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Finding the Paleoindian spearthrower: quantitative evidence for mechanically-assisted propulsion of lithic armatures during the North American Paleoindian Period

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ABSTRACT

Archaeologists have long assumed that fluted points were used by North American Paleoindians as spearthrower dart armatures despite a lack of empirical evidence of the spearthrower from the Paleoindian Period. Employing non-subjective, quantitative data derived from velocity-dependent microfracture features observed on damaged fluted and un-fluted Paleoindian lithic points, this research presents empirical evidence for the existence of the Paleoindian spearthrower. In addition, the research serves as proof-of-concept for a novel quantitative method of lithic analysis that has far-reaching potential to contribute significantly to our understanding of the human past.

1. Introduction

Since the initial discovery of stone tools in association with extinct Pleistocene fauna at Folsom, New Mexico (USA) in 1926 (Figgins, 1927), Paleoindian fluted point cultures have been at the forefront of American archeology. By the early 1980's, Clovis, the earliest fluted point complex, had been documented throughout most of the North American continent.

Although early Paleoindian research tended to focus on fluted points and big-game hunting, our perspective on Paleoindian cultures has since been tempered with the appreciation that even though these widespread assemblages share broad similarities, they nonetheless exhibit variations in regional point morphology, niche adaptations, and occupation dates (Willig, 1991). Despite this, the concept of a Clovis big-game hunting tradition persists due to repeated associations of Clovis cultural materials with the remains of extinct megafauna (*e.g.*, Frison and Todd, 1986; Graham et al., 1981; Haury, 1953; Haury et al., 1959; Hester, 1972; Laub et al., 1988; Leonhardy, 1966; Meltzer, 2014; Overstreet, 1996; Overstreet and Kolb, 2003; Sanchez et al. 2014; Sellards, 1952; Waguespack, 2007, 2012; Warnica, 1966).

Perhaps more than any other New World culture, the Clovis Paleoindian complex has been popularly defined by a single artifact form; the fluted Clovis point. While there is no doubt that fluted points were used to dispatch late-Pleistocene megafauna (Surovell and Waguespack, 2007; c.f. Speth et al. 2013), the question remains: *how* were these points used to bring down such large game? Surprisingly little is known about Clovis hunting practices, and although it is widely assumed that the fluted point was the primary weapon armature of the Clovis hunter, it is not known explicitly whether this weapon took the form of a thrust spear, thrown javelin, or mechanically propelled spearthrower dart, since no hafted fluted points have been recovered to date. Since the lives of hunter-gatherers are closely tied to their subsistence activities, the correct identification of Paleoindian subsistence technologies will ultimately lead to a better understanding of Paleoindians themselves.

A common perception of Paleoindian weaponry suggests that hafted fluted points were propelled with the use of a spearthrower (*e.g.*, Amick, 1996:414; Fagan, 1987:180–181; Frison, 1989:766), a device which allows a dart (rather than a spear *per se*, which is herein considered to be a thrusting weapon) to be launched with greater speed and a flatter trajectory than a hand-thrown javelin.

Attesting no doubt to the significant advantage afforded its user, the spearthrower has been shown to have an extremely broad spatial distribution that includes western Europe, the Americas, the circumpolar regions, Australia, Melanesia, and Micronesia (Hutchings and Brüchert, 1997:890). It is also a device of considerable antiquity, having been in use in the Old World since at least the Solutrean of Upper Paleolithic Europe approximately 18,000 years ago, and perhaps much earlier (Cattelain, 1989; cf., Caton-

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Thompson, 1946; Knecht, 1994). Consequently, there is no reason to assume that early migrants to the New World could not have possessed the device, but there is currently no empirical evidence that it was actually used by Paleoindian hunters.

Despite this, popular archeology textbooks have long described, and sometimes illustrated, Paleoindians employing spearthrowers to launch fluted point-tipped darts (*e.g.*, Fagan, 1987:180-181, 2005:121, 2013:291). PBS has even featured in one of its documentaries a prominent Paleoindian archaeologist demonstrating the effectiveness of (hypothetical) Clovis spearthrowers (Eder, 1988). Well-known experiments designed to test the performance capabilities of Clovis weaponry were conducted on elephant carcasses in the 1980s, and may have served to perpetuate the image among academics (Frison, 1989; Huckell, 1982). References to the probable existence of Paleoindian spearthrowers, in the Americas more commonly known by the Nahuatl term "*atlatl*" or ""*atl–atl*", are relatively persistent in the academic literature, for example:

> The association of Clovis type projectile points and mammoth remains in archaeological sites … has convinced most Paleoindian investigators that the Clovis projectile point used on a thrusting spear and/or with atlatl and dart was the weaponry used to kill the mammoths [Frison, 1989:766].
>
> Most of the [Folsom] projectile points recorded are fragments, presumably broken on impact during use as atlatl dart tips [Amick, 1996:414].
>
> Paleoindians used an atlatl, or spear-thrower, to increase the power and distance of their throws … [Ellis, 2013:Fig. 2.2].

