Comparative Headstone Analysis and Photogrammetry of Cemeteries in Orange County, Florida.

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COMPARATIVE HEADSTONE ANALYSIS AND PHOTOGRAMMETRY OF CEMETERIES IN ORANGE COUNTY, FLORIDA.

by

TYRA A. ROBINSON

A thesis submitted in partial fulfillment of the requirements for the Honors in the Major Program in Anthropology in the College of Sciences and the Burnett Honors College at the University of Central Florida, Orlando, Florida

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Thesis Chair: Dr. John J. Schultz
Abstract

Headstones manifest an abundance of historic information and embody society’s cultural and socioeconomic statuses over time. Cemetery research has been conducted throughout various regions in the United States, but very little has been focused on headstone analysis in the state of Florida. The purpose of this comparative research is to use a typology established by Meyers and Schultz to compare headstone attributes of Orange County, FL and establish a temporal correlation (2012). The analysis of this study has the ability to highlight societal perceptions and ideals surrounding death and mortuary practices while providing a historical context specific to the state of Florida. Data was collected from two cemeteries in Orange County, representing the headstones of 853 individuals. The methodology of this study entailed visiting the cemeteries, photographing headstones, and noting headstone attributes. Following the model set forth in Meyers and Schultz, attributes taken into consideration for this project were stone type, shape, time period, and sex of the individual (2012). In addition to assessing headstone typology for historic cemeteries, the development of best practices for photogrammetry of headstones will be examined. The questions addressed in this research will hopefully illuminate mortuary trends in Central Florida and encourage future research and literature to shift its focus to include southern regions of the United States in terms of historical Cemetery context. Additionally, practices developed in photogrammetry can aid public archaeology conservation and restoration efforts of historic cemeteries that are endangered of being lost due to external circumstances.
DEDICATION

Granddaddy, you instilled in me the confidence to take on challenges and to be proud of the accomplishments that I’ve made thus far. I can only hope that I am making you proud while you rest in eternal peace. I miss you.

Love, Baby Girl.
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Chapter One: Introduction to Cemetery Research

Similar to many aspects of nature, death is an inevitable life event that can occur at any moment. The life that an individual has left behind can sometimes be embodied by the commemoration of their death. Cemeteries have always provided cultural contexts and serve as historical repositories that can capture the intimate details of individuals from the past. The carved details of the headstone can express a symbolic representation of the deceased, such as religious beliefs, surrounding death and resurrection, as well as socioeconomic status (Deetz, 1977). In addition to providing insight about socioeconomic status, headstones can reflect political climate such as times of war (Mallios and Casterino, 2006). Furthermore, they serve as a temporal reference to specific time periods of an individual’s existence and perspectives of that time (Meyer, 1992; Strangstad, 1995). Headstones are an aspect of cemeteries that hold significant information that can provide insight to temporal references to headstone artwork, verses or epitaphs, relationships, and so forth (Carmack, 2002; Meyer 1992; Dethlefsen and Deetz, 1966). Ergo, these headstones can serve as artifacts, some of which are well maintained while others are left in poor conditions that encourage destruction. Some of the risk factors that headstones can be exposed to include coastal erosion, vandalism, lack of maintenance and abandonment (Carmack, 2002; Greene, 2008; Meyer, 1992; Sloane, 1991; Stangstad, 1995; Yalom, 2008). Despite being an exemplary representation of culture, historic cemeteries have received poor documentation and representation throughout literature. Genealogical groups and individuals seeking to make personal family connections mostly focus on headstones without much analysis.
to offer. Most of the literature encountered has presented methods on the location of family graves and plots, along with distinctive characteristics that can aid with burial identification (Baugher and Veit 2014; Carmack 2002; Meyer 1992). Additionally, the type of gravestone representation in literature can be categorized by lengthy descriptions and 2D images. Although these representations can be helpful, there are current digital documentation methods such as photogrammetry that are being used throughout archaeology for similar purposes (Anderson, 1984; McCarthy, 2014). Photogrammetry offers a solution to the problem of preservation and can be examined as a solid method of sustainability for historical information contained within headstones. While photogrammetry may offer a solution to alternative documentation of historic cemeteries, it also has its own options to explore for data sustainability. Researching these options are an integral element to digital preservation of artifacts like headstones and should be explored to discover which options optimize most of the data.

Cemeteries as Cultural Landscapes

Cemeteries can be described as “collective representations” that provide a symbolic delineation of the living communities common beliefs and values (Warner, 1959). While simultaneously representing the living, cemeteries also serve as a material space for the dead. The material artifacts of headstones, family plots, and graves all serving to represent the individuals’ interned (Warner, 1959; Carmack, 2002; Meyer, 1992). The duality present in the essence of the cemetery, transforms it into a sacred place. One where, both the living can commemorate their loved ones by visiting, but also be reminded of the lingering presence of death by the on-going personal identities captured by material artifacts. To add an additional symbolic layer, cemeteries create a sacred space that provide a continuous cycle of agreement.
and form of understanding that the living will not let the dead embrace death because of memorialization (Warner, 1959).

As Western ideals regarding death and burials shift, the development in cemeteries also reflects this transition. Cemeteries become indicative of economic development and the funerary industry parallels this development as well (Sloane, 1991; Mallios and Casterino, 2006). Approaching cemeteries from a socioeconomic perspective highlights how private ownership and commercialization essentially re-establishes cemeteries as cultural institutions (Sloane, 1991; Yalom, 2008). Despite this re-establishment, the decline in cemeteries as a sacred place was increasing due to changes in use of cemeteries, Western customs, modern health-care, and the rise of cremation and price increases in the funerary industry (Sloane, 1991; Hijiya, 1983).

Lack of Research in Florida

Literature that is currently circulating mainly focuses on the northeastern region of the United States. Much of the research on grave markers and graveyards can be found completed in states such as New England, New Jersey, and New York (Meyer, 1992; Little, 1998). However, some efforts have been made to focus research on southern states. Diana Combs was the first to publish a southern cemetery research project, *Early Gravestone Art in Georgia and South Carolina* (Little, 1998). These efforts have continued to stretch further south including states like Texas, Georgia, and Alabama (Jordan, 1982; Booth, 1999; Westfall, 1999). While these publications capture some perspectives on mortuary practices in the southern states, they are not representative of Florida’s burial practices. *Fifteen Florida Cemeteries: Strange Tales Unearthed* (Haskins, 2011) is currently the only book that focuses its research on cemeteries located
throughout Florida. In addition to Haskins book, most recently a study conducted in Florida that focused on temporal trends of grave marker typology and headstone attributes (Reynolds, 2012).

**Research Purpose**

The goal of this comparative research is to use a typology established by Meyers and Schultz to compare headstone attributes of historic cemeteries located in Orange County, Fl. The geographical location of the sample is concentrated in central Florida in Orange County. The time frame ranges from pioneer to present. Using the headstone typology developed by Meyers and Schultz as a guide, headstone attributes that will be focused on are the stone type, shape, time period, and sex of the individual (2012). In addition to headstone analysis, the development of best practices for photogrammetry techniques based on the creation of 3D models of two headstones will be incorporated in the research project. The foci will include areas of photogrammetry that involve data acquisition and software workflow details. Finally, the development of best practices for digital curation of the headstones from this sample will be established.

**Thesis Objectives**

The objectives of this research project included analyzing cemeteries ranging from historic to modern periods in Orange County, Florida to establish:

1. A comparative analysis of headstone attributes to Meyers and Schultz study conducted in 2010.
   
   a. What frequency of stone typology is correlated to a specific time period?
   
   b. What is the frequency of marker shape is correlated to a specific time period?
c. What is the frequency for the presence of iconographic images on headstones in relation to a specific time period?

2. Development of photogrammetry techniques for headstone documentation
   a. What were some environmental factors to consider during the data acquisition process?
   b. How does use of a cell phone vs. a DSLR camera affect the quality?
   c. How was workflow determined during model building process?
   d. How was the quality of the model affected when settings were altered and then compared to each other?

3. What digital avenues are available for the dissemination of this research project?
   a. What are the available options, and do they provide the necessary fields for data sustainability?
   b. What type of data/data files should be included during the digital curation process?
Chapter Two: Comprehensive History of American Cemeteries

American burial grounds have constantly evolved since some of their earliest establishments. Drawing most of their inspiration from European traditions, American cemeteries begin to change as the number of them increase and the year’s progress (Carmack, 2002; Greene, 2008; Sloane, 1991). These movements have produced a number of types of cemeteries, from Church Graveyard to Veteran, there is a style that resonates with specific American culture and attitudes toward death. In addition to exploring cemetery typology, examining some of the logic behind headstone movements will also provide context on past American perspectives about death.

