

Reconstructing early human behavior at Olduvai Gorge, Tanzania

Charles P. Egeland (faculty mentor)

Curran Fitzgerald (student researcher)

Alexa Uberseder (student researcher)

This statement certifies that both the students (Curran Fitzgerald, Alexa Uberseder) and faculty mentor (Charles P. Egeland) were involved in the development of this OUR URCA award application.

Project goals

The Early Pleistocene (between about 2.6-1.0 million years ago) witnessed two critical events in human evolution: (1) the invention and proliferation of flaked stone tool technology and (2) the acquisition, butchery, and regular consumption of large (>10kg) animals. While the list of excavated and analyzed sites dating to this time period has increased dramatically over the past 25 years or so, a consensus on several issues, including most prominently the importance of meat in the diet and the cognitive abilities of early humans, remains elusive. These questions are particularly important given suggestions that stone tools and an expanded diet were critical to the development of characteristics that distinguish humans from other apes, such as the transport of materials to favored locales (Potts, 1991), extreme encephalization (Aiello and Wheeler, 1995), superlative colonization ability (Antón et al., 2002), and a truly unique life history (Kaplan et al., 2000). Two specific matters are of concern here:

- How important was animal tissue in the diets of early humans? Were they active hunters, passive scavengers, or a combination of both? It was initially assumed that because the animal bones recovered at early sites were found in association with stone tools they necessarily represented the remains of meals and, furthermore, that hunting was the major, if not exclusive, mode of acquisition (Leakey, 1971). Many anthropologists in fact targeted hunting as *the* critical adaptation that ultimately led to “humanness” (Lee and DeVore, 1968). Subsequent studies demonstrated that the formation of early archaeological sites is an extremely complex process that involves not only human agency but carnivores, water action, and weathering, all of which can accumulate, remove, or destroy bones (Binford, 1981). Others questioned whether hunting was even necessary, noting that passive scavenging can yield energetically meaningful amounts of meat and/or marrow (Blumenschine, 1991). It is also unclear, given that the animal bones at some early sites have been found to be totally unrelated to early human subsistence (Domínguez-Rodrigo et al., 2007), if, and how often, animal tissues constituted an important component of the diet (Egeland, 2012). This issue has implications for how we view the importance of meat-eating in human evolution.
- How selective were early humans in their choice of rocks for stone tool manufacture? There are a variety of dimensions along which early humans may have selected raw materials, and this study will consider one characteristic, rock quality, that in all likelihood was particularly relevant for ancient knappers. Previous assessments of material quality are based largely on informal impressions or experimental parameters that are difficult to replicate (Jones, 1994), and the distinctions themselves are often converted into imprecise categories (e.g., high vs. low quality) that may be insensitive to the cognitive appreciation and cultural preferences of early humans. In fact, ethnographic research reveals that the search for and recognition of suitable raw material can be one of the more cognitively demanding aspects of stone tool production (Stout, 2002). Therefore, an objective measure of raw material quality and the degree to which early humans were sensitive to this parameter can potentially reveal much about the cognitive sophistication of Early Pleistocene humans.

We seek to contribute to these debates through laboratory and field work at Olduvai Gorge, Tanzania, which, as part of the Ngorongoro Conservation Area UNESCO World Heritage Site, preserves an unparalleled record of human bio-behavioral evolution between two and one million years ago. The meat-eating issue will be explored through an analysis of fossilized animal bones from the site of DK, which, at 1.86 million years old, is one of the oldest archaeological localities in the gorge. This aspect of the study will determine first if humans were responsible for the collection of the animal carcasses in the first place and, if so, how much meat was being consumed. Raw material selectivity will be assessed first by documenting inter- and intra-source variability in rock quality for several outcrops that are known to have been used as supplies for stone tools by early humans at Olduvai. These data will in turn be compared to artifacts at several Olduvai sites to determine if early humans were in fact selective in their choice of rocks or were simply utilizing what was close by without much regard to quality, much as modern chimpanzees do (Mercader et al., 2002).

Methods

Alexa Uberseder will participate in the bone analysis, which will employ standard zooarchaeological methods to reconstruct the formation of the bone assemblage (Egeland and Domínguez-Rodrigo, 2008). The DK collection consists of approximately 400 pieces, and all specimens will be entered into a Microsoft Access relational database. The following data will be collected:

- Identification of bone fragments to taxon (the specificity of identifications will depend on how fragmented each specimen is), body size, and skeletal part. These data reflect what animal species were present on site, what parts of the carcasses were being transported to the site, and a general picture of the site's habitat.
- Identification of processing marks (cutmarks, tooth marks, burning), which reveal how animals were being processed for consumption by early humans and other agents (e.g., carnivores).

