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From blunt to cutting: Distinguishing alternating method flakes in early stages on rounded blanks

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ABSTRACT

Two main knapping strategies can be used to start bifacial reduction on a lithic cobble or nodule: the alternate strategy, in which first one face is knapped and then the other; and the alternating strategy, in which both faces are removed in the same sequence, interspersing core about-turns between strikes. Flaking reduction of spherical and elliptical blanks (cobbles or nodules) is a common knapping process documented in many archaeological records. Rounded and thick edges require different fracture parameters and give rise to constraints in terms of viable knapping methods. When analysing abandoned cores, it is only possible to see the last strikes, so it is important to know how they were shaped or exploited in the earlier knapping stages in order to understand the entire reduction process. As cortical flakes are the direct evidence of the first reduction phases, we undertook an experimental programme for the purpose of comparing the first flakes generated using the alternate and alternating knapping strategies. We have focused our efforts on identifying and diagnosing distinctive features produced by each strategy in the first or cortical flakes. Our study indicates that several platform attributes can be considered as diagnostic features to differentiate between the alternate and alternating knapping strategies, and that this kind of analysis can be translated to archaeological assemblages.

1. Introduction

Understanding the way in which stone tools were produced in the past is important in order to infer the technological behaviours (Pelegrin, 1985, 1993; Delagnes and Roche, 2005; Braun et al., 2008; Stout et al., 2008, 2010) and capabilities of extinct hominin populations. Bifacial reduction strategies such as the alternate and alternating methods can be considered basic flaking methods that appeared early on in the technological record and were applied throughout hominin evolution (Pelegrin, 2005). Therefore, identifying the application of the alternate and alternating methods, as well as their origin and evolution, could be useful in constructing the referential framework for technological evolution as well as for all of the derived cognitive, motor skills, technological and cultural implications. Given the continuity and evolution of the reduction sequence (Braun et al., 2005), in a state of abandonment, many tools and cores do not exhibit the necessary attributes to identify how the knapping sequence was started, so primary reduction flakes may be a reliable indicator of the knapping sequences carried out. If it is possible to experimentally identify distinguishing attributes on flakes, then the recognition of different first stage reduction strategies could be translated to the archaeological record.

Bifacial tools (e.g. handaxes) and cores (e.g. discoid) can be shaped and exploited using different types of blanks like large flakes, cobbles and nodules, or slab-like fragments as a matrix. From a technical point of view, cobbles and slabs tend to present thick rounded or squared edges that usually make beginning to perform bifacial reductions difficult (Callahan, 1979, pp. 64; Jones, 1994). The result of this starting phase determines the entire shaping process and is dependent on the structure (Roth and Dibble, 1998), shape (White, 1998; White and Ashton, 2003), and

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size (Crompton and Gowlett, 1993) of the raw material of the blank. The application of bifacial knapping strategies on tools and cores requires removing flakes from both faces of the blank, and during this process, the cortex should be more or less completely detached, the volume controlled and adapted, and the shape regularised. If the blank has restrictions in morphology, the success of the first reduction stage can be decisive when a specific designed form, especially a biface, is sought. In this scenario, the alternating flaking method has been largely proclaimed as an appropriate strategy for transforming squared and thick edges into bifacial ones (Burton, 1980; Andrefsky, 1998; Baena, 1998; Moore, 2003; Pelegrin, 2005). In addition, the alternating method has been found to be highly capable of invasiveness, especially compared to the alternate method (Moore, 2003).

The alternate method can be deconstructed into two different knapping sequences, affecting first one face of the blank, and then the other. In contrast, the alternating method involves working both faces at the same time in a single sequence, involving much more complexity in core management, work planning and the ability to anticipate. In the technological record, some kinds of structured reduction strategies seem to appear in Early Stone Age assemblages (Delagnes and Roche, 2005) as can be interpreted from the concatenation of short series of sub-parallel removals on rounded blanks that can be seen, for instance, in the Gona lithic assemblage (Semaw, 2000). However, the first clear identification of alternating sequences seems to appear somewhat later. The first evidence of the use of the alternating method is claimed to be from the sites of Kanjera South (Kenya) around 2.0 Ma (Stout et al., 2010, pp. 477), the Gadeb sites (Ethiopia) (de la Torre, 2011, pp. 778) *ca.* 1.4–0.7 Ma, and Gesher Benot Ya'aqov (Israel) *ca.* 0.8 Ma (Goren-Inbar et al., 2011, pp. 1909).

