations, who modified and managed the forest to their uses while maintaining forest cover (Heckenberger et al., 2003). The Amazon Rainforest actually did not experience wide-scale deforestation until the 1970's, when colonization programs aggressively started expanding and encouraging the settlement of previously hardly accessible areas (Brondízio & Moran, 2012).

Currently, deforestation (see Figure 1) and conservation in the Amazon result from a complex web of interrelated factors, and there is no one cause or solution. Both large-scale agricultural enterprises and small-scale settlement schemes, influenced by government credit policy, impact the forest, with profitable world markets for beef and soy incentivizing the conversion of forest land to pasture or farmland. Additionally, logging operations, driven by a high domestic and worldwide demand for timber, have resulted in large swaths of both clear-cut and selectively-logged forests, which are subsequently abandoned, often not offering any economic value once the logging operation has moved on. Government policies have themselves greatly aggravated the problem through financing resettlement schemes and a bias toward large scale agriculture and cattle ranching, through building roads facilitating settlement and often environmentally harmful economic development, and through projects such as hydroelectric dams. Finally, while Brazil has one of the most sophisticated satellite monitoring systems (*e.g.*, PRODES), current lax governmental enforcement (due both to lack of political will and to lack of resources to police such a vast territory) is not sufficient to put into effect conservation laws that are in place (Butler, 2015). Although the rate at which it had been occurring has dropped since 2005, net deforestation still is present in the Amazon region and requires much further effort to be adequately addressed.

The focus area of this study is the Amazon Delta and Estuary (see Figure 2), located in the northern Brazilian states of Amapá and Pará. Sitting at the mouth of the world's largest river by discharge, the Amazon River, this area is characterized by an unusual environment containing features of both deltas (*i.e.*, islands formed from sediment) and estuaries (*i.e.*, brackish water resulting from combined seawater and freshwater). As seen in Figures 1 and 2, this region manifests lower deforestation rates than other parts of the Amazon but is vulnerable to demographic, economic, and environmental pressures.

To some extent, the lower deforestation rates in the Amazon Delta and Estuary can be explained by the region's natural characteristics. The soil and climate are not conducive to soy cultivation, and a large part of its central Marajó Island is already grassland and is used, among other things, for cattle herding. Furthermore, although (or because) the area has been inhabited for millennia and, being adjacent to the seashore, was one of the first regions of Amazonia settled by Europeans, it has historically exhibited a high and sustainable degree of human-forest coexistence, with an economy strongly characterized by a combination of forest management and agriculture (Vogt et al., 2015).

Another factor related to lower deforestation rates is the widespread small-scale production of açaí (see Figure 3). Scientifically known as *Euterpe oleracea*, açaí is a palm tree native to northern South America occurring mainly in floodplain areas. Its edible black-brown berry is an important staple food source for rural and urban inhabitants of the region (see Figure 4) and has experienced a great increase in demand in the past three decades, including national and international expansion since the 1990's. Açaí cultivation employs a sizable population and has a marked effect on the society and environment of the region. Its greatest center of production is in the Amazon Delta and Estuary, but production
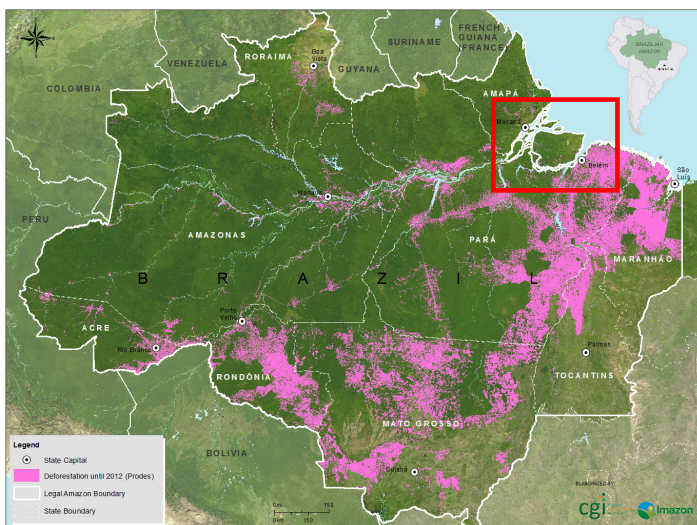

