Journal of Anthropological Archaeology 33 (2014) 99–107

Contents lists available at ScienceDirect

Journal of Anthropological Archaeology

journal homepage: www.elsevier.com/locate/jaa

Copying errors of potters from three cultures: Predictable directions for a so-called random phenomenon

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ARTICLE INFO

Article history:
Received 27 June 2013
Revision received 15 December 2013
Available online 11 January 2014

Keywords:
Copying error
Motor skill
Cultural learning niche
Random evolution
Ceramic vessels
Morpho-metric attributes

ABSTRACT

The impact of copying error on change in artifact morphology is studied through a field experiment with three groups of potters, each with a distinct potting tradition (one from France and two from India). The nine French potters and the 12 Indian potters had to reproduce – in five specimens – four different model shapes with two different weights of clay (in total, each potter threw 40 pots). Results show that the variability generated while copying depends on both the difficulty of the task and the cultural learning niches of the potters. We conclude that, even though unintended, the copying error is culturally constrained and therefore its amplitude and directions predictable. This is attributed to the cultural selection of motor skills during apprenticeship.

Introduction

Within the framework of the dual-inheritance theory, cultural transmission is seen as the primary mechanism for the evolution of cultural features (Boyd and Richerson, 1985; Cavalli-Sforza and Feldman, 1981; Durham, 1991; Henrich and McElreath, 2003; Mesoudi and O'Brien, 2008; Richerson and Boyd, 2005; Shennan, 2008). According to this theory, in the course of transmission, cultural features are reproduced with variations on which selective forces of different kinds are exerted. These variations could be partially generated by unintended copying errors occurring during learning (e.g. Eerkens, 2000; Eerkens and Bettinger, 2001; Eerkens and Lipo, 2005, 2007; Hamilton and Buchanan, 2009; Kempe et al., 2012; Steele et al., 2010). These copying errors result from the physiological limitation of the human perception which prevents individuals from accurately reproducing model artifacts. According to previous studies, such copying errors would be random with no "predefined or predictable direction" (Eerkens and Lipo, 2005: 319).

From an archaeological point of view, "models" are traditionally defined in terms of morpho-metric classes or types once related to functional or chrono-cultural attributes (e.g. Gardin, 1980; Karasik and Smilansky, 2011; Orton et al., 1993; Read, 2009; Whallon, 1972). The implicit assumption is that these classes or types correspond to "cultural models" which craftsmen have copied to fulfill specific cultural demands. They are characterized by intra-class (or type) variability which defines their degree of standardization. This degree of standardization has been shown to increase with the frequency at which the artifacts are made, highly standardized artifacts being characterized by a coefficient of variation of around 3% and even less in the case of mass production (Roux, 2003). This low variability, verified empirically on craft products, corresponds to the magnitude of values considered to be inherent in human perceptual-motor capacities (Eerkens, 2000; Eerkens and Bettinger, 2001; Eerkens and Lipo, 2005).

It is generally accepted that copying errors lead to random variations which will amplify overtime, giving rise to different morphological types and possibly to distinct lineages of objects, if multiple chains of transmission evolve independently and if no other cultural evolutionary forces are at work (e.g. Eerkens and Lipo, 2005; Kempe et al., 2012; Neiman, 1995). Our aim here is to provide an explicit experimental study to analyze the amplitude and the nature of the copying errors. Even though previous experimental studies have been conducted (Eerkens, 2000; Kempe et al., 2012), these studies have mainly involved perceptive (shape and length perception) and cognitive skills (e.g. Mesoudi and Whiten, 2004; Mesoudi et al., 2006). However, the replication of a model artifact not only implies the capacity to faithfully *perceive* the model shape but also the capacity to faithfully *produce* forms (i.e. a 3D shape) from the model shape (a 2D shape). It is therefore still unclear (i) whether the variation created in the course of transmission

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http://dx.doi.org/10.1016/j.jaa.2013.12.003

relates to motor skills, perceptive skills or both; (ii) whether the variations created by motor skill and/or perception are of the same amplitude; (iii) what role, if any, the level of task difficulty and the cultural context play in the copying errors.

