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Considering the function of Middle Palaeolithic blade technologies through an examination of experimental blade edge angles

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ABSTRACT

Over the last three decades a number of archaeological investigations have demonstrated the widespread use of both laminar and Levallois methods of blade manufacture throughout the European Middle Palaeolithic. These strategies are observed in varying quantities in both Early and Late Middle Palaeolithic contexts, and have been documented in a number of archaeological horizons concurrently and in isolation of one another. However, despite their (co-)occurrence investigations have not considered the potential practical benefits of either blade strategy, and the actual functionality of these blade manufacturing techniques. Using an experimental dataset, this article investigates differences in the function of both strategies through a consideration of their edge angle, an important functional attribute of lithic artefacts. A null hypothesis of 'no difference' was examined through a statistical framework to assess the degree of variance between both blade strategies. Analyses demonstrate considerable difference in both the distribution of edge angles produced, and the mean edge angle values observed. Through the analytical framework it can be demonstrated that both blade production methods would have provided distinct differences for past hominin populations, with respect to their microfracturing properties and attrition rate. However, when reviewed against other edge angle analyses, against a functional backdrop, their edge angle in isolation cannot explain their appearance and subsequent use. Further work considering the functional attributes of these blade strategies is now important in conjunction with technological analysis to assess the role of artefact design during the Middle Palaeolithic, and the different 'potentials' of both blade manufacturing techniques to past hominin populations.

1. Introduction

The European Middle Palaeolithic has long been recognised for its technological flexibility, with Neanderthal populations utilising an assortment of raw material morphologies and core volume management strategies for the creation and transformation of lithic artefact blank types (Boëda, 1988a, 1988b, 1995; Delagnes, 1993; Geneste and Plisson, 1996; Peresani, 2003; Brenet et al., 2013). A more recent development within discourse on Middle Palaeolithic technological variability is the documentation and examination of both laminar and Levallois (elongated recurrent unidirectional/bidirectional) systems of blade technology throughout the period in question (Révillion, 1993a, 1993b, 1995; Révillion and Tuffreau, 1994; Delagnes, 2000; Koehler, 2011a, 2011b). Laminar blade production systems are oriented towards the production of blades through volumetric exploitation of anthropogenic or natural ridges on the lateral faces of a core's perimeter (Révillion, 1993a, 1993b; Inizan et al., 1999; Hoggard, 2017). In contrast, Levallois blades are exploited through a delineated core surface, with a distinct non-interchangeable core hierarchy: one a dedicated surface of striking platforms, the other a flaking surface (Boëda, 1988a, 1988b, 1995). Combined, these two strategies constitute a conscious decision by Neanderthal populations to undertake a *débitage* system which is oriented towards the production of elongated and stereotyped (i.e. similar in overall shape) artefacts through a homothetic core configuration. 'Homothetic' configurations are here defined sensu Boëda (2013) as any technological system that is fixed (*concrète*), with an overall unchanging morphology (shape), but a changing form (shape *plus* size).

Over the quarter of a century, discussions on blade production systems have focused on three main aspects of hominin behaviour. These include aspects of: 1) technological evolution and/or technological continuity (Révillion, 1993b; Koehler, 2011b), 2) cultural affinities or *technocomplexes* (Delagnes, 2000; Delagnes and Meignen, 2006; Depaepe, 2007), and 3) behavioural and technological organisation within the immediate and greater landscape (Locht, 2002; Koehler et al., 2014). Notwithstanding, the three main research themes

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concentrate on laminar methods of blade production, with limited discussion on the co-occurrence and relationship of the two blade technologies (Ortega et al., 2013). There are, however, a number of avenues of research that have been neglected.

One important consideration is their actual functionality, their use, and how the artefacts perform. While aspects of morphology and functionality are noted with reference to laminar blade production systems (Jensen, 1986; Eren et al., 2008; Taller et al., 2012), these studies tend to focus on production techniques other than hard hammer percussion (which is typical for the Middle Palaeolithic) and focussing only on laminar-based methods of blade production. The omission is significant because a consideration of function and artefact morphology would not just highlight the potential value of functional studies to understanding hunter-gatherer artefact variability e.g. Torrence (1989), but also provide a testable platform for a number of observations within the Middle Palaeolithic. These include the adoption of individual blade strategies throughout both periods of the Middle Palaeolithic, and the adoption of both blade production methods within the same archaeological horizon e.g. the IIIA and IIIB horizons of Le Rissori (Adam, 1991, 2002) and Angé (Locht et al., 2008). Of importance here is the question: do these artefacts represent differing behaviours and activities, given their morphology, or do they represent equifinal behaviour, used for the same activities? A consideration of function would also permit a route of investigation into observed changes in the quantity and distribution of both technological blade systems: specifically, from a high-Levallois/low-laminar Early Middle Palaeolithic to a low-Levallois/high-laminar Late Middle Palaeolithic.

One important aspect of investigating function is the 'edge angle' or 'working edge angle' of an artefact (that is the angle of all potentially usable edge on a particular artefact or artefact class). As Eren and Lycett (2016: 392) note, the ability of unretouched tools thought to have been used in cutting activities depends on some aspect of the artefact having a suitable edge angle. Given this, it is unsurprising that ethnographic/ethnoarchaeological (Gould et al., 1971; White and Thomas, 1972; White et al., 1977; Gould, 1980) and archaeological (Wilmsen, 1968; Ferguson, 1980; Jensen, 1986; Hayden et al., 1996; Taller et al., 2012; Key and Lycett, 2015; Eren and Lycett, 2016) studies have investigated artefact edge angle to understand past hominin technological and functional behaviour.

