

Letters to the Editor

A Forum for Commentary on Articles and Research Issues

Comment on Shea and Sisk's "Complex Projectile Technology"

Shea and Sisk, in a recent article in *PaleoAnthropology* (2010) argue that complex projectile weapons were "an enabling technology" for *Homo sapiens* populations expanding out of Africa. Complex projectile weapons improved hunting success, opened new niches related to hunting smaller game, and perhaps conferred success in aggressive encounters with other populations. As an aficionado of prehistoric weaponry, I find their model at least emotionally satisfying, but one incidental error must be corrected.

"Complex projectile technology" is defined by Shea and Sisk (2010:102) as "weapons systems that use energy stored exosomatically to propel relatively low mass projectiles at delivery speeds that are high enough to allow their user to inflict a lethal puncture wound on a target from a "safe" distance... The bow and arrow stores energy in the flexion of the bow. The spearthrower stores energy in the flexion of the dart." Unfortunately, the last statement is untrue, and this definition of CPTs becomes incorrect when it is applied to the spearthrower, or atlatl. Accurate understanding of the mechanical principles of prehistoric weaponry, as well as some practical ability to use them, is necessary to evaluate their functions and implications.

Although a good many people, including practiced atlatl users (Farmer 1994; Perkins 1992, 1995; 2000; Perkins and Leininger 1989; Lyons 2004), continue to believe that the flex of the spearthrower or the flex of the dart, or both, provide spring force to propel the projectile, this is not the case. The atlatl works as a lever, or more accurately, one lever added to the system of levers that is the body during the motion of throwing (Baugh 2003; Butler 1975; Cundy 1989; Hutchings and Bruchert 1997; Whittaker 2005, 2010). Specifically, the atlatl lengthens the lever arm at the wrist. By flexing the wrist rapidly a small distance, the distal end of the atlatl moves a much greater distance, and the spearthrower acts as a lever to impart energy to the dart. The motion is essentially the same as in a normal throw with a rock or a ball, where the final acceleration is imparted by "snapping" the wrist. However, the hand alone, flexing at the wrist, is a short lever arm. When the wrist flexes to propel a dart from an atlatl with the usual flipping motion (Figure 1), the atlatl provides a much longer lever arm, hence its mechanical advantage over throwing a javelin by hand alone.

It is true that both the dart and the spearthrower may flex during the throw. In a normal throw with most spearthrowers, the point of the projectile remains aimed at the target while the proximal end of the dart is flexed upward as the atlatl flips it away, and the dart then oscillates in flight until it stabilizes itself (see Figure 1). So the dart does

store energy in flexing, but this energy is expended in side-to-side oscillation; little or none of it helps to spring the dart forward. This can be confirmed very easily by setting a dart with its butt end on the floor, compressing it from the point until it flexes, and letting it spring up—it will not leap up from the floor more than a centimeter or two. Some atlatls also flex, and it makes intuitive sense that this flex would help propel the dart. Modeling the atlatl as a spring suggested to Baugh (1998; 2003) that a flexible atlatl could add 7–12% to the velocity of a dart. However, examination of high speed photos of a flexing atlatl and dart showed that in fact the dart has departed from the atlatl before the flexed atlatl has time to rebound and add its stored energy to the throw (Whittaker and Maginnis 2006; Whittaker 2010).



Figure 1. A typical throw with an atlatl. The atlatl flips the dart away. The flexing of the dart also can be seen.

Shea and Sisk's discussion of the implications of complex projectile weapons remains interesting and I am not quarrelling with it here. In fact, I would still refer to a spearthrower as a complex projectile weapon. It does not work by "storing energy exosomatically" but it uses one complex and compound tool to propel another. Perhaps a better definition of a complex projectile technology is one in which "human energy is mechanically enhanced or stored."

Finally, although spearthrowers precede bows all over the world, their mechanical principles are quite different. The bow acts as a spring, storing human energy in the draw; the atlatl acts as a lever, enhancing human energy in the throw. The spearthrower is thus not the inspirational ancestor of the bow, unless prehistoric people made the same mistake about how they work as some moderns.

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