To address these issues, we conducted a field experiment where we asked French and Indian potters to replicate models of vessels from visual observation. Experimenting in France and in India allows us to take into account the role of the cultural context in artifact variability. As Washburn's study has showed with Art students, cultural knowledge influences the replication of images and objects (Washburn, 2001). Hence it is likely that the cultural setting influences the way traditional craftsmen reproduce specific models. The method adopted enables us to measure the intra-potter and inter-group variability and to assess the mechanisms underlying the copying error phenomenon. As we shall see, the variability in replicating objects is inherent to both motor and perceptive skills and the distance between the replicas and the models depends on the difficulty of the task and on the cultural learning niches. In the discussion, we ask therefore whether copying errors, an unintended phenomenon considered as universal, nonetheless follow predictable directions determined by the task difficulty and the learning traditions from which they stem.

Materials and method

A standardized experiment in three cultural settings

Three cultural groups of expert potters participated in the study: nine French potters (group F), six Indian potters from the Hindu community (group Prajapati, abbreviated Pr), and six Indian potters from the Muslim community (group Multani, abbreviated Mu). All the participants had practiced the craft for more than ten years. Potters from the two Indian groups (Pr and Mu) originated from the same region in Northern India. However, they belong to distinct cultural groups and have different technological traditions (Roux, 2013). In India, pottery production is a specialized activity that is carried out on a domestic scale. It is learned within endogamous castes that produce traditional objects in mass production (Kramer, 1997; Roux and Corbetta, 1989; Saraswati et al., 1966). By contrast in France, the social organization of pottery as a handicraft has been modernized since the industrial revolution: the apprenticeship has been transferred from family workshops to public schools and the mass production of standardized usual objects has since been replaced by an artistic personal production. As a result, the training conditions of the nine French potters were much more heterogeneous than those of the Indian potters. In addition to these distinctive social organizations, the instruments (wheels) vary in the three cultural contexts. French potters use electrical wheels activated by a pedal (Fig. 1, left panel), while the Prajapati use high-inertia fly wheels launched with a wooden stick (Fig. 1, middle panel), and Multani potters use foot-operated, low-inertia kick-wheels (Fig. 1, right panel).

A standardized experiment was set up in one pottery workshop located in France (Bourgogne) and in two pottery workshops (one Pr and one Mu) located in the same Indian village (Bulandshar district, Uttar Pradesh). Working in their usual conditions of practice, potters were asked to reproduce four different model shapes using two different quantities of clay, giving a total of eight experimental conditions (Table 1). The shapes (referred to as cylinder, bowl, sphere and vase, respectively) were presented as 2D drawings without providing any indication of absolute dimensions to be produced. The quantity of clay provided for each test corresponded to a mass of 0.75 kg or 2.25 kg. The four shapes were not part of any of the potters' daily repertoire. The vase was the most difficult shape to produce, due to the very small height of the maximum diameter and therefore the high risk of collapse (Gandon et al., 2011). The eight experimental conditions were produced in five specimens, thus each participant produced a total of 40 pots.

The participants were instructed to faithfully reproduce the model shapes, to throw vessels with the thinnest walls possible, and to refrain from embellishment operations once the vessel was thrown. Participants practiced the task the day before the experiment, producing at least one vessel under each of the eight experimental conditions. During the experiment proper, the order of the different conditions was randomised within each block of eight trials so as to avoid systematic learning effects.

Data recording and analysis

The experimental sessions were videotaped (Panasonic NV-GS320) and the image of each finished vessel was extracted from the films. The 2D coordinates of the cross-sectional profiles of the vessel were obtained from each image by tracing each profile out on a Cintiq 21UX Wacom® tablet with integrated screen. The coordinates were converted from pixels to centimeters using a predetermined calibration factor. The coordinates were re-sampled to generate an equal number of points (256 in total) at regular height intervals along the *y*-axis and were finally smoothed with a low pass filter.

The absolute dimensions of each vessel were then measured. For the two open shapes [cylinder and bowl], we measured the base, the aperture and the height, and for the two closed shapes [sphere and vase], we added the maximal diameter and the height of the maximal diameter (Fig. 2). For each potter, we also calculated, for each of the eight experimental conditions, the average profile which corresponds to the average of the five specimens produced for each experimental condition.

Fig. 1. Wheels used in the three cultural settings. From left to right: the electrical (pedal operated) wheel used by the French potters, the high inertia stick-wheel used by the Prajapati potters, and the low-inertia kick-wheel used by the Multani potters.