Figure 1. Deforestation in the Brazilian Amazon Rainforest. The pink areas show deforestation up to 2012; the selected area is the Amazon Delta-Estuary ("Deforestation in the Amazon accumulated by the year 2012", IMAZON).
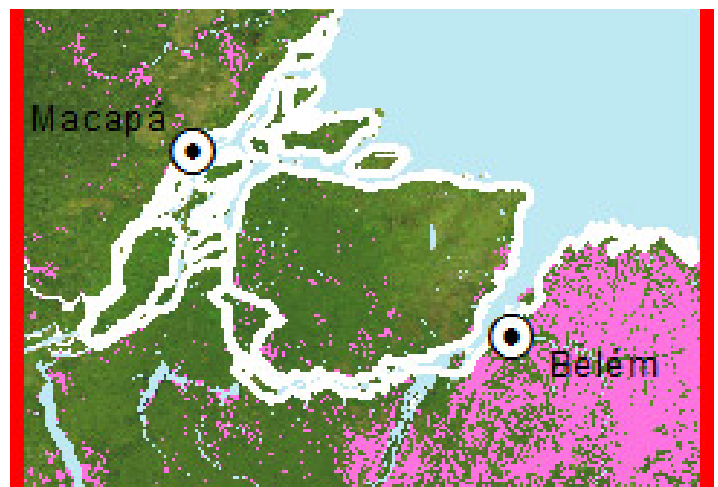

Figure 2. Deforestation in the Amazon Delta-Estuary. This figure shows the much lesser extent of deforestation in the Delta-Estuary ("Deforestation in the Amazon accumulated by the year 2012", IMAZON).

Figure 3. Euterpe oleracea (Photos E. Brondízio, various dates).

does occur in other areas throughout the Amazon, from the state of Maranhão, on the eastern edge of the Amazon, to the far western state of Acre (Instituto Brasileiro de Geografiae Estatística, 2015).

Açaí has been consumed by indigenous populations in the Amazon Delta and Estuary since pre-Columbian times, and even up to today it is strongly associated with caboclos, people of mixed European, indigenous, and African ancestry. Traditionally, as a staple food source, açaí was consumed primarily by rural populations in the region and relatively unknown elsewhere, even within other parts of Amazonia. However, with increasing urbanization starting during the 1970's, this began to change. As rural residents moved to the city, they continued their consumption of açaí obtained from the surrounding areas, introducing the berry to others as well. After the 1980's, açaí consumption was spreading to other urban areas of the Amazon. By the 1990's, açaí was venturing out of the delta-estuary region into other areas of Brazil, including the highly-urbanized and economically affluent south and southeast, and then continued further into international markets. One factor that particularly stimulated the consumption of açaí in Northern markets was its branding as a health food or even a "superfood" (see Figure 4).

Açaí cultivation, particularly in the delta, is characterized by active agroforestry and forest management techniques (Brondízio, 2008). Agroforestry encompasses a broad range of techniques combining forest management with agriculture and/or husbandry, which allows intensification and diversification of production. Specifically in açaí cultivation, where it has been very successful, agroforestry techniques include the selective pruning of branches (preventing açaí clumps from becoming too clustered, which would block sunlight), spacing of trees, and selection and arrangement of tree species in a forest garden. Açaí production does not require many inputs at the time of planting or management but is particularly labor-intensive and even dangerous at harvest, requiring climbing of the palms to cut off the berry and involving the not-uncommon risk of encountering snakes nested within açaí clumps (Brondízio, 2008).

The farmers that engage in açaí cultivation are predominantly small-scale forest farmers living in the delta-estuary region, with families often having lived in the same

Figure 4. Açaí at the market, as a staple (Photos E. Brondízio, various dates), and as a "health food" ("Landing Page").

household and engaged in the same living for generations. Many açaí producers are economically disadvantaged, often living in sharecropping arrangements on land owned by absentee landlords. Though benefiting to some extent from increasing demand for açaí, they still suffer from dependency on middlemen, the high cost of getting açaí to market in urban centers (see Figure 4), and limited opportunities to aggregate value to açaí products locally. Another obstacle facing forest farmers is their societal label as extractivists (Brondízio & Siqueira, 1997). As described earlier, there exist various federally-administered credits and subsidies aiming to promote agricultural expansion and support disadvantaged farmers. However, these programs make a key distinction between intensive and non-intensive/extractive systems, with heavy preference given to intensive ones. Due largely to lack of understanding by outside actors, including government agencies, as well as historical labels, farmers engaging in açaí production are still viewed (and largely stigmatized) as extractivists. The label "extractivist" suggests a passive role for producers obtaining resources from the forest without a significant amount of investment into it (a gross misrepresentation of their actual work), a perception which bars them from access to many types of government credit. In practice, agricultural practices promoting clear-cutting are seen to be intensive and thus enjoy easier access to funding (leading one to question the effectiveness and efficiency of governmental credit programs).

