Forensic Facial Reconstruction: Integration of Science and Art

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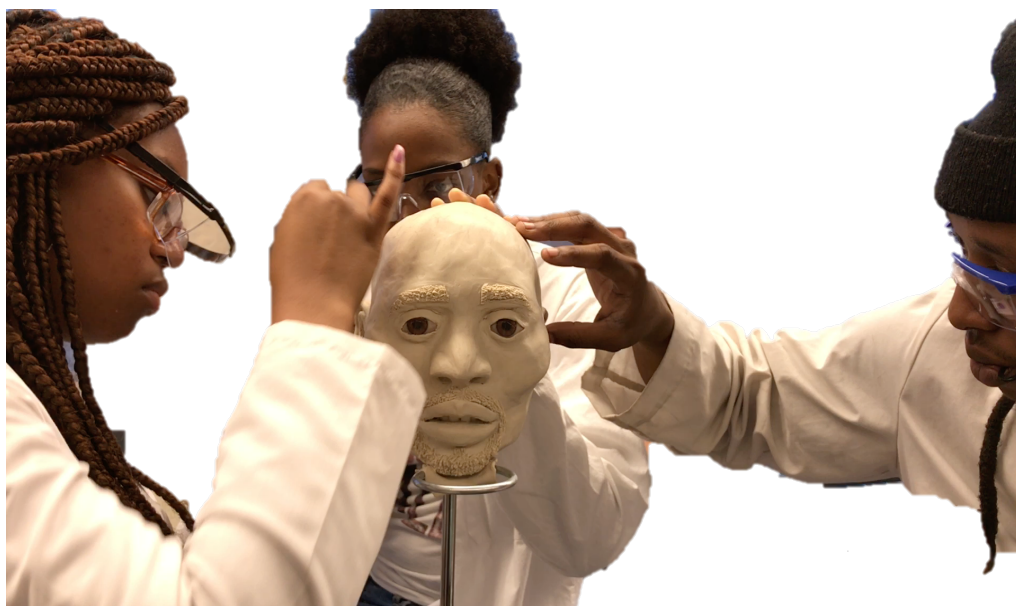Eric B. Clark
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Author Biographies

Karla-Sue C. Marriott, PhD, Full Professor, has served as PI and CoPI on NIH, NASA and NSF research projects. She currently serves as PI/PD of the NIH-NIBIB-ESTEEMED program to increase the number of underrepresented researchers pursuing a career in biomedical sciences. An active scholar, she was selected as a state of Georgia Governor's Teaching Fellow (GTF) for 2015. Dr. Marriott is the coordinator for the SSU Forensic Science Program, as well as interim-chair for the Chemistry & Forensic Science department. Dr. Marriott is a self-taught freehand painter-artist. She is very active in the Savannah community and was a 2018 TEDxSavannah speaker.

Eric B. Clark, MFA, Assistant Professor, is a ceramic sculptor with interests in combining multiple construction and finishing processes to create unique forms with an industrial aesthetic. Eric is native to Savannah, Georgia; he holds a B.F.A. from Armstrong State University under the direction of John G. Jensen; M.F.A. from Georgia Southern University under the direction of Jane Pleak and Jeff Schmuki. Eric shows work nationally and internationally, receiving numerous awards and honors. Eric has been teaching art since 2011, and he is currently teaching a variety of media as an Assistant Professor of Art at Savannah State University.

Introduction

Forensic facial reconstruction is a method used in the field of forensic science to reproduce the likeness of an individual from skeletal remains, primarily used in cases of missing or unidentified persons. We developed a facial reconstruction exercise through which students explored the integration of methodologies from the sciences and the arts, while comprehending the power and potential such blending can contribute to the practice of forensic science. Students were expected to learn pertinent anatomy and develop sufficient sculpting skills to be applied towards the reconstruction of faces from unknown skulls.

Exercise Goals

1. Explore useful integration of methods from science and art.
2. Comprehend the utility of blending science and art to the practice of forensic science.
3. Master and employ specialized artistic, as well as scientific techniques towards the development of a useful and relevant product.
4. Demonstrate competency in the management and documentation of scientific data.
5. Demonstrate harmonious teamwork with accountability.
6. Demonstrate competency in the ability to search and use scientific literature.
7. Use scientific literature to support the presentation of results.