Unfortunately, these, and similar statements offer no empirical evidence of the spearthrower during the Paleoindian period, nor do they offer references to the origin of the spearthrower hypothesis beyond supposition. It is not difficult, however, to understand why many people may assume that Paleoindians possessed this type of weaponry. The range and power advantage provided by the spearthrower (Cattelain, 1990; Hutchings and Brüchert, 1997; Rozoy, 1992; Stodiek, 1993), relative to the thrusting-spear or javelin, could have provided Paleoindian hunters with the ability to successfully penetrate the armor-like hides of mammoths (see Frison, 1989) greatly increasing a hunter's chance for success. Likewise, the device's portability likely permitted Clovis hunters to avoid alternative big game hunting technologies, such as traps or drives coupled with killing lances, thus maintaining a highly mobile subsistence strategy.

Opponents of the Clovis spearthrower hypothesis generally rely on normative arguments based on technological and morphological aspects of lithic armature design; specifically, that the appearance of notched points in the Archaic Period, which are generally smaller than Paleoindian lanceolate forms, signals the initial adoption of spearthrower technology. Wright (1995:35), for example, who argues that the spearthrower is associated with notched points, has created a model that traces the diffusion of the spearthrower from a source in the Archaic Southeast; in similar fashion, O'Brien and Wood (1998:96) also suggest an Archaic origin for the spearthrower. Gramly (1984), also relying on the interpretation of hafting technology, cites flute widths as a reflection of haft diameter to conclude that Clovis points were employed as spear armatures (rather than javelins, or spearthrower darts) at the Vail site.

Empirical evidence for the initial appearance of the spearthrower in the New World is undeniably early. Cockrell and Murphy (1978; see also Royal and Clark, 1960) report a shell spearthrower hook from Warm Mineral Springs, Florida, in association with human remains, in Early Archaic deposits dated between approximately 9000 and 10,000 years ago (see also Clausen et al., 1975). Other spearthrower hooks are reported from the Windust Phase at Marmes Rockshelter in Washington (Rice, 1972), dated between approximately 9000 and 10,000 years ago (Sheppard et al., 1987); from Fort Rock Cave, Oregon, dated approximately 8500 years ago (Cressman, 1977:105); and from the Roadcut site at Five Mile Rapids, Oregon, dated between approximately 7600 and 7900 years ago (Cressman, 1960:24, and Figs. 20 and 40).

Heite and Blume (1995:53) report a slate "bannerstone" from deposits dating to approximately 11,000 years ago at the Blueberry Hill site, Delaware. At least some items labeled "bannerstones" are reputed to have functioned as spearthrower weights, and if such is the case for the Blueberry Hill bannerstone, then it would prove to be the earliest artifactual evidence of the spearthrower in North America. The narrow, 0.9 cm diameter groove in this slate object (Heite and Blume, 1995:Fig. 28), however, suggests alternatively that it may be a grooved and shaped abrader, possibly a shaft smoother. If this object is indeed a shaft smoother, it seems a reasonable size for smoothing spearthrower dart shafts.

One is forced to conclude, therefore, that the earliest concrete evidence for the use of the spearthrower in the New World is currently represented by the spearthrower hooks from Warm Mineral Springs, and Marmes Rockshelter. The 9000 to 10,000 year old associated dates suggest that the spearthrower was in use by at least the Early Archaic Sub-Period.

This paper presents evidence derived from lithic fracture velocity for the existence of the spearthrower during the preceding Paleoindian Period. Data derived from prior replicative experimentation (Hutchings, 1997, 1999, 2011; Tomenchuk, 1985) have demonstrated that the instantaneous fracture velocity ($\dot{C}$) associated with a lithic fracture surface can be determined at the site of certain micro-topographic features on that fracture surface. Furthermore, since the derived fracture velocity is related to the specific loading event that produced the fracture, it is possible to relate the fracture velocity and loading rate of a damaged lithic armature to the delivery technology that was used originally to propel that armature (*e.g.*, spear, javelin, dart or arrow) (Hutchings, 2011). This paper employs such non-subjective, quantitative fracture velocity data derived from the damaged surfaces of North American Paleoindian points to demonstrate that at least some Paleoindian points were subject to much higher loading rates than can be achieved without mechanical assistance. Since North American archaeologists would generally agree that there is no supporting evidence for the use of the bow and arrow during the Paleoindian Period, the spearthrower is, therefore, indicated.

2. A brief review of method

Detailed overviews of the method employed in this research have appeared elsewhere (Hutchings, 1997, 1999, 2011), but its novel nature combined with its potential for significant contributions to the discipline necessitate at least a brief review of method and terminology. Readers intending to evaluate or employ the method for their own purposes, however, are directed to the detailed theoretical and methodological discussions found in Hutchings (1997, 1999, 2011).

The mechanical process of fracture in brittle solids, such as stone suitable for flint-knapping (*i.e.*, those that are both isotropic and cryptocrystalline), involves the "dynamic interaction of a progressing crack front with two elastic waves, the longitudinal (or dilational) wave, and the distortional (or transverse) wave. These waves are generated by the initial loading event (in the case of the longitudinal wave), and by bond rupture episodes along the [progressing] crack front" (in the case of the distortional wave) (Hutchings, 2011:1738; see also Tomenchuk, 1985: 437–438). These waves can, *but do not always*, leave macro- and micro-topographic,