HYPOTHESIS

In an investigation on land-use change between the 1960's and the present, researchers affiliated with the CASEL center at Indiana University study two municípios in the Amazon Delta and Estuary, Mazagão and Ponta de Pedras, and demonstrate increased forest recovery in correlation with the boom in açaí, confirmed by satellite, archival, and ethnographic data (Vogt et al., 2015). Açaí production is increasing throughout the delta and estuary, but, up to now, there has been little study of this relation at the overall delta-wide level. As there are many other variables that affect deforestation and açaí production, the hypothesis of this investigation is that there is a weak, but statistically significant, negative correlation between deforestation and açaí production in the Amazon Delta and Estuary.

METHODS

This study maps açaí production trends and deforestation for the past decade (2002-2012) throughout the Amazon Delta and Estuary. Census data for volume of açaí produced is obtained from the Brazilian Institute of Geography and Statistics (IBGE), and data for yearly and cumulative deforested area is obtained from the PRODES project. Using ArcMap (GIS) software, volume of açaí and deforested territory are joined to shapefiles for municípios (administrative units roughly equivalent to counties) ($N =$ 44), also obtained from IBGE. As seen in Figures 5 and 6,

resulting images show net deforestation and average yearly açaí production for each município between 2002-2012 as a percentage of the regional total (as percentages are easier to understand than absolute numerical values but show the same relative relationships between different municípios). Differing amounts of deforestation or production volume are shown by different shades, allowing for a visual comparison of maps. The base maps were generated by Scott Hetrick (Center for the Analysis of Social-Ecological Landscapes – CASEL, at Indiana University), using maps from the University of Maryland Global Forest Change project (Hansen et al., 2014). Finally, SAS software was used to calculate the regression.

The map designating the increase in deforested area between 2002 and 2012 thus represents the total area forested before 2002 that was deforested by 2012. The map representing açaí production, on the other hand, represents for each município the average volume of açaí production over 12 years (using even years between 2002 and 2012). The reason for this difference is that volume produced can change yearly independently from previous years, while deforestation can be easily measured cumulatively.

METHODOLOGICAL LIMITATIONS

A macro-level study has several limitations. First, the use of municípios as the observation units prevents much more detailed study of local trends as there may be large variation within municípios themselves (especially for some larger municípios). However, there is no açaí data for the census-sector level (which would be ideal). Furthermore, whereas deforestation data is quite accurate (with 20 by 30 meter resolution) and updated yearly using satellite imagery, census data can be notoriously incomplete and/or inaccurate. Açaí production data are estimates at best, but this is the only data available for any quantitative study. There is no data for the different types of açaí cultivation methods (agroforestry versus plantation farming), but this difference does have environmental implications. Due to data and time restraints, this study does not take into account confounding variables such as urbanization, population, and production of other commodities such as wood and beef, which do have environmental implications, nor can it state the direction of the relationship. Finally, a total of four municípios within the delta and estuary were excluded from this study due to inconsistencies within census data.