Typology of Cemeteries

Church Graveyard

This type of cemetery was one of America’s first burial grounds. The tradition was first established in Europe, where many elite individuals would be buried underneath the church floor or the church burial yard (Carmack, 2002). This interment method was carried over into America. According to David Charles Sloane, reports indicated that in 1823, “there were over 570 vaults underneath New York City Churches.” (1991) Due to overcrowding and the pungent smell of decomposition, the bodies were transferred to a new location, which lead to the creation of town cemeteries (Carmack, 2002). Property located near the outskirts of town became dedicated to future interments. However, many of these town cemeteries lacked organization in
comparison to later cemeteries. In addition to a lack of organization, due to a raising number of deceased due to epidemics such as yellow fever and smallpox, many cemeteries had coffins buried on top of each other. Often times these coffins would be a few inches from the ground surface creating an almost mound like effect (Greene, 2008).

Potter’s Fields

Class distinctions were as evident in death as they were in an individual’s waking life. Potter’s fields served as the place of internment for the poor and the homeless, orphans, illegitimate children and strangers (Greene, 2008). Even though these individuals were viewed as a lower status in society, rules were adhered to in regards to who could be buried in a potter’s field. Individuals who committed suicide and criminals were not buried in potter’s fields, due to their actions going against religious beliefs (Greene, 2008).

Rural or Garden Cemeteries

America’s attitude toward death changed from a morbid perspective on death toward recognizing the beauty of the afterlife. Garden cemeteries grew popular in the mid-1800s. These cemeteries made an effort to appear more aesthetically pleasing by emulating a park (Carmack, 2002; Greene, 2008; Sloane, 2008). The first garden cemetery, Mount Auburn Cemetery in Cambridge, Massachusetts was created by a network of paths, ponds, wetlands, foliage, and benches (Greene, 2008). These garden of graves would serve as a public park for many of the individuals living in that city and it was very common to find people enjoying a Sunday picnic or an afternoon stroll in these garden cemeteries (Carmack, 2002). Additionally, not only did the landscape of the burial grounds change but the language associated with burial grounds transformed as well.” Graveyards” and “burial places” were soon being referred to as
“cemeteries” and the names of these cemeteries began to highlight the beauty of the cultivated spaces such as “Laurel Hill (Pennsylvania, 1836), Green-Wood (New York, 1838) and Spring Grove (Ohio, 1845) (Carmack, 2002). In addition to the cultivation of beauty in death, these cemeteries also placed an emphasis on family and membership. Mount Auburn offered family plots that would be available for purchase, as well as allowing those family members to become part of the Mount Auburn Corporation (Greene, 2008). This allowed families to remain buried near their loved ones and tend their plot in whichever fashion they desired.

Veterans

Prior to the Civil War, soldiers were interred at various locations such as cemetery plots on posts and forts or even where their death occurred (Carmack, 2002; Greene, 2008; Sloane, 2008). It wasn’t until July 17th 1862, that Congress enforced legislation that permitted the government to purchase land to be used as national cemeteries (Carmack, 2002; United States Department of Veterans Affairs, 2018). The original fourteen veteran cemeteries are located throughout various parts of the U.S. While these cemeteries were located throughout the U.S, a majority of the original fourteen were established in the northeastern region of the nation. Some of the locations of the national cemeteries are Alexandria, VA, Annapolis, MD, Danville, KY, and Washington, DC (Carmack, 2002; Greene, 2008; Sloane, 2008; United States Department of Veterans Affairs, 2018).
Significance of headstones

When properly documented, headstones are an exemplary artifact assemblage. Due to the nature of their design, they can withhold historic information that pertains to various topics surrounding societal values and attitudes, religious views, socio-economic status and individual demographics. While encompassing this information, headstones can also provide a temporal reference (Dethlefsen and Deetz, 1966; Strangstad, 1995). Without headstones, cemeteries would not be the cultural repositories they are and presented are a few specific reasons as to why headstones are significant for cemetery research:

1. Most of the early headstones created were crafted by part-time carvers. Many of these carvers participated in other roles in the community such as a carpenter, smiths or rope makers. Because these individuals weren’t specialists, the work that they produced is considered folk art. Folk art, in regards to cemetery research is integral to understanding trends in traditional cultural views of the interned and the living (Dethlefsen and Deetz, 1966).

2. There are plenty of instances of variation in style due to geographical influences. While the presence of stylistic differences is noticeable, most carvers adhered to designs specific for that time period. These styles were restricted by larger social attitudes toward death that were employed and exercised by Americans during that time (Dethlefsen and Deetz, 1966). These social trends are Plain Style, Death’s Head, Cherub/Angel, Urn and Willow, (Victorian) Monumentalism, and Modern Plain Style (Hijiya, 1983).
3. Headstones innately have their own chronological perimeters. Being that most of headstones are dated, temporal information can be inferred surrounding several topics that concern the purchase of the stone, erection of the stone, and internment date (Dethlefsen and Deetz, 1966; Strangstad, 1995).

4. Headstones have the potential to highlight studies focused on kinship. Historically, familial information has been associated with specific design use. These familial affiliations can be identified through the traditions used by the carver (Dethlefsen and Deetz, 1966; Carmack, 2002).

5. As mentioned above, headstones possess temporal significance due to being dated during the crafting. Temporal information such as age at death can aid with gathering demographic information about a specific population (Dethlefsen and Deetz, 1966).

6. In addition to containing a temporal reference, a significant amount of headstones are embellished with epithets and symbology. These stylistic elements embody a number of societal attitudes regarding death, religious preferences, and cultural influences near time of death and provide insight to the cultural understanding of the living (Dethlefsen and Deetz, 1966; Carmack, 2002; Meyer, 1992; Yalom, 2008).

   If cultural significance wasn’t enough, Headstones also offer information about historic trends surrounding economic and political climate. When data collected from a cemetery is compared to historical data regarding the economy in a specific time period, there is a correlation to materials selected and the style of headstone (Mallios and Casterino, 2006; Sloane, 1991). Additionally, major political influences such as WWI influenced the style of headstones selected.
Attitudes towards death once again had a major shift that celebrated honoring the dead more humbly (Mallios and Casterino, 2006).

Western Attitudes regarding death and headstone movements

Headstone styles and types were not selected randomly. As mentioned before, the selection process for commemoration was an intricate ordeal that was influenced by many factors ranging from the economy, politics, and materials available. However, despite these additional elements introduced in deathly matters, social and religious components regarding death had the most influence on headstone selection (Sloane, 1995). The five styles that will be discussed are Plain Style, Death’s Head, Cherub/Angel, Urn and Willow, Monumentalism, and Modern Plain Style (Hijiya, 1983).

Plain Style (1640-1710)

This style can mostly be observed during the time period of the mid-17th century through the early 18th century. From a technological perspective, this style thrived mostly because most colonists didn’t have the access to the tools, knowledge and income to craft elaborate headstones (Hijiya, 1983). And while these factors did influence most plain style headstone production, there are some instances of ornate headstones that are within that temporal frame. This variability can be attributed to attitudes that encompass the ideas of human beings and the human body (Hijiya, 1983). Theologically, man viewed themselves as a shadow in comparison to God and in having this perspective, their headstones reflected the humble status of mankind (Hijiya, 1983).
Additionally, many individuals believed in a stark distinction between the body and soul. The body held no significance during the transition to their final resting place, but it was the soul that was considered eternal. This societal attitude is supported by the presence of epitaphs that read “Here lies the body of…”, the headstone soon became a representation of the physical remains and not the soul (Hijiya, 1983). A final factor to consider when analyzing the use of Plain Style, are the traditional European views that were adapted by many Americans during that time. These views were that death was an inevitable part of the life cycle, and headstones were considered another task to complete (Hijiya, 1983). So to craft something ornate, would not be practical when there are plenty of other tasks that can be done.

