WHAT IS THE SIGNIFICANCE OF BIPOLAR TECHNOLOGY IN THE EVOLUTION OF STONE TOOLS?

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The emergence of stone tool technology stands as a pivotal milestone in human evolution. Bipolar knapping (Figure 1), has been identified in the earliest archaeological evidence of hominin stone tool production[1]. And as such it may hold a crucial role in understanding the mechanisms behind the emergence of stone flake technology of our earliest ancestors. Bipolar knapping, which uses both hammerstone and anvils may represent a valid intermediary technology sharing aspects with both simple percussive behaviours, such as nut cracking and more complex knapping techniques[2].

2

WHAT IS BIPOLAR TECHNOLOGY?

Figure 1: Bipolar technology is a stone knapping technique where a core is placed on an anvil and struck with a hammerstone, causing fractures from both the impact and the counterforce from the anvil[3].

3

WHY STUDY BIPOLAR TECHNOLOGY?

- Hypothesized role in stone tool evolution[2]
- Technological resilience across time and space[4]
- Lack of clear diagnostic criteria – need for consistent identification[5,6]
- Raw material bias – expanding research beyond quartz[7,8]

4

RESEARCH QUESTIONS

RESEARCH QUESTION 1

What are the diachronic and synchronic trends in bipolar knapping throughout the Pleistocene and did it provide adaptive advantages over other stone tool production methods?

RESEARCH QUESTION 2

To what extent could the bipolar technique represent a precursor stage of hominin technological development prior to the onset of habitual freehand knapping?

RESEARCH QUESTION 3

Is it possible to consistently identify bipolar knapping products and differentiate them from other knapping techniques across raw materials?

METHODS

WORKPACKAGE 1 - SYSTEMATIC REVIEW

To address research question 1 I will conduct a large-scale systematic review of published archaeological and ethnographic evidence of bipolar technology throughout human evolution. Archaeological data will be the primary focus.

WORKPACKAGE 2 - EXPERIMENTAL ARCHAEOLOGY & KINEMATIC ANALYSIS

To address research question 2 a comparison of the kinematics and handgrips associated with bipolar knapping, freehand knapping, passive hammer knapping and nut cracking will be undertaken on a range of raw material types and morphologies.

Analysis of quantitative kinematic parameters, including the position of hammerstone, trajectory length, velocity, acceleration and kinetic energy across knapping techniques will be used to test whether the mechanics of bipolar knapping are more closely related to nut cracking than to other stone flake production methods.

WORKPACKAGE 3 - MACHINE LEARNING APPLICATION

To address research question 3 experimental assemblages produced during work package 2 will be subjected to techno-typological and quantitative analysis and machine learning approaches will be employed to differentiate bipolar knapping from other techniques across various raw materials.

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