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Their lips are sealed: identifying hard stone, soft stone, and antler hammer direct percussion in Palaeolithic prismatic blade production

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ABSTRACT

The present experiment examined the differentiation between hard stone, soft stone, and antler hammer in Upper Palaeolithic direct percussion, prismatic blade production through the experimental knapping by two knappers who were asked to produce a series of medium-sized blades. The use of two knappers in the experiment tested knapper variability in the resultant experimental assemblage. While the majority of the attributes of blades and proximal fragments – including the presence of lipping, platform preparation, bulb presence and prominence, and curvature amongst others – did not vary significantly in regards to which hammer type either knapper used, a number of blade attributes differed, significantly yet weakly, and there was almost no direct correlation between the individual knappers blades and the hammer type they used. This suggests strongly that for a given goal of producing medium-sized blades, this can be accomplished equally well using antler, hard stone, or soft stone hammers, and the resultant blades will be difficult to tell apart. Therefore, based on the results of this series of knapping experiments, we would be hesitant in using the 21 variables tested here to differentiate between blades produced with antler, hard stone, and soft stone hammer types in the archaeological record.

1. Introduction

In discussing the 'big deal about blades' in human evolution, Bar-Yosef and Kuhn (1999) noted that a tenacious, yet erroneous, generalisation had been that the adoption of a blade technology was a hallmark of anatomically modern humans, and often included in a checklist of fully modern behaviour. Blade production, had, however, been in use before the Upper Palaeolithic, as evidenced in numerous European, African, and Eurasian sites, with continuing debate as to the merits of a blade technology (Eren et al., 2008), why it would be ignored by some groups (Pastoors, 2009), or the relative complexity of prismatic versus Levallois blade production (Coolidge and Wynn, 2004). Blade production has been viewed as having been attractive from a raw material conservation point of view, as well as allowing a greater control of size of blank which would have been useful for lithic traditions based on composite tools (see discussion in Bar-Yosef and Kuhn, 1999). For the former at least, experimental work based on North American Paleoindian (Jennings et al., 2010) and European Middle/Palaeolithic (Eren et al., 2008) technology has, however, suggested that blade production is not more efficient than flake production.

Beyond just the production of blades, researchers have gone further and differentiated between blades produced using hard and soft hammers, with Palaeolithic soft hammer blade production identified in Europe (Aubry et al., 2001; Pasty et al., 2002; Sirakov et al., 2007; Bordes and Teyssandier, 2011; Aubry et al., 2012; Wierer, 2013), Asia (Chauhan, 2009; Patnaik et al., 2009; Zwyns et al., 2012), Africa (Soriano et al., 2007; Villa et al., 2010), and the Near East (Meignen, 2002; Berillon et al., 2007; Lengyel, 2007; Kuhn et al., 2009). Researchers argue that differentiating between hard or soft hammer in blade production "often provides some indication of the relative position of a site within the Late Upper Palaeolithic cultural sequence" (Sano et al., 2011, 1472), while others have, in the context of the Middle Palaeolithic, used the evidence for the use of different hammer types to interpret Neanderthal site spatial complexity, and therefore buttress arguments for behavioural complexity (Henry et al., 2004).

The majority of experiments conducted on distinguishing between hard or soft hammer percussion have been on the debitage

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produced during biface manufacture or the production of flakes (e.g. Hayden and Hutchings, 1989; Pelcin, 1997; Redman, 1998; Bradbury and Carr, 1999), with the attributes usually noted as distinguishing the hammer type being lipping, bulb, thickness, weight, length, crushed platform, platform width, curvature, and platform angles. Using a mechanical knapper Pelcin (1997) examined the difference between flakes produced with steel and antler hammers on glass. The results showed that the glass flakes produced with an antler hammer were longer, thinner, but with no difference in width or platform width and all flakes produced had lipped platforms. Redman (1998) analysed the debitage produced by multiple knappers during the production of chert bifaces. Redman (1998, 90–91) argued that the results suggested that categories of hard hammer flake and soft hammer flake "are, in a sense, meaningless" as greater variability was seen between the three different knappers rather than hammer. The only variables immune to idiosyncratic knapper difference were bulb thickness, max thickness and mid-point thickness; while immune to knapper difference they were nevertheless only weak at distinguishing between hammer types.

Experimenting specifically with the effects of hammer types in direct percussion prismatic blade production has been less frequent. Pelegrin (1995, 2000) presented results of experiments, describing, but not quantifying, that soft organic hammer blades are characterised by small, plain, lipped platforms with diffuse bulbs compared to hard stone hammer blades, and soft stone hammer blades are similar to hard stone but more elongated and with less marked bulbs. While Pelegrin (2000) noted that the experiments he outlined were undertaken by a variety of knappers, the experiments did not analyse knapper variability specifically.