Death’s Head (1670-1770)

The Death Head was a popular image that emerged during the late 17th century and continued through the late 18th century. The Death Head consist of a skull accompanied by a pair of wings. It is believed to be the symbolic representation that death is a fleeting experience and can occur hard and fast to anyone (Dethlefsen and Deetz, 1966; Hijiya, 1983). There are some other interpretations that support the popularity of the Death Head. These interpretations contests that the Death Head is a reminder that death is always something to be conscious about and potentially fear (Dethlefsen and Deetz, 1966; Hijiya, 1983). This hypothesis could have stemmed from the mixed anticipation of the eternal joy and horrors that accompanied by the nature of death expressed by Puritans. While the imagery can be interpreted from a literal perspective, the author provides an idea that the Death Head has the potential to resonate with the living on a intellectual level (Hijiya, 1983).
Cherub/Angel (1740-1820)

The Cherub/Angel started appearing toward the end of the Death’s Head era during the late 18th century and its usage progressed to the early 19th century. Why this style had some overlap with the Death’s Head imagery was due in part because some Cherub/Angel started off as Death’s Head and were altered to look like a Cherub/Angel (Dethlefsen and Deetz, 1966; Hijiya, 1983). Some of the earlier representations of the imagery were crafted horribly by some cravers. Conversely, some were very detailed and could easily be distinguished from other motifs due to the high level of intricacy coupled with the carver’s efforts (Dethlefsen and Deetz, 1966; Hijiya, 1983). The religious influence as to why Cherub/Angel were being used on headstones are that they are representative of heaven and are present to redeem the souls of individuals interned (Hijiya, 1983). Additionally, during this time period there was an Age of Reason, in which most Americans began to adapt a healthier attitude toward the wholesomeness of mankind and their expectations of salvation (Dethlefsen and Deetz, 1966).

Urn and Willow (1780-1850)

This Urn and Willow imagery began to appear during the late 18th century and flourished until the mid-19th century. While prevalent in American cemeteries, this imagery has a number of European Influences (Hijiya, 1983). Historically, the Weeping Willow was a 18th century European shrub that was commonly located in cemeteries. This imagery embodied the duality perspectives of psychological and philosophical concerned with death during that time period. From a literary standpoint, the Willow is a representation of the grief over death (Hijiya, 1983).
As its imagery connotes a melancholy appearance in the way it is naturally “slumped over” (Hijiya, 1983). During this time, focus was now shifted to the mourning process of death as new practices developed such as funeral services, the erection of the gravestone, and the painting or stitching of mourning pictures and the creation of elegies (Hijiya, 1983). Death had been transformed into a social phenomenon instead of a spiritual experience and the position of Death had altered wherein the relationship was no longer between man and God but the dead and the living (Hijiya, 1983). This shift occurred during the end of the Great Awakening and religious views transitioned from Puritan to Unitarianism and Methodism (Dethlefsen and Deetz, 1966). In comparison to earlier designs, stylistically, the Urn and Willow became universal and lost the essence of personalization in regards to death and memorialization during the early 19th century (Dethlefsen and Deetz, 1966).

Monumentalism (1840-1920)

Monumentalism was present during the mid-19th century and continued until the early 20th century. This style grew in popularity based on the idea that highlight the past life of a particular person was important. This idea is supported by the rise of stone motifs that represented an individual’s professional life such as a bible for preacher or a pen for a writer were increasingly incorporated on the headstone (Hijiya, 1983). Additionally, individuals began to use inspiration from other cultures in their headstone/grave marker styles. These inspirations were drawn from the Classical Roman period and Ancient Egypt.

One notable style of headstone that grew in popularity was the obelisks. The obelisk became representative of the resistance of time (Hijiya, 1983). Additionally, during this time,
geometric spheres and boxes also ascended to popularity for headstone shapes. In addition to unique shapes and personalization, size of the headstones increased tremendously. Headstones crafted during this time period have been recorded to be ten to twenty feet tall and can weigh tons (Hijiya, 1983). Similar to the Urn and Willow era, Monumentalism was retrospective but introduced an element of individuality. This allowed the dead to be commemorated in a variety of styles, shapes, and imagery. This approach to headstones only strengthen the horizontal bond between the dead and the living (Hijiya, 1983). If commemoration through elaborate headstones wasn’t enough to be a part of the living world, additional funerary customs arose that cemented the desire of the dead to become immortal. These customs included intense embalming practices and the listing of living children in funeral programs (Hijiya, 1983).

Modern Plain Style (1900-2001)

The Modern Plain Style emerged during the early 20th century and has continued into the 21st century. This stylistic period is characterized by a vast lack of ornament and minimum inscriptions. And while headstone shapes and styles were changing, so were the layout of cemeteries. Cemeteries ideology transitioned to adapt an idea that headstones should be simple and flush to ground level and many cemeteries at the time restricted the erection of vertical headstones (Hijiya, 1983). During this time period, WWI was fully in effect and the amount of deaths that occurred began to influence the way cemetery real-estate was considered (Hijiya, 1983; Mallios and Casterino, 2006).

The resurgence of the plain style is due in part to a similar attitude exhibited during the mid-17th century, death was to be expected and effort in commemoration should be a minimum
(Hijiya, 1983). Another driving force behind Modern Plain Style has some correlation the age of
death of those interned. Due to advances in medicine, people were dying at older ages and the
amount of grief felt by the living was not as intense in comparison to past time periods (Hijiya,
1983; Sloane, 1991). In addition to a reduction in grief, another contributor to this style can be
discovered in a theological context. During this time, individuals began to shift placing their
importance on earthly matters, such as man and refocusing their ideals on religious freedoms
(Hijiya, 1983). This shift even leads to the clergy occasionally protesting extravagant funerary
measures. The final influence to consider when discussing the emergence of Modern Plain Style,
is that the American population indulged in ignorance of death. Topics that surrounded the death
were becoming a taboo and did not warrant the same attention as past time periods, this
transition in attitude gave way to the use of minimalistic headstone styles (Hijiya, 1983).
Chapter 3: Methodology and Cemetery Sample

Central Florida

The selection process for the location of the cemeteries was contingent on the amount of data that would be comparable to data collected during the Meyers and Schultz study. Both Oakland and Beulah are located in Central Florida (Figure 1), paralleling similar regions of the previous study which was conducted throughout Central and Southeastern Florida. Each cemetery possessed a range in time periods dating pre 1920s up through the 2000s. With this range displayed in internment years, it allowed for a comparable temporal representation. Oakland cemetery was fairly large in size and had nearly three times the amount of headstones in comparison to Beulah. Which allowed for the reduction in sample size of number of cemeteries for the overall study.
Figure 1. Google Pro Image with pinned cemetery locations. The yellow pins note the location of Oakland and Beulah cemetery in Orange County, FL.
Data Collection

Data collection commenced summer 2017 and entailed visiting each cemetery and collecting data using a digital platform. Headstone attributes that were being analyzed were predetermined by grave maker attributes set forth by the Meyers and Schultz study conducted in 2012 (2012). Data entry of these attributes were housed in digital collection sheets created using a Google form. These digital forms documented decedent's name, birth date, death date, headstone shape, headstone material, indication of multi or single grave, iconography type, cemetery location, field notes, and image number. Out of these ten date categories, four were selected for analysis. The selected categories were death date, headstone shape, headstone material, and iconography type (presence of iconography). These responses were eventually populated in a spreadsheet for analysis purposes (Figure 2).

Figure 2. Google spreadsheet with responses from data collection sheets including headstone attributes.
Time Periods and Data Collection Guidelines

Headstones were cataloged in eleven time frames contingent on death dates, (pre-1920, 1920-1930, 1930-1940, 1940-1950, 1950-1960, 1960-1970, 1970-1980, 1980-1990, 1990-2000, 2000-2020). While Meyers and Schultz used a 20-year time frame, for the purpose of this study and to introduce refinement, this project used a 10-year time frame. With the exception of the first and last time frames, all other ranges represent a ten-year periods. Due to the current activity of the cemeteries, both the earliest (pre-1920) and latest (2000-2020) time range were consolidated in order to provide a broader temporal range in data. Guidelines established for data collection determined the number of headstones analyzed and their relation to the amount of burials. These guidelines mirrored similar guidelines to the previous study, wherein headstones that did not have a death date were not included in the data for evaluation. Additionally, burials that represented more than one individual, were counted twice in order to avoid arbitrary gender assignment based on headstone attributes. Headstone attributes used for analysis are described in the following section.

Headstone Attributes

Marker Type

The marker types presented during data collection ranged from common styles such as Upright or Ground to more obscure styles such as Obelisk or Woodmen of the World. Marker types that were encountered during data collection were noted on the data collection forms which in some cases resulted in a variety of marker types represented in a particular cemetery.
Marker Material

Marker material encountered during the data collection process held a similar variation to marker types, wherein, there was a range of materials used to create headstones expressed in particular cemeteries. That range in material included materials such as Marble, Granite, and a few other materials noted on the data collection forms.