Description of Activity

This exercise was conducted in student groups over two semesters in forensic science courses *FSCI 4401: Crime Scene 1* and *FSCI 4402: Crime Scene 2*. Students were divided into four (4) groups and provided with unknown skulls purchased from Bone Clones, incorporated. The ethnicity, sex and age of each skull was known only to the instructor, and students were asked to use their knowledge of anthropology to determine sex, ethnicity and approximate age. The entire process required an extensive scientific literature review, studying anthropology, anatomy/cranial features, mathematics, 3-D digital imagery and sculpting.
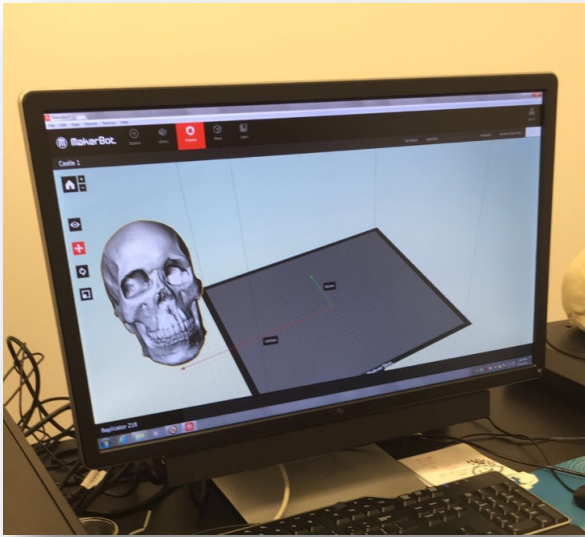