RESULTS

This map shown in Figure 5 displays the percentage that each município listed contributes to the total production of açaí in the region, averaged over ten years. Production is on average highest on the island of Marajó (toward the center of the delta-estuary) and nearer the urban areas of Belém and Macapá.
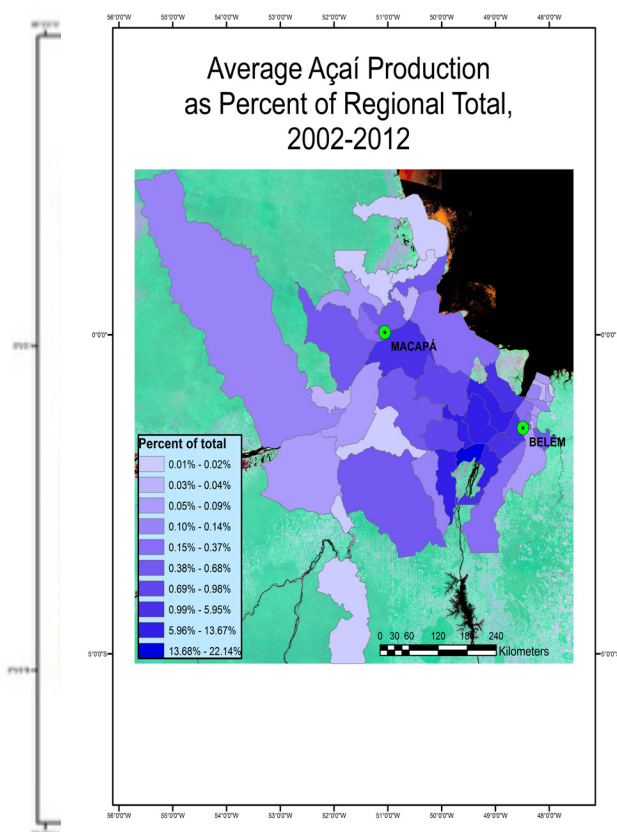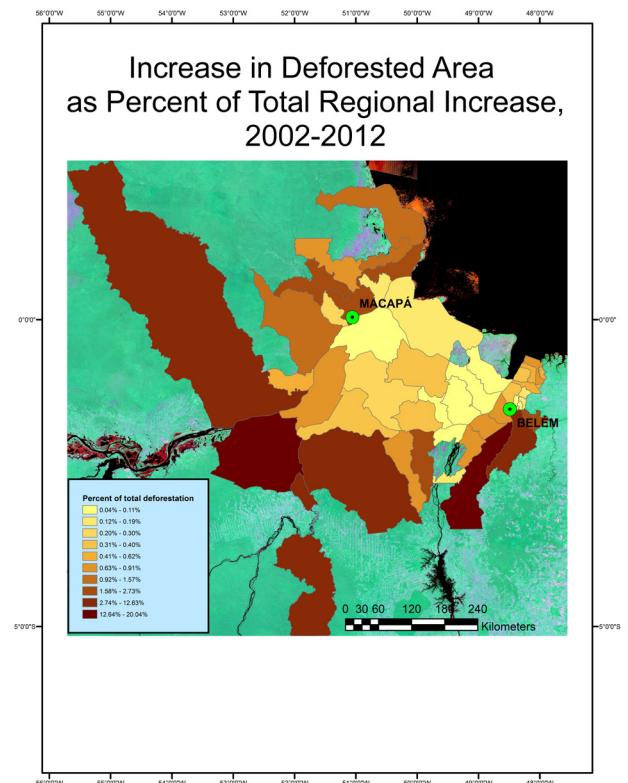

Figure 5. *Açaí* production per município.

Figure 6. Deforestation per *município*. This map shows the percentage by *município* of the total increase of deforested area between 2002 and 2012 for the entire region. There is much variation across municípios independent of size.

REGRESSION ANALYSIS

The regression analysis shown in Figure 7 plots cumulative deforestation between 2002 and 2012 against average annual açaí produced (entering deforestation is the dependent variable). Each data point represents a município. The correlation, as shown by the trend line, is slightly negative, with a slope of -0.01063. However, analysis does not demonstrate statistical significance: the R^2 value is extremely low (0.0360), and the F ratio is extremely large: 0.2170.

DISCUSSION

A side-by-side comparison of the maps allows an easy visualization of the relationship (see Figure 8). There does appear to be a negative relationship between average açaí produced and increase of deforested area. Areas with lower recorded volumes of açaí produced (shown in lighter shades on the left) tend to have higher increases in deforestation, shown by darker colors on the right. With some exceptions, there is a trend toward increasing açaí production toward the geographical center of the delta-estuary and Marajó Island, with decreasing production (and increasing deforestation) toward the periphery, in areas further from the main market hubs of Belém and Macapá. Additionally, there are higher concentrations of açaí production near urban areas (at least those indicated, Macapá and Belém); while some municípios near urban areas have experienced very high amounts of forest loss, other municípios immediately adjacent to them actually demonstrate some of the lowest rates of forest loss. However, when subjected to a statistically rigorous test, this correlation fails to hold. This result is not surprising, given the complexity of the processes involved. There are many confounding variables and factors affecting deforestation as well as açaí production, including proximity to major urban centers and topography; this complexity increases the larger the area observed becomes.