Iconography

Iconography images were documented as they were encountered during the data collection process. The presence of the iconographic images were indicated by the category that the images could potentially have fallen under. In some cases, more than one type of category was noted on a headstone. These instances were documented on the data collection form when encountered.

Figure 3. Representative iconography observed in sample.

Figure 3A. Hobby, Oakland Cemetery.

Figure 3B. Floral, Beulah Cemetery.
Figure 4. Representative headstone shapes observed in the sample.

Figure 4A. Upright, Oakland Cemetery.

Figure 4B. Miscellaneous, Oakland Cemetery.

Figure 4C. Vault, Oakland Cemetery.

Figure 4D. Military, Oakland Cemetery.

Figure 4E. Ground, Oakland Cemetery.

Figure 4F. Cube, Oakland Cemetery.

Figure 4G. Beveled, Beulah Cemetery.

Figure 4H. Slant, Beulah Cemetery.

Figure 4I. Ledger, Beulah Cemetery.
Figure 5. Representative headstone materials observed in the sample.

Figure 5A. Granite, Beulah Cemetery.

Figure 5B. Soft Gray Granite, Beulah Cemetery.

Figure 5C. Slate, Beulah Cemetery.

Figure 5D. Marble, Oakland Cemetery.

Figure 5E. Miscellaneous, Beulah Cemetery.
Chapter 4: Individual Cemetery Results

Cemeteries were analyzed individually to determine the frequency of each headstone attribute selected for the scope of this research project (headstone type, headstone material, and presence of iconographic images). These results were grouped in their respective cemeteries. Additionally, historical information about the cemeteries along with data pertaining to the earliest and latest date of interment will be included in the following sections.

Oakland

Situated in a small quite neighborhood, Oakland cemetery is a well-maintained cemetery that is still active. The Oakland Cemetery Association, established in 1914, was created with the purpose to provide burial grounds for the members of its community and their families. Historically, families completed purchases for their plots through this organization. Currently, the Oakland Cemetery Association still maintains the Oakland cemetery and even assist with genealogical endeavors if records permit (Figure 5). There were 704 dated headstones observed for this cemetery.

Figure 6. Entrance to Oakland Cemetery and welcome signage.
Headstone Type

Oakland contained 704 dated headstones, while there was a wide variety of headstone shapes represented in the data (Table 1), Ground and Upright markers were the most observed marker type. Upright markers represented 225 headstones and was followed by Ground markers and represented 219 headstones. These two markers were consistently represented throughout all internment time periods. Beveled and Miscellaneous marker types had the least number of headstones but were represented temporally in all time periods.
Table 1. Summary of headstone types: Oakland Cemetery, Oakland, Florida.

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</thead>
<tbody>
<tr>
<td>Beveled</td>
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<td>1</td>
<td>6</td>
<td>3</td>
<td>3</td>
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<td>9</td>
<td>6</td>
<td>8</td>
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<td>4</td>
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<td>5</td>
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<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Ground</td>
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<td>6</td>
<td>12</td>
<td>11</td>
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<td>0</td>
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<td>2</td>
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<td>15</td>
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<td>5</td>
<td>5</td>
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<td>10</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
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<td>5</td>
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<td>3</td>
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<td>3</td>
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<tr>
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<td><strong>46</strong></td>
<td><strong>46</strong></td>
<td><strong>48</strong></td>
<td><strong>62</strong></td>
<td><strong>61</strong></td>
<td><strong>75</strong></td>
<td><strong>69</strong></td>
<td><strong>83</strong></td>
<td><strong>62</strong></td>
<td><strong>45</strong></td>
<td><strong>704</strong></td>
</tr>
</tbody>
</table>
Headstone Material

Headstones in the Oakland Cemetery were mostly created with Soft Gray Granite, which indicates a significant number of burials related to a later time period (Table 2). Soft Gray Granite represented 363 headstones. Followed by Marble, which represented 209 headstones. Headstones created with Granite, Slate, Limestone, Brown Sandstone, and Miscellaneous exhibited low numbers.

Table 2. Summary of headstone materials: Oakland Cemetery, Oakland, Florida.

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<th></th>
</tr>
</thead>
<tbody>
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<td>Brown Sandstone</td>
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<td>13</td>
</tr>
<tr>
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<td>0</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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</tr>
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</tr>
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<td>6</td>
<td>6</td>
<td>7</td>
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<td>0</td>
<td>5</td>
<td>2</td>
<td>3</td>
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<td>5</td>
<td>37</td>
</tr>
<tr>
<td><strong>Total (Decades)</strong></td>
<td><strong>107</strong></td>
<td><strong>46</strong></td>
<td><strong>46</strong></td>
<td><strong>48</strong></td>
<td><strong>62</strong></td>
<td><strong>61</strong></td>
<td><strong>75</strong></td>
<td><strong>69</strong></td>
<td><strong>83</strong></td>
<td><strong>62</strong></td>
<td><strong>45</strong></td>
<td><strong>704</strong></td>
</tr>
</tbody>
</table>

Iconographic Images

The presence of iconography can be noted throughout all time periods but was heavily represented by headstones with death dates pre-1920s and 1990-1999 (Table 3). Additionally, for time frame of pre-1920s, high instances of iconography display a strong correlation with headstone attributes: Marble and Upright. The correlation can be inferred from the overlap of these three headstone attributes being consistently observed in that time period. Conversely,
iconography recorded for the time frame of 1990-1999 display a correlation with headstone attributes: Soft Gray Granite and Ground. And while underrepresented in the total number of burials, time periods that displayed the least amount of iconography were 1920-1929, 1930-1939, 1950-1959.

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<td>327</td>
</tr>
<tr>
<td>Total (Decade)</td>
<td>107</td>
<td>46</td>
<td>46</td>
<td>48</td>
<td>62</td>
<td>61</td>
<td>75</td>
<td>69</td>
<td>83</td>
<td>62</td>
<td>45</td>
<td>704</td>
</tr>
</tbody>
</table>

Beulah
The city of Beulah began its growth as a community by the settling family, The Reaves. The Reaves travelled from the north and owned a large majority of the property within the community (Quesinberry, 2016). Additionally, the Reaves created this cemetery on private land and later donated it the Beulah Baptist Church as a free resting place for its members (Figure 6). One of the earliest burials is Andrew Jackson Dunaway, interned in 1866. He was a confederate soldier and the first mayor of Beulah. This cemetery is well maintained and under the custody of Beulah Baptist church (Quesinberry, 2016). There were 280 dated headstones observed for this cemetery.
Figure 8. Entrance to Beulah Cemetery with welcome sign.

Figure 9. Aerial photo of Beulah showing the cemetery layout. Winter Garden, FL.
Marker Type

Beulah contained 280 dated headstones, while there was a wide variety of headstone types represented in the data. Ground and Upright markers were the most observed marker type (Table 4). Both marker types were noted in all time frames, but Upright was more prevalent pre-1920s, an indication that this cemetery had more usage in earlier periods. Additionally, Ground headstones had a peak towards the middle range of time periods having the most instances in 1950-1959, 1960-1969, and 1970-1979. Vaults had the lowest numbers of all the headstone types with only two noted in Beulah during early time periods.

Table 4. Summary of headstone types: Beulah Cemetery, Winter Garden, Florida.

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</tr>
</thead>
<tbody>
<tr>
<td>Beveled</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ground</td>
<td>4</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>15</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>12</td>
<td>9</td>
<td>5</td>
<td>102</td>
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<td>2</td>
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<td>1</td>
<td>3</td>
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<td>1</td>
<td>17</td>
</tr>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Slant</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>0</td>
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<td>1</td>
<td>0</td>
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</tr>
<tr>
<td><strong>Total (Decade)</strong></td>
<td><strong>45</strong></td>
<td><strong>21</strong></td>
<td><strong>29</strong></td>
<td><strong>20</strong></td>
<td><strong>29</strong></td>
<td><strong>32</strong></td>
<td><strong>27</strong></td>
<td><strong>22</strong></td>
<td><strong>26</strong></td>
<td><strong>16</strong></td>
<td><strong>13</strong></td>
<td><strong>280</strong></td>
</tr>
</tbody>
</table>
Marker Material

Headstones in Beulah were mostly created with Soft Gray Granite, which indicates a significant number of burials related to later time periods (Table 5). Soft Gray Granite can be noted throughout all time periods, with highest number of headstones in 1960-1969 and 1990-1999. While not having the largest number of headstones created in Marble, the material still was present in all time periods. It had the most number of headstones noted in pre-1920 with 35 headstones. Conversely, headstone materials with the lowest numbers were Brown Sandstone, Slate, Granite, and Miscellaneous. These materials had a low number of headstones throughout several time periods.