The vast majority of subsequent analyses of archaeological assemblages from around the world that have differentiated hard/soft stone/antler direct percussion in Palaeolithic prismatic blade production have cited Pelegrin's (2000) experiments (e.g. Meignen, 2002; Aubry et al., 2001; Pasty et al., 2002; Lengyel, 2007; Sirakov et al., 2007; Soriano et al., 2007; Chauhan, 2009; Bordes and Teyssandier, 2011; Villa et al., 2010; Zwyns et al., 2012; Wierer, 2013). The present experiment sought to examine the differentiation between hard stone, soft stone, and antler hammer in direct percussion, prismatic blade production through the experimental knapping by two knappers who were asked to produce a series of medium-sized blades, defined here as between 30 and 50 mm in length. The use of two knappers in the experiment tested knapper variability in the resultant experimental assemblage.

2. Methods

2.1. Material and experiment organisation

The chert used in the experiment was nodular chert from the Aquitanian Formation, collected from a near primary source in Aragón, Spain, close to the confluence of the Segre and Ebro rivers. The majority of the nodules have a thin to very thin cortex, with the form ranging from flat and lenticular, to more rounded nodules; both complete and split nodules were selected. Nodules of varying sizes and forms were collected and subsequently separated into groups in a manner that each pile contained roughly the same proportion of shapes and sizes. These were then assigned randomly to each knapper. The knappers were then free to choose which nodules to use, and if a given nodule was deemed unsuitable for blade production after beginning, it and all its debitage was collected and removed. During the knapping of each nodule, the majority of debitage was collected periodically and bagged, and after the knapping of each nodule, all the cores and remaining debitage (mainly fragments and <20 mm debitage) were bagged. In order to keep the techniques separate, if a nodule was knapped with more than one technique (i.e. during the antler knapping, using a soft stone for core preparation) all of the resultant debitage was bagged and the differing technique noted. Overall, the chert was of a medium to medium–high quality, with many of the nodules not particularly suitable for sustained blade production (due to a lack of homogeneity, imperfections/inclusions, thermal damage etc.) – for the final analysis, only nodules which produced a good series of blades were subsequently sampled. Granite cobbles collected from a river bed, were used for hard stone hammers, limestone cobbles collected from the sea shore for soft stone hammers, and deer antler for soft organic hammer. The granite and limestone cobbles used were sub-circular to oblong, and ranged from c. 150–400 g in weight with the larger hammerstones generally used in the core preparation and the smaller for blade extraction; the deer antler weighed 220 g.

The two participants used in the experiment are both accomplished knappers with around 10 years of knapping experience each. The knappers both used a similar method of prismatic blade production, using the three techniques of hard stone, soft stone, and organic hammer; however, the technical procedures used (see Inizan et al., 1999 for the differences between method, technique, and technical procedures) were open to the knappers, and varied according to their knapping style: the differing technical procedures included the differing style of core preparation such the abrasion of an overhang, the preparation of an edge prior to removal and so forth.

2.2. Attributes analysed and statistical procedures

The knappers were asked to produce blades of 30–50 mm in length, with 25–55 mm blades subsequently sampled for analysis. After all the knapping was completed, the debitage was divided into 25–55 mm complete blades and flakes, <25 mm and >55 mm complete debitage, proximal fragments, and non-proximal fragments. The 25–55 mm blades and the proximal fragments were then sampled randomly using SPSS 21.0 (IBM SPSS), which was also used for all of the statistical analyses. The sample consisted of 420 artefacts – 105 complete blades for each knapper using three different hammer types, and the same for the proximal fragments. In all, 19 attributes of the complete blades were analysed, with a further three attributes analysed for the proximal fragments (Table 1); when necessary log transformations were used during analysis with these noted in Table 1. The measurements for dimensions are in millimetres, grams for weight, and degrees for curvature, following a standard method for taking dimensions (e.g. Andrefsky, 1998).

Relative bulb thickness is bulb thickness minus mid-point thickness, with occurrences of false bulb thicknesses due to blade morphology not used in the analysis; blade curvature was calculated based on Andrefsky (1998). For bulbs, the definition of

Table 1
Attributes analysed.

Max length	Curvature
Max width	Impact point distance (ordinal)
Max thickness (LOG)	Platform type
Mid-point thickness	Lipping
Weight (LOG)	Bulb
Platform width (LOG)	Bulbar scar
Platform thickness	Impact point
Length/width ratio	Platform crushing
Length/thickness ratio (LOG)	Fragment type
Width/thickness ratio (LOG)	Break type
Relative bulb thickness (scale and ordinal)	Platform collapse