Based upon their review of the scientific literature, students agreed to apply the widely-used Manchester Method (Gupta, Sonia et al, 2015) of Richard Neave which combines the Russian and American techniques for facial reconstruction. This method involves using the detailed traces of muscle insertion on the skull to establish facial detail and form while relying on tissue thickness data (Rhine & Campbell, 1980) to model soft tissue depth.
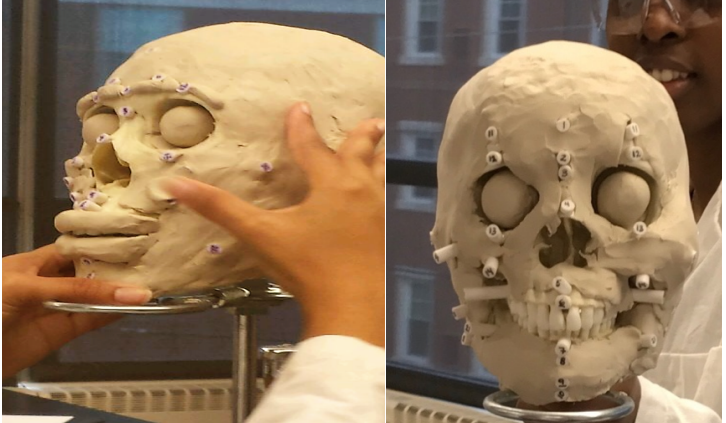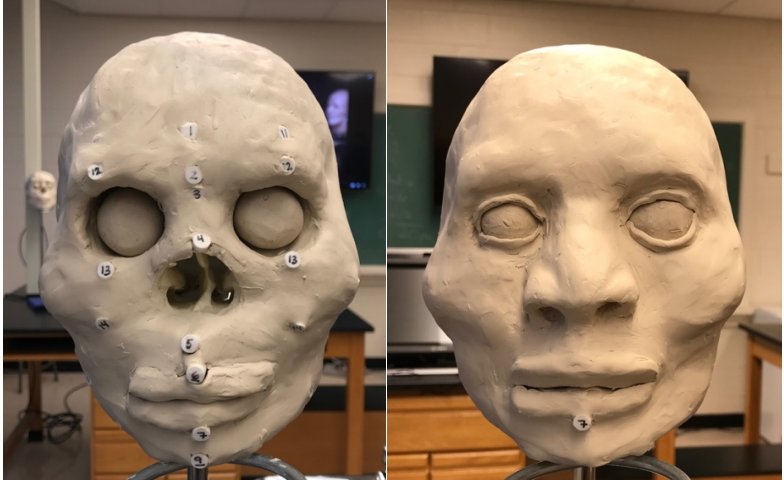
Students placed tissue depth markers on each skull to provide a blueprint before applying oil-based clay for the facial reconstructions.
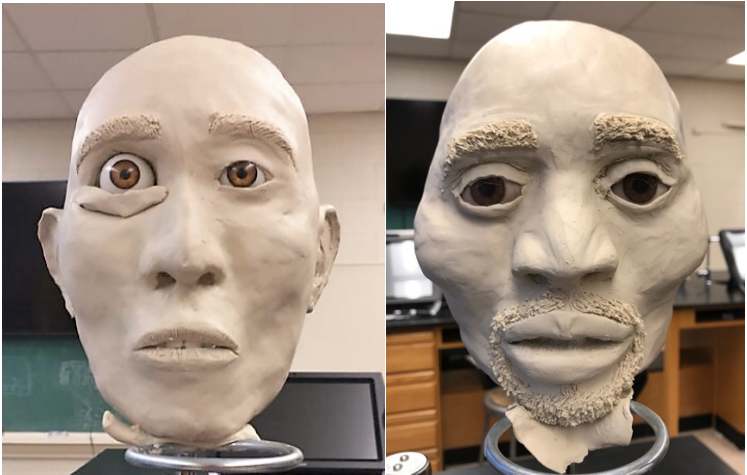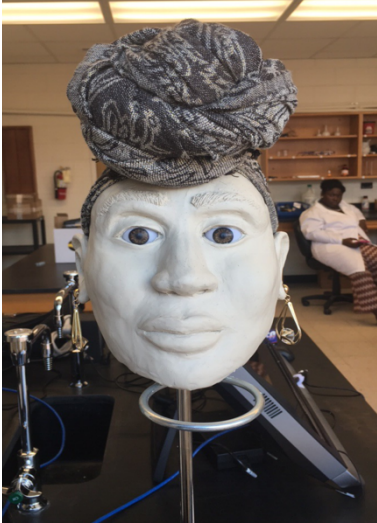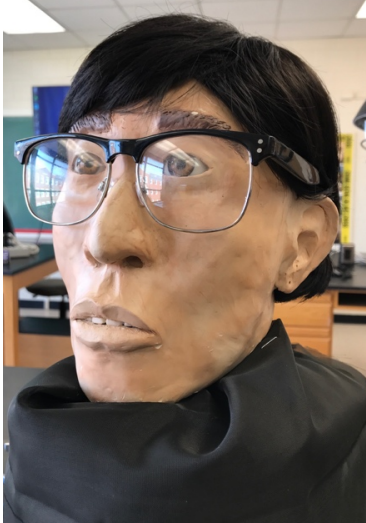
Student weekly progress is documented in the **Timeline Table** below.