Table 5. Summary of headstone materials: Beulah Cemetery, Winter Garden, Florida.

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<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
<td>5</td>
</tr>
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<td>9</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>82</td>
</tr>
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<td>22</td>
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<td>7</td>
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<td>4</td>
<td>1</td>
<td>0</td>
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<td>1</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total (Decades)</strong></td>
<td><strong>45</strong></td>
<td><strong>21</strong></td>
<td><strong>29</strong></td>
<td><strong>20</strong></td>
<td><strong>29</strong></td>
<td><strong>32</strong></td>
<td><strong>27</strong></td>
<td><strong>22</strong></td>
<td><strong>26</strong></td>
<td><strong>16</strong></td>
<td><strong>13</strong></td>
<td><strong>280</strong></td>
</tr>
</tbody>
</table>
Iconographic Images

The presence of iconography can be noted throughout all time periods but was heavily represented by headstones that were in the pre-1920s time period (Table 6). Time periods that had the lowest number of headstones containing iconography were 1920-1929, 1930-1939, and 1940-1949. There is a strong temporal correlation between the high prevalence of iconography present in relation to high number of Upright headstone shape and Marble headstone material. All three of these headstone attributes are observed the most in the pre-1920-time frame.

Table 6. Summary of the presence of Iconography: Beulah Cemetery, Winter Garden, FL.

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<td>32</td>
<td>27</td>
<td>22</td>
<td>26</td>
<td>16</td>
<td>13</td>
<td>280</td>
</tr>
</tbody>
</table>
Chapter 5: Aggregated Results

In order to assess temporal trends, data collected from the individual cemeteries were aggregated. The analysis was completed in order to highlight the frequencies of headstone attributes in correlation to specific time periods. The headstone attributes considered for this analysis consisted of: headstone type, headstone material, iconographic images. The following sections will present this information in their respective headstone attributes.

Headstone Type

While analyzing the aggregated data, there were two notable headstone types that dominated the sample (Table 7). Out of 984 headstones, Upright markers had the highest frequency consisting of 32.93% of the data collected. Followed by Ground markers with a similar frequency at 32.32%. Following Upright and Ground markers, Slant headstones comprised 10.67% of the data. The remainder of headstone types had a low frequency below 10%, Miscellaneous (7.22%), Beveled (7.22%), Ledger (3.56%), Cubed (2.44%), Military (1.93%), and Vaults (1.12%).

The data presents a high number of headstones among the Upright marker type during earlier time periods (pre-1920, 1920-1929) but as the time periods increase, with the most recent time periods, Ground markers increase in frequency (Figure 10). Temporally, Beveled, Ground, Slant, Upright, and Miscellaneous were represented throughout all time periods. Upright
headstones were mostly concentrated in pre-1920-time frame. Marginalized headstone shapes such as Cubed and Vaults exhibited a decline as time periods increased. Additionally, Vaults were the least observed headstone shape out of the entire sample with only 11 occurrences out of 984 headstones.

Table 7. Summary of aggregated results for headstone types for Oakland and Beulah cemetery.

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<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beveled</td>
<td>3</td>
<td>1</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>19</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>71</td>
<td>7.22%</td>
</tr>
<tr>
<td>Cubed</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>2.44%</td>
</tr>
<tr>
<td>Ground</td>
<td>15</td>
<td>13</td>
<td>20</td>
<td>17</td>
<td>44</td>
<td>36</td>
<td>41</td>
<td>43</td>
<td>45</td>
<td>27</td>
<td>17</td>
<td>318</td>
<td>32.32%</td>
</tr>
<tr>
<td>Ledger</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>0</td>
<td>35</td>
<td>3.56%</td>
</tr>
<tr>
<td>Military</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>19</td>
<td>1.93%</td>
</tr>
<tr>
<td>Slant</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>23</td>
<td>8</td>
<td>9</td>
<td>105</td>
<td>10.67%</td>
</tr>
<tr>
<td>Upright</td>
<td>97</td>
<td>31</td>
<td>26</td>
<td>27</td>
<td>16</td>
<td>21</td>
<td>33</td>
<td>17</td>
<td>19</td>
<td>22</td>
<td>15</td>
<td>324</td>
<td>32.93%</td>
</tr>
<tr>
<td>Vaults</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>1.12%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>27</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>9</td>
<td>77</td>
<td>7.83%</td>
</tr>
<tr>
<td><strong>Total (Decade)</strong></td>
<td>152</td>
<td>67</td>
<td>75</td>
<td>68</td>
<td>91</td>
<td>93</td>
<td>102</td>
<td>91</td>
<td>109</td>
<td>78</td>
<td>58</td>
<td>984</td>
<td></td>
</tr>
</tbody>
</table>
Figure 10. Bar Chart depicting headstone type frequency distribution for Oakland and Beulah cemetery.
Headstone Material

Temporally, the data presents an increased frequency among Marble during the time periods of Pre-1920, 1920-1929 and 1930-1939, with the highest frequency represented in the Pre-1920-time period (Table 8). Marble’s numbers decline in later time periods such as 2000 – 2009 and 2010 – 2020. As the time periods progress, the number of headstones created with Soft Gray Granite increase. The temporal frequency of Soft Gray Granite is notable in the time periods of 1950-1959, 1960-1969, 1970-1979, 1980-1989,1990-1999, and 2000-2000, with the highest frequency represented in the time period of 1990-1999. Marble, Soft Gray Granite, and Granite are the only headstone materials represented throughout all time periods. Limestone was the least observed headstone, with only 2 noted headstones out of the sample.

Soft Gray Granite had the highest number of headstones with 504 observations. Soft Gray Granite represented the overall data at 51.52% (Figure 11). Following Soft Gray Granite, Marble represented the second highest frequency at 29.57%. The other headstone materials that exhibited a low frequency below 10% were: Granite (9.45%), Miscellaneous (6.10%), Brown Sandstone (1.83%), Slate (1.32%), and Limestone (.20%).
Table 8. Summary of aggregated results for headstone materials for Oakland and Beulah cemetery.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Sandstone</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>18</td>
<td>1.83%</td>
</tr>
<tr>
<td>Limestone</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0.20%</td>
</tr>
<tr>
<td>Slate</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>1.32%</td>
</tr>
<tr>
<td>Marble</td>
<td>115</td>
<td>36</td>
<td>28</td>
<td>22</td>
<td>24</td>
<td>15</td>
<td>12</td>
<td>11</td>
<td>14</td>
<td>11</td>
<td>3</td>
<td>291</td>
<td>29.57%</td>
</tr>
<tr>
<td>Soft Gray Granite</td>
<td>17</td>
<td>18</td>
<td>25</td>
<td>28</td>
<td>50</td>
<td>68</td>
<td>66</td>
<td>62</td>
<td>84</td>
<td>49</td>
<td>40</td>
<td>507</td>
<td>51.52%</td>
</tr>
<tr>
<td>Granite</td>
<td>9</td>
<td>3</td>
<td>11</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>15</td>
<td>13</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>93</td>
<td>9.45%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>6</td>
<td>60</td>
<td>6.10%</td>
</tr>
<tr>
<td>Total (Decades)</td>
<td>152</td>
<td>67</td>
<td>75</td>
<td>68</td>
<td>91</td>
<td>93</td>
<td>102</td>
<td>91</td>
<td>109</td>
<td>78</td>
<td>58</td>
<td>984</td>
<td></td>
</tr>
</tbody>
</table>
Figure 11. Bar chart depicting headstone material frequency distribution for Oakland and Beulah cemetery.
Iconographic Images

When aggregated, the data presents that 47.66% of the headstones collected had iconography present. Temporally, headstones that were in the time period of pre-1920 such as Upright markers, contained the most iconography. Over time, this prevalence of iconography has some peaks and finally decreases during later time periods. Similar to results noted in Beulah cemetery, headstones that were in the Pre-1920-time period had 83 headstones containing iconography. By having a strong prevalence in the earliest time period, it shows a correlation to additional headstone attributes such as Marble and Upright. Headstones created in 1990-1999 were also observed to have a significant amount of iconography present, making up 63% of the headstones collected during that time period (Figure 12).

Table 9. Summary of aggregated results for presence of iconography for Oakland and Beulah Cemetery.

