Does Handaxe Shape Strongly Influence Cutting Performance? A Large-Scale Quantitative Experiment

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Introduction

Handaxes represent one of the most temporally enduring and geographically widespread of Palaeolithic artifacts and thus comprised a key technological strategy of many hominin populations. Archaeologically observable variation in the shape of handaxes has been frequently noted (e.g. Wynn and Tierson, 1990; Lycett, 2009). It is logical to ask whether some of this variability may have had functional implications. Certainly, functional explanations for handaxe form variation represent one of the few hypotheses that may be directly tested, and in turn, aid our understanding of the factors that may have been most relevant in determining patterns of shape diversity within the Acheulean technocomplex. Here, we report the results of a large-scale experiment designed to examine the influence of variation in handaxe shape on cutting efficiency.

Figure 1. The 500 handaxes forming the experimental assemblage utilized here.

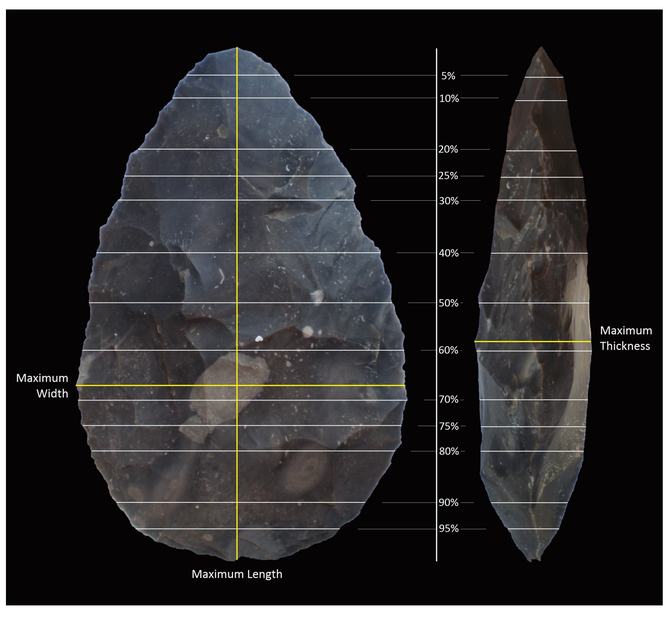

Figure 2. The 29 variables recorded form each handaxe.

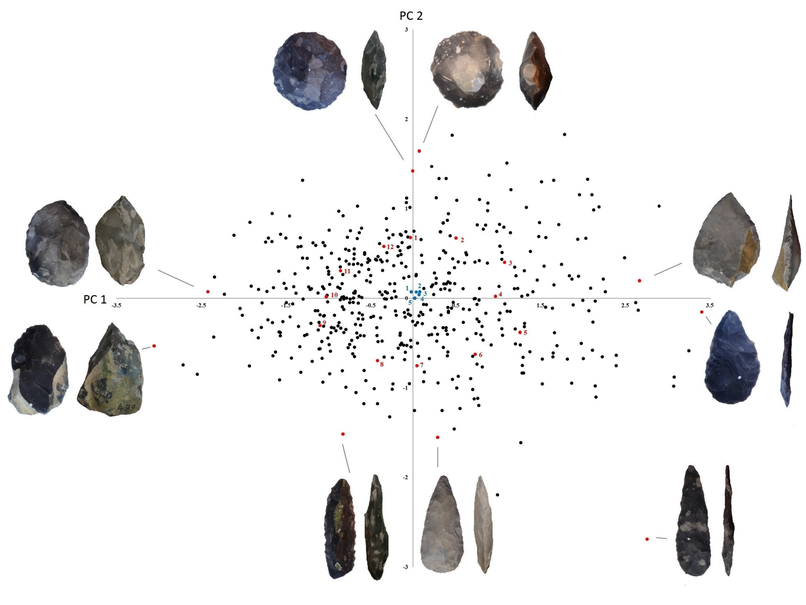

Figure 3. Handaxe shape variation as described by PC1 and PC2 .

Method

To examine how shape potentially influences a handaxe's cutting performance, a large and highly variable replica assemblage was produced (n = 500 handaxes; Figure 1). Subsequent to their orientation into a standardised position, shape was recorded for each handaxe through the measurement of 29 size-adjusted variables (Figure 2). Principal Component Analysis (PCA) transformed these measurements into a series of PCs describing shape variation within the assemblage. A plot of PC1 against PC2 can be seen in Figure 3.

Five participants each used 100 randomly distributed handaxes. Each tool was required to cut through 11 length of double-ply cardboard, three lengths of 6mm thick rope, and two lengths of (30x2mm) solid neoprene (Figure 4). Although not directly replicating Lower Paleolithic behaviors, the use of synthetic materials provided identical task conditions across all 500 handaxes and limited any impact that skill may have upon results. Cutting performance (efficiency) was recorded via the time taken to cut all lengths of material.