Curran Fitzgerald will participate in the raw material analysis, which will involve the collection of sixty rock samples from each of six raw material sources (total sample = 360). The following data will be collected:

- GPS coordinates of all raw material sources to determine their distance from various archaeological sites at the gorge. This will help determine how far early humans were willing and able to travel in order to procure and transport flakable stone to make tools.
- Rebound hardness for all samples. This will be estimated with a Schmidt rock hammer (Proceq Silver Schmidt Concrete Test Hammer PC, N-Type), which is portable for straightforward and immediate use and data collection in the field, produces consistent, quantitative results comparable across rock types, and can be quickly and easily applied to large sample sizes amenable to inferential statistics. Rebound hardness is a commonly utilized estimate of raw material quality, as it reflects the ease with which a rock can be shaped into a useable stone tool (Braun et al., 2009).
- This database of inter- and intra-source variability in quality will then be compared to the frequencies of raw materials actually chosen by early humans at various sites in the gorge to determine if they were cognitively sensitive to material quality or simply selecting what was locally available.

Role of the faculty mentor

The faculty mentor will:

- Provide the excavated material for analysis.
- Provide all logistical support for student researchers.
- Assist Uberseder in the identification and analysis of the bone collection.
- Assist Fitzgerald, along with the project geologist, in the identification of raw materials.
- Assist the student researchers in the use of appropriate statistical tests in the analysis.

Roles of the students

Alexa Uberseder will:

- Complete the curation (washing/labeling/bagging) of bone specimens.
- Carry out preliminary sorting of faunal material (e.g., vertebrates vs. non-vertebrates; birds vs. mammals).
- Assist the faculty mentor in the identification of the bone collection.
- Assist the faculty mentor in the statistical analysis of the resulting data.
- Prepare an oral presentation, in consultation with the faculty mentor, for UNCG's Spring 2015 URE.

Curran Fitzgerald will:

- Accompany the faculty mentor and the project geologist to raw material outcrops to collect rock samples.
- Collected GPS data on raw material locations.
- Complete the curation (washing/labeling/bagging) of rock samples.
- Assist project geologist in the use of a rock hammer to quantify raw material quality.
- Prepare an oral presentation, in consultation with the faculty mentor, for UNCG's Spring 2015 URE.

Benefits to the faculty mentor

Egeland directs the excavations at the DK site. This work forms part of The Olduvai Paleoanthropology and Paleoecology Project (TOPPP), which is an international, collaborative, and trans-disciplinary endeavor focused on tracking early human behavioral responses to Early Pleistocene environmental changes. This work will directly contribute to the overarching goal of the faculty mentor's research program, which is to reconstruct the interaction of early humans with their environments.

Benefits to the students

Having the opportunity to participate in this research project in zooarchaeological bone analysis at Olduvai Gorge, one of the world's most important paleoanthropological sites, would provide Alexa Uberseder with greater knowledge and understanding in the field of anthropology. It would give her a once in a lifetime opportunity to have hands-on experience with analyzing a bone assemblage. This type of experience is invaluable and would provide her with learning opportunities that are unattainable in a classroom environment. Since continuing her academic career in anthropology, Uberseder has become intensely interested in human evolution and prehistory. Analyzing a faunal assemblage at this site could reveal how humans were using and processing animals, something she is intensely interested in. Highly motivated to pursue a career in biological anthropology, this project would give Uberseder a competitive edge in regards to furthering her education and career. This research experience not only would be beneficial to her career, but is also something that would broaden her personal experiences and viewpoints of the field of anthropology and what it takes to be successful.

Participating in this research project will provide Curran Fitzgerald with unprecedented participatory experience in archaeological research methods, data collection, and analysis. By conducting lithic raw material analysis at Olduvai Gorge, he will have the opportunity to develop a specialized personal research skillset under the tutelage of highly experienced researchers, and to contribute to the distinguished body of research that continues to emerge from one of the most important and productive paleoanthropological sites in the world. The skills and experience gained from locating, collecting, curating, and testing raw material samples will not only enrich Fitzgerald's experience in the field, but also contribute to his personal academic career goals and research interests. As an anthropology major and psychology minor, Fitzgerald has focused much of his undergraduate career on studying the evolution of cognition in the hominid lineage, and intends to pursue this line of inquiry in a graduate school setting after completing his degree at UNCG. Conducting research on raw material selectivity at Olduvai Gorge will allow Fitzgerald to produce and examine primary data regarding the cognitive abilities of Early Pleistocene humans, and to interact extensively with highly-qualified professionals working in his intended field of study. These experiences will be invaluable to Fitzgerald personally, academically, and professionally as he prepares for graduate school and a career in anthropology.

Justification of the award amount

The student researchers have applied to be participants in UNCG's 2014 Olduvai Gorge Paleoanthropological Field School. While this program provides a world-class study abroad experience, the costs to students are quite considerable (several thousands of dollars). Therefore, the requested award amount of \$1,500 per student will help them offset some of this cost and permit them to participate in the program rather than remaining in the US to seek employment.

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