As a consequence, the conceit and aim of this paper is to assess the extent to which laminar and Levallois technological blade strategies differ in their working edge angle. This is achieved through documenting the manufacture of an experimental assemblage using both laminar and Levallois technological blade strategies. A null hypothesis (H_0) that there is no difference between the edge angle of laminar and Levallois blade production artefacts are then tested. The findings of this statistical framework are then discussed with respect to other studies on edge angle within both the ethnographic/ethnoarchaeological and archaeological literature in order to understand the extent differences in edge angle were important to Neanderthal populations utilising both methods of blade production in isolation, in conjunction, and with respect to the wider Middle Palaeolithic toolkit.

2. Methodology

An experimental approach is here favoured given its numerous advantages to hypothesis-driven archaeological enquiry (see Eren et al., 2016 for an overview). An experimental approach allows the analysis of fresh edge angles from a large number of blades, of known technological identity, through controlled flintknapping conditions. This issue of technological identity of particular importance when considering blade production methods given the difficulty in identifying Levallois products (Gricor'ev, 1972; Copeland, 1984; Böeda, 1986; Van Peer, 1992) and the difficulty in differentiating between laminar and Levallois strategies through the blanks produced (Bordes, 1961; Perpère, 1986). Furthermore, for any analysis of edge angle it is important that undamaged and fresh edge angles are analysed in order to reduce measurement error resulting from artefact condition. To produce the experimental blade dataset (n = 266), a flintknapper (James Dilley) proficient in the manufacture of both blade techniques undertook a series of reduction sequences until core exhaustion. Core exhaustion is defined here as any objective piece (sensu Andrefsky, 1998) which can no longer be shaped/transformed to an adequate Levallois core morphology, adhering to Boëda's (1995) definition of Levallois core configurations, or sufficient longitudinal or horizontal core convexities (*cintrage* and *carénage*) to permit blade production through a laminar technique. Throughout the experiment, the flintknapper's conscious aim was to optimise reduction of the nodule through blade technology, using one technique on one nodule. Therefore, cresting and semi-cresting (as a method of initiating and maintaining laminar blade production), and other core rejuvenation techniques including platform renewal, tabletting, and additional flaking were adopted where necessary. Given the observation of these behaviours throughout the Middle Palaeolithic (Adam, 2002; Locht, 2002; Koehler, 2011b) this experiment still parallels a Neanderthal strategy of blade behaviour. All blades were manufactured exclusively through direct hard-hammer percussion which is the primary technique of producing blades throughout the Middle Palaeolithic (Delagnes, 2000), using quartzite pebble hammerstones of similar size and weight.

A high-quality homogeneous flint sourced from north Norfolk (UK) was used throughout the experiment. This material used was of varying nodule size and morphology and features a thin (~5 mm) layer of chalky cortex. Cylindrical, globular and lenticular nodules were used and given the advantageous flintknapping qualities of the flint used, specifically the degree of homogeneity throughout the structure of the flint, heat-treatment was deemed unnecessary. In total, seven laminar and 13 Levallois elongated recurrent (unidirectional/bidirectional) reduction episodes were undertaken. Some of the blades produced are shown in Fig. 1.

Following reduction, all detaches pieces were categorised into two groups: complete (unretouched) blades and other products. Here, blades are defined as material produced from the exploitation surface of a Levallois core, or the circumference of a laminar core, where the overall length of the blade is twice its width or greater. This adheres to the conventional morphometric definition adopted elsewhere (e.g. inter alia Bar-Yosef and Kuhn, 1999; Inizan et al., 1999). All material which appeared to feature an elongation index of 1.75 or above was first catalogued as a blade, before being remeasured to ensure all material conformed to the 2:1 length-to-width ratio. Crested and semi-crested blades, Levallois core-edge blades (*éclats débordants*) and elongated core chunks were excluded from analyses. All blades were then labelled appropriately, stored, and measured following completion of all experiments. Blades with damaged edges were excluded as these would provide more erroneous edge angle results. In total, 195 laminar and 71 Levallois blades were complete, undamaged, and are examined in this article.

Six edge angle measurements were recorded for each blade examined. For this, a similar method to Eren and Lycett (2016: 385) was undertaken. First, a line bisecting the blade's axis of percussion (axial length) was drawn. Three orthogonal lines were then drawn at 25%, 50% and 75% intersections of the axial length, determining six edge angle locations. As all 266 featured complete edges, 1596 edge angle measurements were recorded in total.

In order to measure each edge angle (θ), the Dibble and Bernard (1980) 'Caliper method' was implemented. While there are a variety of methods for measuring edge angle, including the application of polar coordinate graph paper (Odell, 1979), clay impressions (Burgess and Kvamme, 1978) and goniometers (O'Brien and Lyman, 2000; Dogandžić et al., 2015), the Caliper method has been proven in comparison to be more accurate in reducing systematic error (Dibble and Bernard, 1980). This method allows an edge angle to be recorded from a thickness measurement taken at a predetermined distance from the blade edge,