Expanding the scope of experimental archaeology using the Perception-Process-Product conceptual framework

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Abstract

This paper presents the Perception-Process-Product analytical framework that aims to expand the scope of experimental archaeology . ¶

¶ **Keywords:** Experimental archaeology; Ethological analysis; Ethnographical analysis; The curse of knowledge; Collaborative knowledge production

Contents

1 Introduction

This paper presents the Perception-Process-Product (hereinafter referred to as "Triple P") conceptual framework to expand the scope of experimental archaeology, which tends to center around the reverse engineering of a past technology in a minimal or least-effort manner while ignoring the rich contextual information it affords. The Triple P framework aims to **a)** amplify the expression of variability in experimental replicas (product) and their associated behavioral channels (process) as well as sensory experiences (perception) and **b)** better identify the complex interacting relationships across these three levels of variations (**Figure** 1). To accomplish these

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two objectives, we advocate the following four measures: 1) normalizing the ethological and ethnographic data collection in experimental projects ; 2) encouraging the involvements of avocational as well as novice participants; 3) boosting the collaboration across labs in a global scale; 4) building an open-access repository for data reuse. It is no doubt that strategies of data collection and analysis of a given experimental project should be primarily derived from the research question, which can be legitimately narrow in scope, but the awareness of the rich toolkit available can sometimes inspires researchers to ask questions that are bold and transformative (Schmidt & Marwick, 2020). Here I will mainly leverage the extensive corpus in experimental designs and inferences revolving around stone artifacts to demonstrate the necessity and potentials of this framework.

Traditionally, experimental archaeology focuses on generating knowledge regarding the causal mechanism at behavioral level to explain the variation of material culture (Eren et al., 2016; Lin et al., 2018; Režek et al., 2020). In the past decades, actualistic experiments becomes more common (Liu & Stout, 2022). Is RCT the golden standard of knowledge (Cartwright, 2007)

the first two p captures different level of variation: EQUIFINALITY (Chami, 2015). The process level can be dismantled into two parts: 1)the cognitive (Stout et al., 2015) and physical demands (Key & Dunmore, 2018) of certain tool-making behavior; 2) the ethological analysis.

One of the major concerns of experimental archaeology design, as in all empirical social sciences, is the validity, namely how good is a particular conclusion or inference approximates the true condition. The concept of validity has multiple dimensions, and one of the most commonly used classification schemes is internal versus external validity. Roe and Just (2009: 1266-1267) defined internal validity as “the ability of a researcher to argue that observed correlations are causal” and external validity as “the ability to generalize the relationships found in a study to other persons, times, and settings”. This balance between these two validity concepts is an issue that cannot be escaped for all experimental archaeology project designs. In the context of stone tool replication, it can be projected into the debate over the use of machines in knapping, a research design that has received increasing attention in the past decades (Eren et al., 2016). Machine knapping is a typical design with high internal validity but low external validity, which has been proved to provides critical insights into lithic fracture mechanics by identifying potential causal variables at the level of individual stone artifact such as determining which angle of blow or how much force of blow will produce the maximal amount of blade area. All the variables of interest are easy to measure, quantify, and control in a machine knapping setting. Nevertheless, being easy to control is not always a virtue as it essentially eliminates the potential interactions between variables operable in the past and thereby providing misleading results when answering archaeological questions. In addition to the applications of machine knapping, the same problem is also incurred by the introduction of standardized artificial material like bricks or video instruction in teaching experiments. As a rule of thumb, external validity should be given more weight in the design when the research focuses on the behaviors of the users of artifacts while internal validity matters more when it comes to the properties of artifacts themselves.

Experimental archaeology is based on the concept of analogy (i.e., the past is at least partially similar to the present in some aspects). It is acknowledged that the validity of this type of analogical inference has long been a subject of debate in archaeology (Wylie, 1985), and a comprehensive review of it is beyond the scope of this essay. For instance, presumably in the paleolithic period the development of stone knapping skills mostly happened during childhood and these children grew up in an environment surrounded by habitual stone tool users and makers. In this case, what can knapping teaching experiments involving modern adults who have zero exposure to stone tools inform us about the past learning behavior? It is important to clarify that no experimental project ever intends or claims to provide the perfect reconstruction of the past but rather aims at identifying variables relevant to the question of interest (Stout & Khreisheh, 2015), which can be often ignored through pure deductive reasoning. In the end, all experiments are wrong, but some are useful, and we need more of them.