This boom in açaí contrasts starkly with a similar regional boom in heart-of-palm (also an internationally valued food commodity obtained from *Euterpe oleracea* as well as other palm trees) that occurred around the mid-twentieth century. Heart-of-palm harvesting was accompanied by unsustainable practices, often resulting in depleted forests. The açaí boom, on the other hand, has (at least in the delta-estuary region) been able to draw on traditional agroforestry knowledge, as well as its traditional status as an already-widespread rural staple. This situation poses a challenge to the paradigm of "pristineness" of nature and its desirability. Areas where significant human interaction with the environment has taken place can successfully maintain forest cover; on the other hand, once the "pristine" nature of a location ceases to be a priority and loses to economic concerns, the environment can
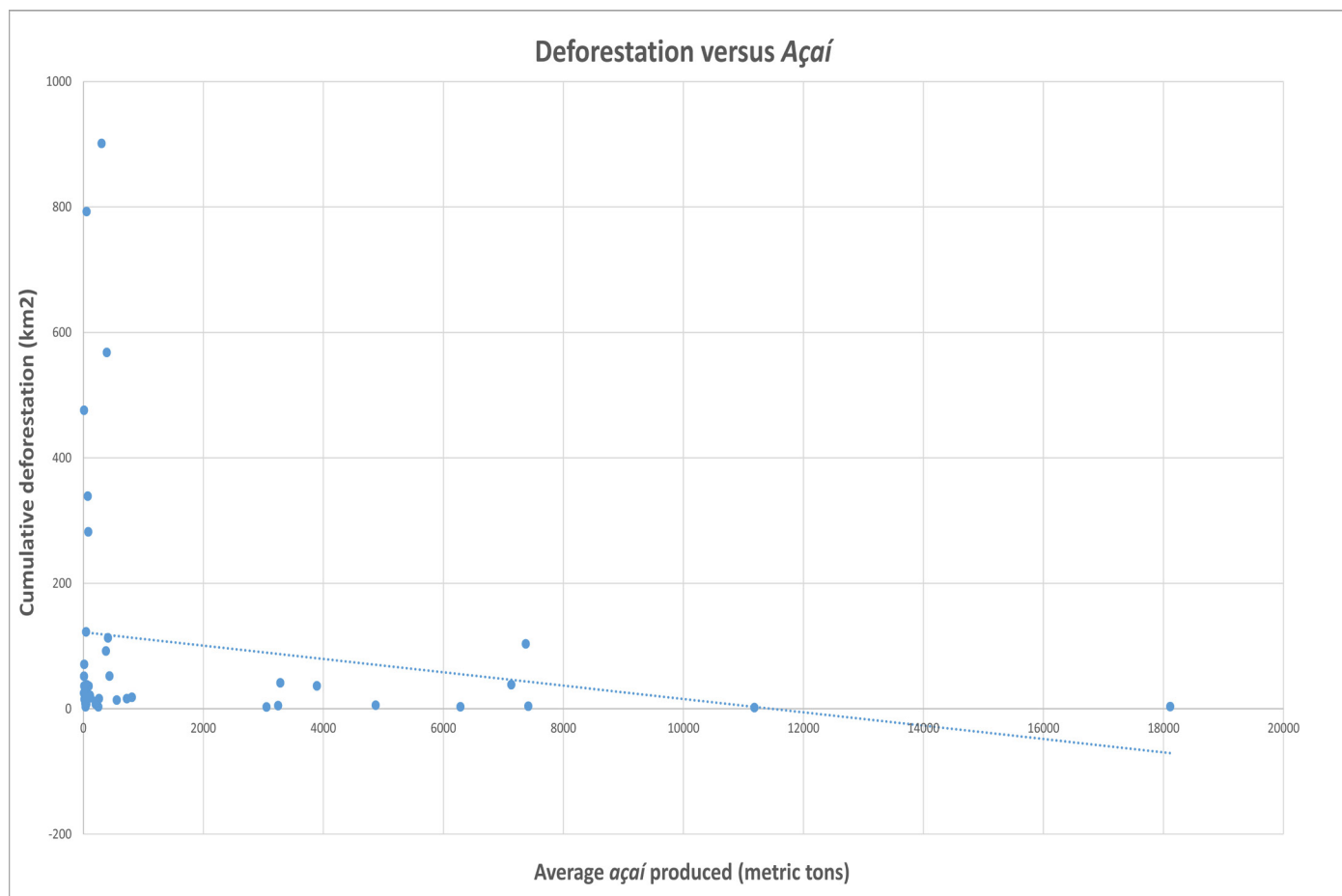

Figure 7. Regression. This scatterplot plots *açaí* produced versus cumulative deforestation for all *municípios* studied.

become quickly degraded.

