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Handaxe reduction and its influence on shape: An experimental test and archaeological case study

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ABSTRACT

The interpretation of handaxe shape is one of the most prominent questions in Acheulean archaeological studies. Nowhere is this question as sharply defined as in Britain, where there are a number of distinct handaxe shape types. Recently reduction intensity has come to the fore as an explanation for the creation of different biface shapes, however many Acheulean researchers do not see compelling evidence for differential reduction at their sites. In this study we report an experiment in which knappers, naïve as to the goal of the experiment, reduced handaxes according to different protocols. Changes in shape and flake scar density were recorded as reduction progressed. These trajectories of shape change are compared to those seen at five British Acheulean sites: Boxgrove, High Lodge, Hitchin, Swanscombe, and Broom. Our results show that although there is evidence for differential reduction intensity at these sites, this did not have a strong influence on shape. Reduction was never exhaustive, suggesting that the life history of these tools was short. Temporally and spatially variable traditions are a better fit for the observed patterns of shape variation.

1. Introduction

Intensity of reduction on flaked stone tools is an important component of variation in Middle and Late Palaeolithic technologies (Buchanan, 2006; Kuhn, 1992, 1994), but its role in determining or affecting the shape of Acheulean bifaces is debated. Understanding and controlling for reduction intensity in the Acheulean is a critical hurdle to interpreting variation in biface morphology (Nowell, 2002; McPherron, 2000). Indeed determining whether Acheulean bifaces were extensively reduced, either to shape them or prolong their use-life, has a bearing on questions of morphological variability, artefact life history, imposition or inadvertent alteration of form in handaxes, as well as hominin planning capacity. The evidence for extensive reduction in the Acheulean currently remains ambiguous and contested (Goren-Inbar and Sharon, 2006; Shipton, 2011; Edwards, 2001), partly because ways of measuring reduction intensity were elusive (see Shipton and Clarkson, 2015). Yet some authors propose that one of the most important determinants of shape and size variation among Acheulean bifaces is the degree of reduction that different pieces have undergone (White, 2006; Iovita and McPherron, 2011; Emery, 2010; McPherron, 1999; Ashton, 2008). Previous tests have examined variation in biface form but lack an independent measure of reduction intensity.

In this paper we set out to test the notion that handaxe form could be altered by reduction intensity in particular ways, depending in part on the positioning of the retouch. We carry out the test in two ways. First, we conduct an experiment whereby pre-knapped handaxes are retouched according to four different protocols by moderately skilled knappers who were naïve to the goals of the study. We measure reduction intensity and shape after each retouching episode and the protocols are then repeated. Handaxe shape could conceivably be substantially altered by such retouching patterns (e.g. flaking only the tip, sides, all margins or tranchet reduction) and it is important to understand what effects such 'knapping styles' might have on handaxe form.

The second stage of the study involved determining whether changes in shape similar to those observed experimentally, are evident on archaeological bifaces as reduction intensity increases. To perform this analysis we studied bifaces from five British Acheulean sites. British bifaces seemed the ideal population to examine the relationship between shape change and reduction intensity because unlike many parts of the world, bifaces here are frequently classified into distinctive types, with different sites represented by particular types (Wymer, 1968; Wenban-Smith, 2004; Bridgland and White, 2014). This raises the question of whether local reduction rules might have created distinctive handaxe morphologies. For this proposition to be true, it is necessary that the degree and type of shape change is correlated to

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increasing reduction intensity. For this study we employed the scar density index (SDI) as an independent measure of reduction intensity on handaxes that is unaffected by the way handaxes are reduced, as recently published by Shipton and Clarkson (2015).

2. Reduction intensity and handaxe variability

2.1. Reduction intensity and handaxe shape

McPherron (1999, 2000, 2006) has proposed that handaxes from across the Acheulean geographic range were continuously reduced and reused by their hominin makers. Certainly the bifacial edge is amenable to extensive reduction once it has been established, and hence lends itself to frequent reflaking before the tool is discarded. McPherron (2000) suggested that handaxes begin life as thick, elongated objects that become relatively wider and thinner over a series of episodes of edge rejuvenation, as early stage thinning flakes should tend to remove thickness rather than width. Towards the end of a handaxe's use-life he suggests that they become relatively thick again as the edge angles increase and thinning flakes become less invasive, thereby removing more width than thickness (McPherron, 2006). Consistently concentrating reduction on different parts of the bifacial edge (such as the tip or the sides) might also result in changes in biface plan shape. McPherron (2006) and Iovita and McPherron (2011) suggest that bifaces were preferentially reduced at the tip, resulting in a trajectory of decreasing elongation as the butt remains largely unaltered while the tip recedes. Alternatively, we consider that reduction of the sides of a biface might preferentially reduce the width, while length and thickness remain approximately constant. Retouching the entire circumference of a biface might result in little change to plan shape, but reduce overall size or alter cross-section.