2 The ethology and ethnography of stone toolmaking

new toolkit such as BORIS were introduced (Friard & Gamba, 2016)

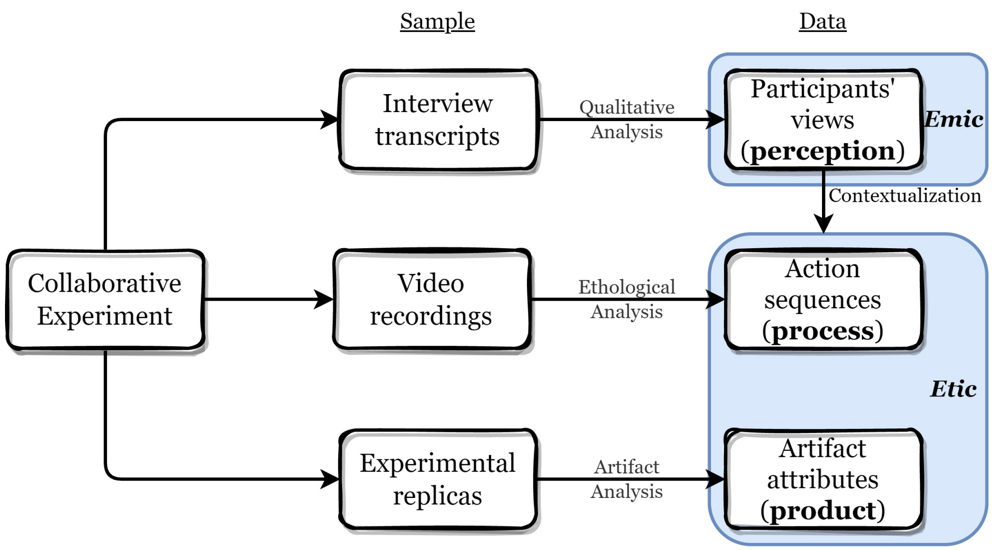

Figure 1: A schematic diagram of the Perception-Process-Product conceptual framework.

Ethological approaches has been first systematically developed and applied in the archaeological research by Haidle (Haidle, 2010, 2009; Lombard & Haidle, 2012), known as cognigram, essentially representing an abstracting process of a series of behavioral sequences achieving a similar goal. This approach is a power and elegant yet limited by the curse of expertise (Hinds, 1999). Like chaine operatoire, it cannot handles variation very well. To some extent it describes the minimal steps to achieve a goal from the perspective of reverse engineering and assume clear causal thinking between each steps. Novices has a different sets of perception on the causal structure of how certain behaviors will modify the raw materials, leading to over-imitation. Here we used the ethogram, or the action grammar, developed by (Stout et al., 2021) as an example. Other coding scheme also exist such as (Mahaney, 2014).

Ethnographies revolving around general archaeological practices (Edgeworth, 2006), experimental archaeology as a field (Reeves Flores, 2012), as well as practices of specific technologies like flintknapping (Whittaker, 2004) are not novel, however, it has never been formally recognized as a legitimate research method in experimental archaeology.

3 The curse of knowledge

We believe that contemporary practices in experimental archaeology, as manifested by the fact the the the majority of scholarly publications are produced as results of experiments conducted by single knapper with strong academic background, tend to be restrained by the cognitive bias known as the "curse of knowledge" or "curse of expertise". The curse of knowledge refers to the phenomenon that it is extremely challenging for experts to ignore the information that is held by them but not others, particularly novices (Camerer et al., 1989; Hinds, 1999). When the knapping expertise is gradually formed through multiple years of observations and trial-and-error learning, an expert knapper develops some specific ways of strategic planning, motor habits, preferences of percussor and raw material types, as well as familiarity of various techniques that become unforgettable. The existence of this cognitive bias is not inherently bad, and these many years of experiences should be appreciated and celebrated by experimental archaeologists. However, what is problematic is that the results of replication experiments conducted by these experienced practioners, often in settings of single knapper, has been constantly framed as grandiose generalization regarding the evolution of technology and cognition that masks a huge range of technological diversity.

Experimental archaeology as a scientific method is rooted in the individualistic reverse engineering in the 19th century instead of inter-generation transmission of knapping knowledge that spans several million years (Coles, 1979; Reeves Flores, 2010).

4 Many places, many voices

Emphasizing variability at its core, the Triple P conceptual framework inherently adopts an collaborative mode of knowledge production, which has been recently advocated in experimental studies (Ranhorn et al., 2020) and museum collection studies (Timbrell, 2022) of stone artifacts.

5 Open science beyond reproducibility

The last step is uploading the data to a open-access repository (Marwick et al., 2017). The building of manufacture can cost (Gilmore et al., 2015; Simon et al., 2015).

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