If the alternating method is understood as a major technical evolutionary innovation for the purpose of reducing thick edges in bifacial reductions, then it could have played a significant role in the technical evolution of large cutting tool techno-complexes and, therefore, it can be presented as something to be taken into account in the structure of Acheulean technological evolution. Based on this scenario, we have designed an experimental programme that aims to analyse the attributes exhibited by flakes produced during the early reduction stages of the alternate and alternating flaking methods. The main goal of the work is to propose some specific variables to be interpreted, like features exclusive to the alternate or alternating methods, allowing these different reduction strategies to later be identified in the archaeological record using the flakes rather than highly reduced or transformed tools or cores.

2. Background and terminology

The alternate and alternating concepts have been described, interpreted and applied diversely in the literature, leading to some confusion with regard to the meaning of the terms and the technical strategies involved. In this work, considering the different points of view proposed and applied (Callahan, 1979; Burton, 1980; Whittaker, 1994; Inizan et al., 1995, 1999; Baena, 1998; Ashton and White, 2003; Goren-Inbar et al., 2011), we understand the alternate method to be when the two faces of the tool/core are independently removed, working first on one face and then on the other. On the other hand, we consider the alternating method to consist of knapping both faces in the same sequence, interspersing core about-turns between each strike.

There is a problem derived from the existing terminology and related to the difficulty of delimiting reduction stages (Bleed, 2002) and deconstructing reduction processes into strategies, sequences, series, methods or reduction systems. Assessing knapping complexity is a key component in explaining the cognitive changes observed in the evolution of stone technology, but there is a lack of consensus as to which criteria should be used (Stout et al., 2010, pp. 476). This makes comparing flaking strategies very difficult. Faced with this problem, which is not easy to solve, we aim to clearly define the different flaking actions and products used in this work as well as those used to make experimental comparisons.

2.1. *The alternate strategy*

By 'alternate strategy' we refer to the process by which one face is partially or completely worked before moving on to the second face (Fig. 1). It is conceptually bifacial, but the hierarchical sequences employed are not. Alternate reduction can be performed with a mixture of methods. The most instinctive of these uses blow by blow removals, using the most highlighted ridges on each face. But in early reduction stages on rounded blanks, taking advantage of the previous removal ridges with sub-parallel or adjacent flaking (Pelegrin, 2005) provides an easier way to reduce the blank and to remove the cortex. Theoretically, only one or very few core turnovers are needed between the two sequences. As a result, in the alternate strategy there are two different production series or shaping sequences, referred to in this work as the 'first alternate' and 'second alternate'.

2.2. *The alternating strategy*

By 'alternating sequence', we refer to the process by which both faces are flaked in a single sequence, interspersing core about-turns between each strike (Inizan et al., 1995, 1999) (Fig. 1). Alternating involves core rotation and tilt rectification, but in addition, continuous core about-turns are performed throughout the sequence. During the knapping process it is necessary to change core position and flaking planes continuously, creating a continuous removal series that entails a different type of complexity in visual reconnaissance (the volume of each side), manual rectifications (continuous core about-turns) and execution (hammer actions). The last scar is the primary hierarchical element because it determines the position and orientation of the core on the next strike. The concavity of the last scar forces the knapper to apply oblique percussions (to the right, to the left, and so on), which are needed to create a new platform for the next blow on the other face of the blank. In this sense, the alternating sequence involves an anticipatory strategy.

3. Materials and methods

In this experimental work, we produced two different samples of alternate and alternating flakes. Different experimental series were created using thirty-five cobbles of flint and quartzite (Table 1). The flint nodules come from Zaragoza region (Spain). It is usually homogeneous and non-fissured raw material, and the cortex is perfectly suitable to strike. The quartzite pebbles come from Tagus River, near to Lisbon (Portugal). They are tough and display fine-grained and homogeneous raw material. The cobbles and nodules had regular shapes and elongated elliptical or spherical morphologies and some slab-like nodules with right-angled edges were also selected.