<table>
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<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>83</td>
<td>28</td>
<td>23</td>
<td>28</td>
<td>26</td>
<td>43</td>
<td>40</td>
<td>47</td>
<td>69</td>
<td>46</td>
<td>36</td>
<td>469</td>
<td>47.66 %</td>
</tr>
<tr>
<td>Total (Decade)</td>
<td>152</td>
<td>67</td>
<td>75</td>
<td>68</td>
<td>91</td>
<td>93</td>
<td>102</td>
<td>91</td>
<td>109</td>
<td>78</td>
<td>58</td>
<td>984</td>
<td></td>
</tr>
</tbody>
</table>
Figure 12. Bar chart depicting the presence of aggregated iconography frequency distribution for Oakland and Beulah Cemetery.
Chapter 6: Photogrammetry

Introduction

With continuous advancements in the 3D modeling realm and fruitful prospects for digital archaeology, photogrammetry has the opportunity to serve as a new form of documentation and method for presenting archaeological data to experts in the field and novice outside of the field. This technology can be more engaging and interactive than traditional images and literary descriptions (Bonacchi 2012; Sylaiou et al. 2009; Comptom et al., 2017). Which could prove to be useful for projects that are focused on community-based archaeological efforts that encourage involvement both from archaeologists and non-archaeologist for the purpose of producing accessible knowledge (Atalay, 2014; Haukaas and Hodgetts, 2016). Due to its recent advancements in the past decade, photogrammetry technology has broadened its potential for various applications (Haukaas and Hodgetts, 2016; McCarthy, 2014). This project aims to explore the potentiality of photogrammetry documentation capabilities in regards to cemetery research, more specifically headstones and examines areas of digital sustainability and dissemination of archaeological data.

Background

Photogrammetry can be defined as the creation of a 3D model from 2D images taken at various angles of the same object and fundamentally based on trigonometry (Azzam, 2017; Haukaas and Hodgetts, 2016; McCarthy, 2014). Historically, photogrammetry has been around for over a 100 years, with its origins being founded in the 1850s by a French army surveyor,
Aime Laussedat (McCarthy, 2014). Laussedat came to the realization that when multiple images were taken by a camera from various angles, that the measurements created by these images were relative to the dimensions of that object (Laussedat, 1854, 1859). During that time, the technique required a considerable amount of technical skill and manual calculations (McCarthy, 2014). However, as time continued, the development of photogrammetry increased. Historically, applications for photogrammetry could be found in both a military context and used by NASA (Blizard, 2014). In regards to archaeology, the technique was mostly used to approach large-scale aerial surveys of topography that included features such as crop marks (McCarthy, 2014). Even with the level of expertise that most cartographers possessed, the practice proved to be time consuming and, the benefits produced were outweighed by its cons (McCarthy, 2014).

While the older techniques of photogrammetry were receiving negative feedback from outside the community of experts, photogrammetry witnessed a substantial technological advancement during the early 1990s (McCarthy, 2014). As digital photogrammetry practices began to develop, changes were made to older techniques such replacing film with digital surrogates or trading optical trains for computers (McCarthy, 2014). In addition to these changes, digital photogrammetry began to process 3D data with pixel correlation algorithms (McCarthy, 2014). Despite these technological advancements, this technique still remained specialized and relatively expensive (Anderson, 1982; McCarthy, 2014).

Since its complete transformation from being a difficult and expensive technique to utilize, its occurrence in archaeology has increased and has been used in various applications for different purposes. Some notable projects that have undertaken the use of photogrammetry are the archaeological excavation in Belgium by the University of Ghent (De Reu et al., 2013; De
Reu et al., 2014), and in Israel by the Tell Akko Project (Penn state, the Uni of Haifa, and others) (Olson et al., 2013). Additionally, digital photogrammetry has found its way into cultural heritage projects such as the documentation of Scottish rock art (McCarthy, 2014; Ortiz et al. 2010).

Data sustainability has become a growing issue with the introduction of new technologies and the advancement of many established digital techniques. The topic has too many intricacies that providing a straightforward answer to what data sustainability is, in itself is a challenge (Richards-Rissetto and Schwerin, 2017). While this aspect of digital archaeology presents some difficulties, it generates many questions that should be evaluated and discussed for future research and projects (Clarke, 2015; Richards-Rissetto and Schwerin, 2017). Due to far-reaching scope that data sustainability can encompass, this project will focus mostly on discussions surrounding topics concerned with data management and data accessibility. In addition to these topics, dissemination practices for this project will be discussed.
Documentation of Artifacts and Workflow

Data acquisition of the headstones occurred during spring 2018. The two headstones documented exhibited different headstone attributes, which were later assessed to determine if the quality of the model would be affected. The two headstones were both Upright markers created from two different materials; Marble and Granite. While not incredibly complex in geometry, there is a size difference between the headstones. Additionally, two environmental elements were introduced during the data acquisition stage. The granite headstone was shot in partial shade, while the marble headstone was shot in direct sunlight. These measures were introduced to assess how environmental factors, such as sunlight could potentially affect the quality of the model. The final factor that will be compared between the models are the devices used to take the photos. Both headstones photos were collected with a Canon digital single lens reflex camera with a 35mm lens and an IPhone 8 plus with a 12MP wide-angle lens.

Comparably, each data set had additional parameters to ensure that the photos were taken with some guideline. While taking the photos, a 2-foot diameter was maintained, and each photo was taken 1 foot apart. This created a data set size between 40 - 70 photos, with an estimated 15-20 photos per ring (Figure 13). Due to the lighting, the aperture was adjusted accordingly to ensure that the headstone in the photo was detectable. These aperture adjustments were restricted to the Canon DSLR camera, because the iPhone is capable of automatic adjustments. The entire data acquisition process took an estimated two hours to complete. Data collected with the DSLR camera took more time to collect in comparison to data collected with the IPhone due to having to adjust the camera aperture depending on sun exposure and the direction the sunlight would shine on the headstone. Wherein, the collection time for the IPhone
would range from 15 – 20 minutes, the time frame doubled with the DSLR camera ranging from 35 – 40 minutes each headstone.

Figure 13. Camera Views setting displaying camera orientation during data acquisition with DSLR camera. There are 68 camera views noted in this model.

The photogrammetry software used in this project was Agisoft Photoscan Pro. The choice to use this software was based on a number of factors, but regarding software logistics; *Agisoft Photoscan Pro* is a reasonably intuitive program and easy to navigate (Douglas, Lin, Chodoronek, 2015; Ortiz et al. 2010). That primary characteristic coupled with unlimited photo uploading feature makes it a strong candidate for software choice for diverse archaeological projects (Azzam, 2017; Haukaas and Hodgetts, 2016). Workflow of the models followed a basic 5-step procedure that included:

1. Uploading the images
2. Aligning the photos
3. Creation of the dense point cloud
4. Creation of the mesh
5. Creation and application of texture

Adhering to this 5-step approach, streamlined the workflow process and is basic enough to allow non-archaeologists the capability to create a 3D model. During the first step, it is essential to remove extraneous images that will affect the triangulation matching process. A large majority of the multi-image photogrammetry packages use an algorithm called Scale-Invariant Feature or SIFT (Lowe, 1999) this algorithm matches features regardless of the orientation of the image (McCarthy, 2014). Once uploading and removal have been completed, the next step would be to align the photos for optimal output. While masking of photos can be achieved with the use of Photoshop, for this project to remain achievable by non-professionals and to keep it as economically feasible as possible, masking was removed from the procedure list. To replace this step and to keep the model clean and reduce processing time, extraneous points were removed using internal tools of the software. The removal of these points was executed during step two after the sparse point cloud was generated (Figure 14 and 15).
The second step of the model building process involved the use of several features under the Gradual Selection tool to better align photos and remove points that would interfere with the dense point cloud creation. During this step, the use of Reconstruction Uncertainty, Projection Accuracy, and Reproduction Error was used, and outliers were manually removed.

The third step of the process is to create the dense point cloud. The processing time of this step is impacted by the quantity of photos used to create the model. During this step, each image is compared to one another, and the number of comparisons is dependent on the pixels from the source images (McCarthy, 2014) (Figure 16 and 17). This process typically requires an extensive amount of computing power and the amount length of process time can be extended depending on setting chosen to build the model. The processing times varied within the high setting models and devices varied for this study, at the most, the longest processing time took estimate two hours to complete (Table 10).
The last two steps of the workflow was not as time-consuming as the building of the dense point cloud and could be completed within 10 minutes. For the generation of the Mesh (Figure 18 and Figure 19), the Arbitrary setting was used. Concerning this project, texture application seemed to become a crucial aspect of the model building process, because it provided the necessary aesthetic element to enhance the quality of the headstone attributes that are essential in cemetery research (Figure 20 and 21). Additionally, application of texture when closely examined displays headstone material at a sufficient quality that can be distinguished from other materials used (Figure 21 and Figure 22). Furthermore, the user can manipulate the orientation of the headstone to view at different angels that can assist with identifying headstone attribute data (Figure 22 and Figure 23).
Figure 18. Mesh of iPhone model.