Timeline with Visual Outcomes:

Weeks	Details	Visual Outcomes
1-3	Planning, literature review, reconstruction method selection (Manchester method was chosen)	

4-6	Skull examinations: age, ethnicity, and sex determinations. Teeth are also examined to indicate age and ethnicity.	
7-8	3-D laser scanning: digital record of skulls in their original state using a Makerbot Digitizer scanner.	

9-13	Learning cranial features: location and names; learning about tissue depth markers and their placement on skulls. Measurement and placement of 21 tissue depth markers on skulls.	
14-18	Building up the face with oil-based clay to the level of the tissue depth markers. Temporary clay sphere placeholders inserted for eyes; clay face sculpting.	
19-23	Face sculpting continued. Nose and lip sculpting, smoothing out clay on face.	

24-29	Replacement of clay placeholders with permanent installation of artificial eyes; eyelid installation, ears and facial hair added, face sculpting as necessary.	
30	Final products with some props added such as wig, glasses, etc. as needed.	 **African Female** **Asian Male** **African Male**

Group Accountability

For this project, each group selected a leader and co-leader, who were responsible for directing the project and submitting project participation accountability forms to the instructor at the end of each semester. This form serves to inform the instructor of the contribution of each individual, as group members are awarded individual grades.

Teaching & Learning Collaboration

In the first semester (Fall 2016) *FSCI 4401: Crime Scene 1* course (Instructor: Karla-Sue C. Marriott), students reviewed scientific literature, studied cranial features, and depth marker measurements. Initially the students developed a project plan with experimental procedure. Student groups were assigned unknown skulls and tasked with determining the ethnicity, sex and approximate age by taking skull measurements and examining the teeth. Students confirmed the ethnicity, sex and age approximation with Marriott before being permitted to move forward. Over the rest of the first semester, students studied cranial features in detail, learning all the bones in the skull, and placed facial depth markers on their skulls in preparation for the second semester.

In the second semester follow-up course, *FSCI 4402: Crime Scene*, Dr. Marriott partnered with Professor Eric Clark, a sculptor from the College of Liberal Arts. Clark instructed the students on how to build-up the facial features on the skulls using oil-based clay with the already in-place depth markers as guides. Students developed general sculpting skills with the use of sculpting tools. They also learned about facial geometry, symmetry and cartilage size estimation for use in sculpting the nose and ears.

Note: Crime Scene 1 and Crime Scene 2 are required sequential capstone courses for students majoring in forensic science.

Group Reflection

During the second semester, each group was asked to assemble and give written feedback as a group. Excerpts from their feedback are presented below.

1. During Crime Scene 1 and 2, have you discovered new talents or skills that previously you didn't know you had? Explain.

   Student response: We as a group can honestly say that we did discover some hidden talents/skills, like for instance one of our group members got better at doing unit conversions, another one had a natural hand for sculpting, and the third one found out some new techniques for when it comes to sculpting. While doing facial reconstruction, it has really showed some of our strengths and weakness and has improved and uncovered many skills.

2. During Crime Scene 1 and 2, are you challenged? Explain.

   Student response: Yes, challenges come in with attempting to find symmetry in the face and also with working with different people and different personalities within the group.

   The most complicated features were when we had to craft the eyelids, ears, and the nose. These were the most difficult because they are all cartilage and have no specific structure. These features depend on the person's genetic makeup.

3. During your Crime Scene 1 and 2 classes, did you use multiple disciplines to help with your project, such as chemistry, biology, painting, anthropology, mathematics, sculpting, technology, anatomy …etc? Make a list and explain how each discipline contributed to the progress of your project.

Student response:
- Biology - we had to identify certain aspects of the skulls such as width (ear to ear) and length (from the eyebrow bone to the back of the skull).
- Anatomy - helped with the muscle structure and the placement of them on the skull.
- Anthropology - we used anthropology to determine the race, sex, and age of the John Doe.
- Mathematics - to determine size and placement of the tissue depth markers; and we had to do unit conversions.
- Geometry - symmetry measurements helped us with the orientation of the cheeks and the length of the nose

Discussion & Conclusion

This project integrated seemingly disparate areas of knowledge and truly blended the arts and sciences. The poetic language that the faces evoked among students and other observers was evidence of that blending. Students discovered skills and abilities, previously unexplored as they journeyed through the emergence of the reconstructed faces, and gained a sense of competence and achievement. They developed an appreciation for the precision and limitations of scientific data, especially as it applies to determinations of age, ethnicity and sex. They also gained an understanding of the value of effective teamwork, and each discovered her/his unique strength and contributed towards the harmonious, common objective of producing a face that reliably revealed the deceased. The project was featured in the Savannah Morning newspaper "Savannah State students debut facial reconstruction projects for forensic science week" and on local television news.

References

Gupta, Sonia et al. (2015). *Journal of Clinical and Diagnostic Research*, Vol-9 (9), ZE26-ZE28.
Rhine, J. S. & Campbell, H. R. (1980). *Journal of Forensic Science*, 25:847-858.

Acknowledgements