No less important than environmental considerations are economic ones; to what extent is the growth of açaí agroforestry benefiting producers and local economies along with the local environment? For example, there is reason to claim that it has: increased market participation, along with technological improvements has enabled physical mobility, shortening the time it takes to reach urban centers and improving educational and medical prospects for residents of otherwise quite isolated settlements in the delta-estuary, facilitating and encouraging new networks and developing and expanding quite a complex economy (Brondízio, 2008).

However, (at least) two factors limit the benefit accrued to local communities. First, in the açaí commodity chain, the producers themselves are at the very bottom and thus have limited control over the marketing of their product. Second, açaí is still exported from the delta-estuary region either predominantly *in natura*, or depulped and frozen. This condition limits the revenue that can be generated by value-added chains. Processes such as canning of heart of palm do take place, but at a limited scale when compared to the final marketed product in large domestic markets (in other regions of Brazil) or internationally. There are instances of communities successfully engaging in further processing of the product; overall, however, an increase in

local manufacturing and processing would do much to capture additional potential value from açaí manufacturing and bring it back to the communities (Brondízio, 2008). The labeling of açaí producers as extractivists in this situation is harmful, reducing the legal and financial incentives to produce açaí (or unnecessarily placing a burden on açaí producers), something which on a legal level ought to be reconsidered for the sake of both conservation and economic equity.

CONCLUSION AND IMPLICATIONS

A spatial representation points to a likely negative correlation between deforestation and açaí, but statistically there is yet no significance to this relationship at the delta-wide level. However, further research and inclusion of additional variables could yield promising results. Potential topics for further investigation include the demographics of açaí producers (to see whether producers have increased in number, or changed in nature), and the extent to which better infrastructure has been a factor in the açaí boom. Additionally, remote sensing data could be used to more quantitatively measure the relationship between density of açaí and deforestation, allowing for a highly detailed analysis, but over a large area. The trajectory of açaí production elsewhere in the Amazon could be compared to that of the Delta and Estuary. Finally,
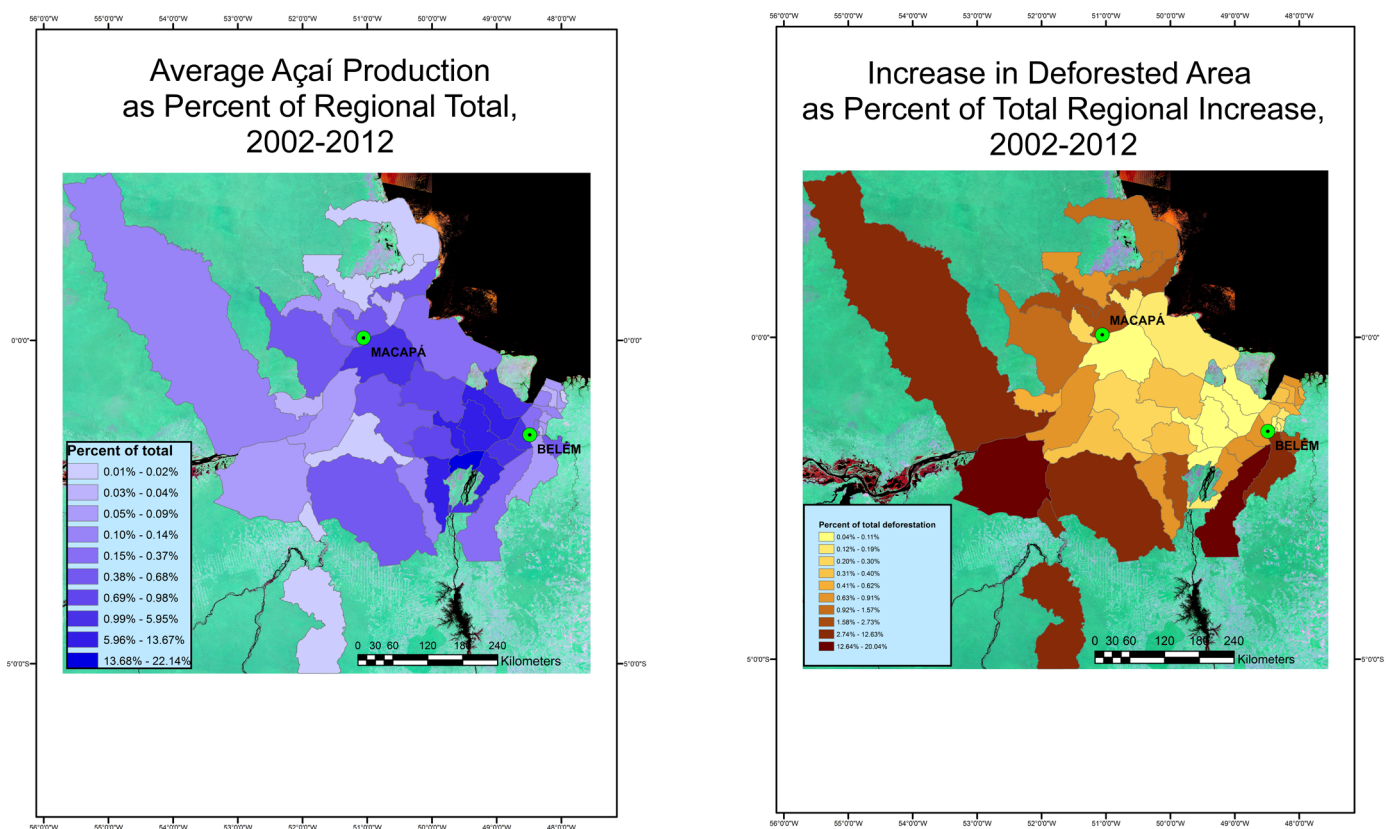

