D2 Experiment Design for Taphonomic Studies: Improving Research Designs, Data Acquisition, and Collaborative Research

Thomas Evans, MA, Montana State University, Department of Earth Sciences, PO Box 173480, Bozeman, MT 59717-3480*

After attending this presentation, attendees will have learned ways to improve taphonomic experimental designs which will improve the science produced, increase data acquisition, decrease monetary expense, and increase collaboration between scientists practicing forensic anthropology, archaeology, and paleontology.

This presentation will impact the forensic science community by outlining a philosophy of research design that, if followed, will improve the scientific quality of taphonomic studies, and increase collaboration between scientists practicing different historical sciences. The collaborative philosophy combined with improvements to experimental design will yield quantifiable reproducible data making the interpretations derived more defensible and rigorous. In addition, collaborative research designs maximize data acquisition per monetary expense which improves both study resolution (discriminatory power) and efficiency.

Applied forensic sciences are, by their nature, historical sciences; observations are collected in the present and used to reconstruct the past. Analytically the fields of archaeology and paleontology perform an identical task; however, their data sets are collected in different ways. It is not surprising that there is an observational and experimental taphonomic literature in all three fields, which has largely developed independently of each other, though there has been a long and productive exchange between anthropology/archaeology and the forensic sciences.

Given that all three fields are interested in the same processes, albeit at different temporal scales, similar experiments and observational studies have been performed in each field. Forensic experiments typically focus on early stages of decay, while archaeological studies focus on longer durations of exposure into disarticulation. Paleontological studies are often even longer in duration since the assemblages studied are frequently accumulations formed through thousands to hundreds of thousands of years. Consequently the studies performed by each group focus on different time frames which often only partially overlap. Needless time, resources, and money are spent performing experiments on only portions of the taphonomic history of a set of remains. If members from the three fields collaborated to perform one experiment from inception and experiment design to publication, all three fields would benefit from a coherent longitudinal data set. Rather than performing three experiments, one would suffice, and the results from different phases could be used by each principle investigator as per their research interests.

Although the three disciplines actively study taphonomy, there are only two general study types: observational and experimental. Observational studies provide essential initial data with which hypotheses can be erected. At present there is voluminous literature involving observations and experiments upon which one can erect hypotheses concerning most taphonomic processes. Consequently it is time for taphonomy to adopt hypothesis driven science utilizing the method of multiple working hypotheses. Not only does such a method yield results faster, but it also increases the chance that the results are correct, which is a problem for research designed to identify positive correlations between variables.

Studies should be designed with clearly defined and explicitly stated multiple hypotheses. The data required to falsify these hypotheses should be determined before the experiment is designed to direct data collection. This procedure will prevent the waste of both money and time in performing unsuccessful pilot studies. Each study should include a control and multiple treatment groups with specimens randomized into each group. Large sample sizes should be used, usually defined as greater than ~30, for each treatment since such large samples improve test resolution and power. Studies should be run for long periods, observing decay processes from death to bone weathering and breakdown. In addition replicates of each experiment should be performed to better constrain the variability within and between treatments and trials. Experiment samples should all have the same known history and future studies should utilize the same specimen histories and data collection techniques. This procedure would enable direct comparison between data collected in multiple experiments conducted by different investigators since the same protocols were followed. Analytically statistics should be used to quantify the variability and differences between treatments. Each investigator should learn which statistical tools are appropriate for each data set, and how to correctly apply them.

Lastly, previous research, including the initial “classic” studies, should be repeated and their conclusions tested. A fundamental tenant of science is the replication of research by other groups. Too frequently previous research is accepted uncritically, leading to further studies based on false conclusions since the original research was not subjected to falsification.

If these general guidelines are followed there will be a general increase in taphonomic information gathered for a lower cost and over a shorter time. Collaboration will improve experimental design, data analysis, and applications to the historical problems faced by each investigator. This will result in the field of taphonomy moving forward at a faster rate and improve the scientific quality of the research performed.

Taphonomy, Experiment, Design

 ** Presenting Author*