Figure 19. Mesh of DSLR model.

Figure 20. Close up of DSLR model.

Figure 21. Close up of iPhone model.
Table 10. Information about the data collection process and the processing time for settings.

<table>
<thead>
<tr>
<th>Number of Cameras and Device Type</th>
<th>Data Collection Time</th>
<th>Processing Time</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>68 Cameras (Canon DSLR)</td>
<td>35 Minutes</td>
<td>2 hours</td>
<td>High</td>
</tr>
<tr>
<td>63 Cameras (iPhone)</td>
<td>15 Minutes</td>
<td>1 hour 45 Minutes</td>
<td>High</td>
</tr>
</tbody>
</table>

Figure 20. DSLR model with texture on high setting.

Figure 21. iPhone model with texture on high setting.
Dissemination and Data Management

While 3D modeling has a considerable amount to offer regarding engaging the public and introducing the collaborative efforts of non-archaeologist to projects (De Reu et al. 2013; Koller, Frischer, and Humphreys 2010). There are aspects of digital archaeology that have to be considered when engaging in these practices. Two of those elements in digital archaeology are dissemination and data management.

Historically, dissemination of 3D data before the advent of technological advancement was a costly venture and held the potential risk of loss of quality and data. Additionally, Internet browsers did not have the capability to show 3D files that were significantly large (Berndt et al. 2010). In addition to issues with file size, online repositories were extremely costly to create, and the maintenance of these repositories were also costly ventures (Kansa and Kansa, 2011). These limitations eventually led archaeologists to disseminate their models through digital avenues like social media platforms and video games; while uncommon in the archaeological community, these practices introduced research to a non-specialized audience (Morgan and Eve 2012; Richardson 2012). It is innovative practices like those that allowed for websites and open source software such as Sketchfab or Blender to become developed in order to openly and with minimum effort share 3D models.

For the purpose of this research project, dissemination via Sketchfab was explored, as well as the use of other social media platforms to share the 3D models created during this
project. Similar to Agisoft Photoscan Pro, the Sketchfab layout is instructive and easy to navigate. Users can create a free account and start to upload their files immediately. One of the major positives about this website is its integration with every major 3D creation tool and its compatibility with every internet browser and the majority of VR headsets on the market (Sketchfab, 2018). With this level of integration, the website hosts a community with over 1 million creators from all disciplines including Archaeology (Sketchfab, 2018).

The uploading process of two high setting headstones started with exploring which file format would be ideal for dissemination. Sketchfab allows the user to choose between an individual file format such as .fbx, .obj, .blend, or .stl or a file that contains additional materials stored in a .zip, .Rar, or .7z. Each type of file format has its own properties that benefit different 3D projects and various ways. To obtain the results that best suited the models created, a .zip file comprised of an obj. and PNG. file formats were uploaded to Sketchfab. Combing the two file formats were necessary, as the obj. File provided the 3D geometric landscape of the model and the PNG. created the texture of the headstone. Additionally, the uploading time for each file was an estimate 2-4 minutes. The user should be cognizant that processing time will be contingent on a number of elements such computational power, the strength of online connection, and the size of files being used (Table 11).

Table 11. File Formats and Size for each model uploaded to Sketchfab.

<table>
<thead>
<tr>
<th>Model and Device type</th>
<th>File Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft Gray Granite on high shot with DSLR</td>
<td>.OBJ(3,267 KB) and .PNG(21,614 KB)</td>
</tr>
<tr>
<td>Marble on high shot with IPhone</td>
<td>.OBJ(5,752 KB) and .PNG(20,532 KB)</td>
</tr>
</tbody>
</table>
Once uploading has been completed, the user is given the ability to add descriptive information about the model and increase discoverability of the project via the website.

There are additional options available that give the user access to disseminate their work on other social media platforms such as Facebook. This option has the potential to increase engagement from communities outside of non-specialized population in regards to 3D archaeology. Another platform used in this project was Instagram. Although not a common digital platform to host 3D models, its usage was to explore the just how far-reaching social media platforms can be regarding engaging non-specialized communities. Models that were uploaded to Sketchfab were recorded for ten secs and placed in a poll to assess which model looked the best per the viewer’s choice. Each model was built on high setting; the significant differences were the headstone materials and the device it was taken with. Option A was the model created with a DSLR and Option B was the model created with an iPhone. The results (Figure 24) were interesting but were of no surprise due to the extremely high quality of model created with the DSLR.
In regards to data management, *Agisoft* projects, .OBJ, and .PNG files were stored on a server that was provided by the Geospatial Technologies Cluster Research Space at UCF. This institutional server was useful for storing the large files generated by the program but does not offer remote accessibility outside of the lab. This was not a pressing issue, considering that there was only one person working on the project. The raw data of these models were stored on an SD card and an external hard drive. Again, these forms of storage did not provide the greatest range of accessibility but were able to store a sustainable amount of data with little to no maintenance.

![Figure 22. Results of Instagram poll regarding model preference. Option A was the model created using data from the DSLR camera and Option B was the model created with data using the IPhone.](image)
Chapter 8: Discussion, Conclusions, and Future Research

Variation in Headstone Attributes Over Time

Headstones serve as the ideal artifact for mortuary studies due to their nature of being located in the same place that they were created and originally fixed (Strangstad, 1995; Dethlefsen and Deetz, 1966). One of the more pressing issues with historic cemeteries is preservation (Carmack, 2002; Greene, 2008; Meyer, 1992; Sloane, 1991; Strangstad, 1995; Yalom, 2008). Regarding Florida, continued efforts should be allocated toward more documentation of headstones that are high-risk form mechanism of destruction such as vandalism, neglect, and development. While these issues are typically a greater concern for small family or community cemeteries (Carmack, 2002), larger and more established cemeteries still risk damage from natural factors such as coastal erosion and disaster like hurricanes (Reynolds, 2012). When headstones are destroyed, so is the invaluable information that accompanies it. The two cemeteries in this study were maintained fairly well and did not exhibit overgrowth. This is one of the notable differences between the Meyer and Schultz (2012) study, where two of the cemeteries (Jones Cemetery and Caraway Cemetery) were substantially neglected.

Additionally, none of the cemeteries in the current study were at the risk of vandalism. Conversely, one cemetery in the 2012 study, Washington Memorial Cemetery, was susceptible to vandalism (Reynolds, 2012). While the cemeteries in this study were well maintained and cared for, they were not exempted from the destruction of natural disasters such as a hurricane. Some forms of damages that arise from hurricanes can be flooding and broken headstones from
fallen trees. Over the course of this research project, this form of destruction was noted. Even though it took some time, the cemeteries were eventually cleaned and observed (by their respective committees) for possible damage to headstones.

The most striking difference between the two cemeteries in this study and the previous study was the size and the proportion of those interned during later time periods. While both Beulah and Oakland possess roughly the equivalent real estate, Oakland had nearly 60% more headstones recorded than Beulah. Most of the headstones located in Beulah are concentrated near the back of the cemetery, closest to the lake’s shoreline. The layout is somewhat uncompleted and smaller sections were haphazardly created furthest from the shoreline. In contrast, the Oakland cemetery does not have much real estate remaining, and the two sections are organized by rows separated by space for cars to pass through. This form of organization optimizes the space. When these cemeteries are compared to the previous study, both Beulah and Oakland contained a significant number of headstones in comparison to 80% of the cemeteries recorded by Meyers and Schultz (2012). Most of those cemeteries that fall in that percentage exhibited more concentrations of particular styles reflective of specific styles or cultural reflections (Reynolds, 2012). Due to the size of the cemeteries used in this current study, they expressed a little more variation in headstone attributes.

Additionally, the cemeteries had differences in the proportion of graves interned in later time periods. While the typology of headstone attributes was established during the Meyers and Schultz study, included headstones that were mostly categorized by earlier time periods. The cemeteries in this study included headstones with later time periods. Oakland cemetery had a higher number of burials that were categorized by the 2010-2020-time frame than Beulah. This
could be due to a number of factors, but the main factor that could contribute to this
disproportion of headstone attributes is the activity of the cemetery. The activity of these
cemeteries can be indicative of the transition of funerary practices, such as the increased
popularity of cremation practices (Sloane, 1991). Although the time frame is not heavily
represented in both cemeteries, the inclusion of the time does provide some representation of the
stylistic periods of headstones (Carmack, 2002; Hiyija, 1983). Counter to the amount of activity
observed in this study, some of the cemeteries studied in the previous project were inactive
during the study. Inactivity of a cemetery can equally provide as much information for cemetery
research as an active one.