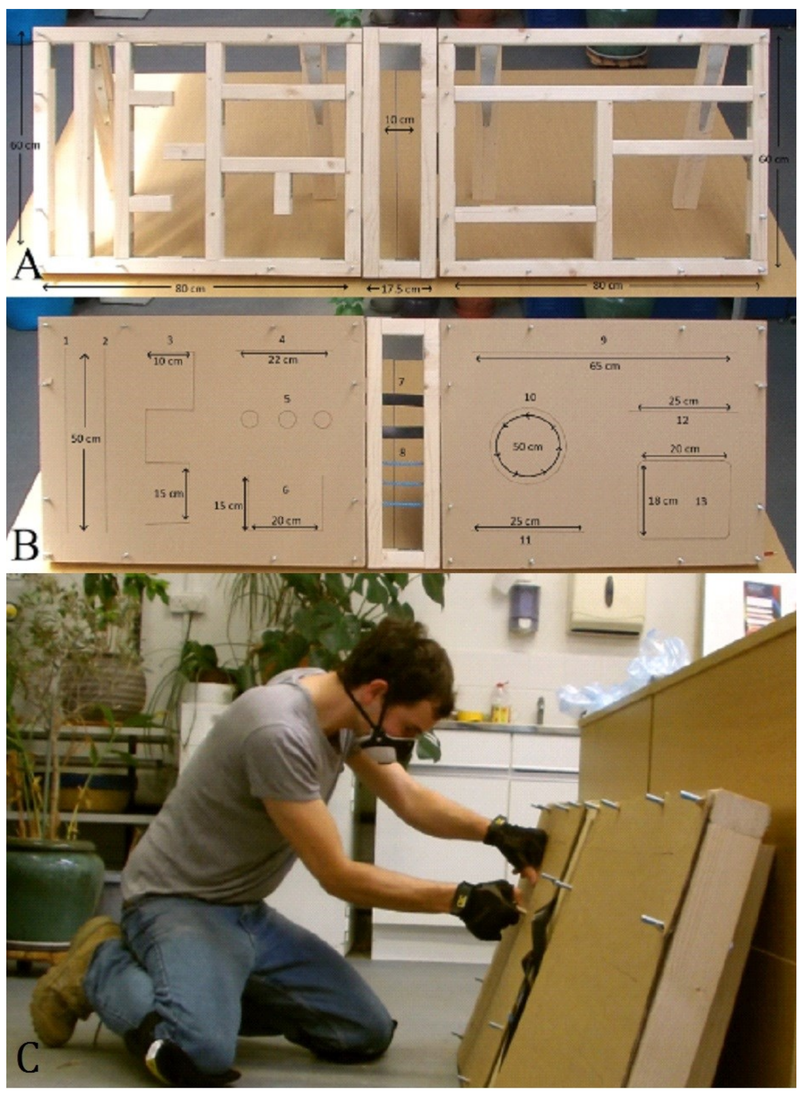

Figure 4. The wooden frame securing the materials in place (A), the lengths of cardboard, rope and neoprene cut (B), and an initial trial run of the experiment (C).

Results

Linear regression of PC1 against 'time taken' (recorded in seconds) did not identify a statistically significant relationship (p = .069). Multiple regression of the scores from PCs 1-6 similarly indicated there to be no significant relationship between handaxe shape and cutting efficiency. (p = .105). In sum, these analyses indicate that despite the considerable variability observed in the handaxe assemblage, shape variation had no significant impact upon cutting

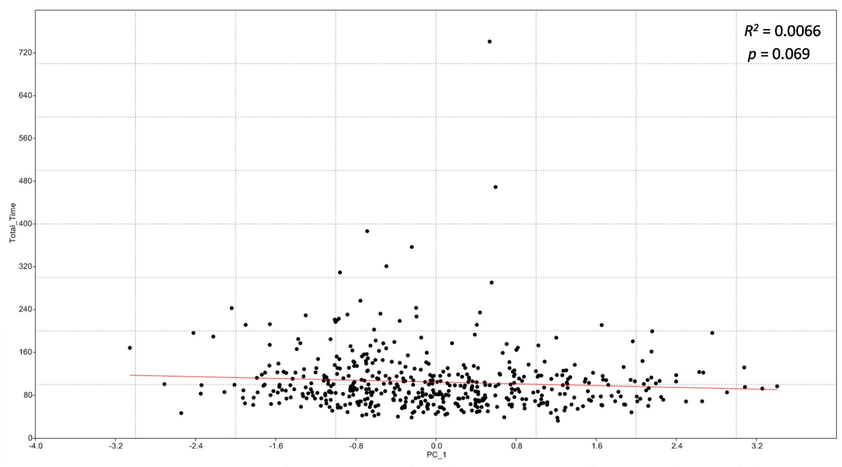

Figure 5. Regression of PC1 against handaxe cutting efficiency (seconds).

Discussion/Conclusion

We investigated the strength of any relationship between handaxe shape variation and cutting efficiency in order to aid understanding of the factors that may have produced shape variation in handaxe artifacts. Our results indicate that considerable variation in handaxe shape may occur independently of any strong effect upon cutting efficiency. Alternative influences (not related to functional utility) are, then, likely to explain the handaxe shape variation observed in the archaeological record. Previous research suggests that differing discard behaviors, raw material properties, reduction/ resharpening behaviors, and cultural factors may be responsible. In light of our results, the need for further research into these alternative hypotheses is highlighted. Our analyses took a broad approach to the investigation of handaxe shape. It remains to be seen whether more specific aspects of morphology significantly impact upon a handaxe's functional performance

References

Wynn, T., and Tierson, F., 1990. Regional comparison of the shapes of later Acheulean handaxes. *American Anthropologist*, 92: 73-84.

Lycett, S.J., 2009. Are Victoria West cores "proto-Levalois"? A phylogenetic assessment. *Journal of Human Evolution*, 56 (2): 175-191

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