A further method of handaxe reduction documented at some sites such as Boxgrove, is tranchet flaking (Bergman and Roberts, 1988). Here the entire tip of the biface is removed in a single blow that may either be transverse or oblique to the long axis of the tool, leaving a broad, sharp cutting edge formed by a single flake scar. Refitting at Boxgrove demonstrates that tranchet flakes were usually the final flakes to be removed from the handaxe and sometimes occur in isolation, suggesting that they were removed to create a razor sharp tip as a resharpening technique (Roberts and Parfitt, 1999). As tranchet flaking removes the distal tip it may produce rounder and squatter handaxes. White (2006) suggests that tranchet flaking was responsible for producing the cleaver-like square-ended ovates in the British Acheulean.

2.2. Handaxe variability in the British Acheulean

A number of distinct handaxe types are noted in the British Acheulean, defined largely by their planform shape. We use a combination of existing typologies to describe the shape variation of the archaeological assemblages used in this study (Wymer, 1968; Bordes, 1988; Debénath and Dibble, 1993) (Fig. 1). Cordate and sub-cordate handaxes correspond to the classic tear-drop shape with convex sides in plan view and the position of maximum breadth towards the butt (Fig. 1A). Limande handaxes are relatively rare and have sides that are nearly straight and parallel in plan view with the position of maximum breadth close to the middle of the piece (Fig. 1B). Ovate handaxes are rounder in planform with markedly convex sides and the position of maximum breadth closer to the middle of the piece (Fig. 1C). Triangular handaxes have straight sides that markedly converge towards the pointed tip with the position of maximum breadth near the base of the piece (Fig. 1D). Unlike the ovate handaxes which are usually flaked all the way round their perimeters, these often have partially cortical butts. Ficron handaxes have concave sides in plan view and are elongate with the position of maximum breadth near the base of the piece (Fig. 1E). Plano-convex handaxes are elongate pointy handaxes with a distinctive asymmetry between a flat and a domed hemisphere (Fig. 1F). The tip of plano-convex handaxes can be either rounded or pointy and the butts are typically thick. A final rare form of handaxe are ovates where the bifacial edge is markedly twisted in profile. Roe (1969) grouped these different handaxe types into two

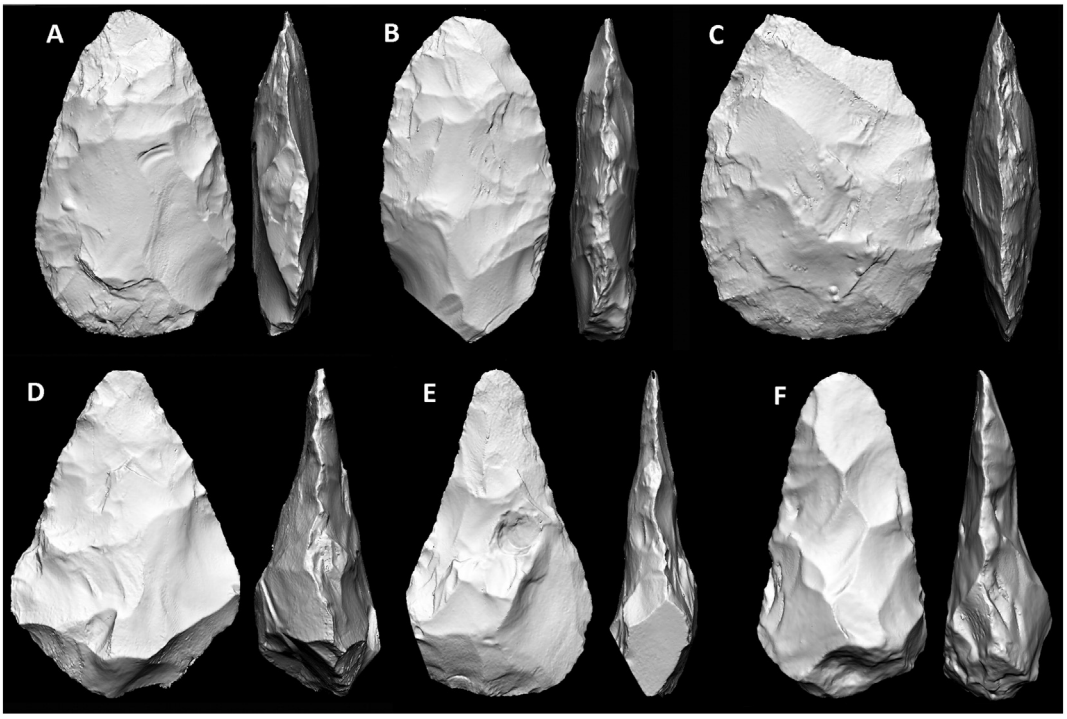

Fig. 1. British handaxe types. A = cordate handaxe from Boxgrove; B = Limande handaxe from High Lodge; C = ovate handaxe from Boxgrove with tranchet scar on the tip; D = triangular handaxe from Swanscombe; E = ficron handaxe from Swanscombe; F = plano-convex handaxe from Hitchin. Note how A, B and C have biconvex profiles whereas D, E, and F have tapered profiles. Note also the asymmetry between the two hemispheres in F.