Furthermore, the time periods of the cemeteries varied between the two studies.
Cemeteries studied in Meyers and Schultz (2012), had headstone data falling between the time
range of 1866-2011. The data collected in the current study has a time frame from 1811-2017.
These differences in time can also influence the headstone attributes expressed in the samples.

When combined and examined as a unit, headstones have the ability to be an
assortment of ideas and perspectives specific to temporal perimeters and locations (Yalom,
2008). When aggregated, the results illuminated common trends in headstones in Central
Florida. Two of the most notable headstone attributes observed in this study are headstone type
and material. Additionally, trends related to the presence of iconography are indicative of
preferred methods in regards to memorialization and accessibility of skilled carvers. A more
detailed discussion of these headstone attributes follows.

While not all headstones contained iconography all headstone designs contain two
attributes, type and material. Throughout cemetery literature, headstone shape is the most noted
feature (Carmack, 2002; Greene, 2008; Mytum, 2000; Sloane, 2008; Strangstad, 1995).

Strikingly similar to the previous study were the aggregated results of this study. Upright markers were simultaneously the most common marker and the earliest observed. Ground markers followed as a close second, and slant markers were the third most common (Figure 7).

While there were stark differences in the sample of cemeteries used for each study, they still exhibited similarity in regards to headstone type. This provides support that selection of headstone shape is influenced by stylistic preferences established by the cultural and traditions at that time. Historically, region can have some effect on this trend, the regional differences within the state of Florida did not affect headstone type. The popularity of Upright markers during the earliest time periods is strongly correlated to the trends of that temporal reference. Being highly concentrated during pre-1920 (63%) (Figure 7), is a clear example of the Plain Style movement that occurred during the mid-17th century and early 18th century (Hijiya, 1983). With Ground as the second most noted, it follows a similar temporal trend to Upright. Where its increased usage is noted during the 1950-1959-time frame (44%), which correlates the Modern Plain Style (Hijiya, 1983). In both studies, Upright and Ground markers follow a similar trend to the current study, where both marker types are the most observed among historic cemetery samples (Figure 25).
Figure 23. Comparative bar chart depicting headstone types in this current project and the Meyers and Schultz project in 2012. Blue bars are from the Meyers and Schultz study and the red bars are from the current study.
Although a considerable amount of information can be inferred from headstone shape, headstone material can highlight temporal trends. Some notable materials observed in the sample are Marble and Soft Gray Granite. These materials had strong concentrations in specific time periods and illuminated a clear transition from one material to the other (Figure 9). Observed during the pre-1920 period, Marble represented 75% of all of the headstones, by the 1960-1969-time period, a transition occurred, and Soft Gray Granite represented 73% of the headstones. Unlike its northern counterparts, Florida experienced the material transition during a later period (Carmack, 2002). Due to Granite’s durability and technological advancements in the funerary industry, it has remained the popular material used today (Carmack, 2002; Greene, 2008; Sloane, 2008, Mallios and Casterino, 2006). In comparison to the study conducted by Meyers and Schultz, there was a similar trend observed in that sample. Not only did the time periods display similar concentrations, Granite for both studies had the similar percentage of representation (Figure 26).
Figure 24. Comparative bar chart depicting headstone material in this current project and the project completed in 2012. Blue bars are from the Meyers and Schultz study and the red bars are from the current study.
Iconography can provide a significant amount of insight into the deceased’s characteristics (Carmack, 2002; Meyer, 1992; Yalom, 2008). For the scope of this project, only the presence of iconography was observed and noted for each period. As noted by Dethlefsen and Deetz (1966), iconography created during the earliest periods could be considered folk art due to the unique qualities of the imagery which were based on the carver’s technical skills. As time progressed, the extent of the iconography imagery increased and encompassed a number of cultural areas such as religion, fraternal, occupational, and so forth (Carmack, 2002). The types of imagery were not evaluated for this study. Notable time periods that exhibited high percentages of iconography were 1990-1999 (63%) and 2010-2020 (62%) (Figure 9). Some contributing factors to consider when discussing this concentration of iconography are that because they are later time periods, equipment and technical skills of carvers have improved dramatically since past time periods (Dethlefsen and Deetz, 1966; Mallios and Casterino, 2006). Additionally, increased variety of iconography imagery coupled with the introduction of memorial photographs has some influence of the increased presence during specific time periods.
Photogrammetry: Future Directions, Data Sustainability, and Ethical Ramifications

The implications of using photogrammetry in an archaeological setting have been beneficial for a number of research projects and contract-led projects because of its low-cost and easy application (McCarthy, 2014). Now that this has been established, the use of photogrammetry should be making process in more community-based archaeology. It has the potential to engage non-expert communities and promote dissemination of knowledge about that community (Bonacchi 2012; Haukaas and Hodgetts, 2016; Sylaiou et al. 2009; Comptom et al., 2017).

When introducing the practices of 3D modeling to a community, the entire process is unveiled, and it doesn’t seem foreign to the non-specialized population engaged with the project. Additionally, when the community is involved with the model building process, it gives those individuals a level of agency that can produce results that are culturally enlightening (Haukaas and Hodgetts, 2016). Due to the intuitive nature of photogrammetry, it is easy to engage non-experts in the documentation process and allowing a “co-creation” of knowledge from both researchers and the community (Colwell-Chanthaphonp et. al. 2010; Haukass and Hodgetts, 2016). Additionally, when communities are encouraged to participate in community-research collaborations, we are able to grasp a better understanding of the accuracy of the 3D models. While this is considered an arbitrary assessment, it provides an additional level of cultural understanding between researchers and the community.

The longevity of data has become a pressing issue with the rise in popularity of photogrammetry and other 3D model methods. The need for accessible and manageable raw data is necessary for any project and for future research. At the micro level, the discussion starts with
examining file formats and determining formats that best suits the needs of the project and progressing on from there. Each file format has its pros and cons, but that type of data that needs to be preserved for the longevity of the project should be the file format of the raw data and paradata (Richards-Rissetto and Schwerin, 2017). It’s that form of data that provides the access to create 3D data, and depending on the project, the type of 3D data that needs to produce can change. Software being used also has some interplay in the type of data formats used during a project. Due to the rapid advancements in 3D technologies, thoughts should be concerned with issues of updates and newer versions that may not be compatible with old file formats (Richards-Rissetto and Schwerin, 2017).

Additionally, the data storage also needs to be carefully selected to promote long-term data preservation. There are a couple of digital repositories for researchers to consider such as tdar (https://www.tdar.org/about) or Open Context which allows user to explore options in data reuse (Kansa et al., 2014; Richards-Rissetto and Schwerin, 2017).

Another element to consider when discussing the application of photogrammetry to archaeology and community-researcher based projects are some ethical ramifications that accompany working with digital data. While dissemination is typically the ultimate goal of research projects, careful consideration should be given to the communities that are partners in that project. With technology readily available for some populations and not for others, it brings to the forefront questions that ask who has the authority over the models? What are the effects of sharing 3D replications of cultural heritage artifacts? (Haukass and Hodgetts, 2016). What these ethical questions encourage is an open dialogue between researchers and the community. When communication is well established and maintained, it allows for that community to participate in
every aspect of the research process from data acquisition to dissemination, which is an essential element of cultural heritage projects.

There are innumerable possibilities that can be explored when mortuary studies such as headstone analysis are combined with the advent of 3D technology. Together, these methods can illuminate the past lives of individuals from various cultures and socioeconomic backgrounds to provide a better understanding of historic Florida. In addition to providing clarity about the past, when used in this context, photogrammetry can perform as an educational tool. Future research that involves photogrammetry should begin to shift its trajectory to establish more standardized workflows and create a convenient form of dissemination that allows the models to provide pertinent information.
Figure 25. Burial deed for lot 187, permission provided by Mark Griffith, Oakland Cemetery Association.
APPENDIX B: Beulah Settlers.
Figure 26. Beulah Settlers, permission provided by Leslie Griffin, Beulah Baptist Church.
APPENDIX C: Data Collection Form.
Figure 27. Digital data collection sheet.
APPENDIX D: Images of wireframe mode of 3D models
Figure 28. Wireframe mode of iPhone model.

Figure 29. Wireframe model of DSLR model.
List of References