Figure 8. Visual comparison of *açaí* and deforestation.

global market trends should be studied: is this increased demand and international market likely to remain stable, or will there be an ensuing "bust"? If so, what would the ramifications be for producers—and the forest itself?

Extensive research has demonstrated the monetary and non-monetary economic value of tropical rainforests. Extractable products, such as various medicinal plants, have already proven profitable. However, ecosystem services go even further in their economic value. Especially for such a colossal entity as the Amazon Rainforest, the total monetary value of the services obtained from it is immense; just the value for the prevention of erosion has been estimated, for instance, at $238 per hectare (Verweij et al., 2009). Various economic sectors (such as agriculture throughout the region) benefit directly from, or depend on, these natural processes. However, as these prices are not included in the costs of products that detract from these natural processes (such as timber products or soy cultivated in formerly forested territory), these services are not captured in the market, thus resulting in perverse market forces that often incentivize deforestation. As açaí cultivation shows, however, this need not always be the case. In addition to products that can be commodified (such as açaí and medicinal products), there are also intergovernmental programs, such as Reducing Emissions from Deforestation and forest Degradation (REDD), that seek to revert current environmental trends by changing the underlying economic incentives, adding a monetary value to the forest. Further research should investigate other potential forest commodities and better mechanisms to capture the value of non-commodifiable ecosystem services.

Açaí is no panacea. First, as described earlier, the conditions in the Amazon Delta and Estuary, which lead to already lower incentives to deforest as well as a strong forest economy, differ significantly from those in other regions of the Amazon. Second, the advent of international açaí production has had at least one harmful side effect: an increase in açaí plantations, which bring with them many of the same problems other types of land-cover change do. Although there are no reliable statistics as to the share of plantation açaí in the total share of açaí produced, this is a concerning trend that, if left unchecked, can reverse the

Figure 9: Local *açaí* processing (Photo E. Brondízio, 2007).

environmental benefits brought about by açaí production. Finally, it remains to be seen to what extent demand for açaí will continue at its current growth. Nonetheless, the example of açaí demonstrates that integration of local economies with national and global marketplaces is possible in a largely environmentally harmonious manner and shows what factors need to be considered to do so. In turn, this example can be carried over to inform other attempts at reconciling economic growth with environmental concerns. Just as the Amazon is a mosaic, addressing deforestation in the Amazon will require a mosaic of various localized solutions; açaí may very well be one of those tiles.

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