APPENDIX

PREDICTIONS FROM THE THEORY

Introduction. A major function of theories is to provide a foundation for prediction. The bipedal use of weapons theory readily yields predictions about the results of future research. These can be used to test its scope and explanatory power, and to suggest new approaches to its subject matter. Such predictions are *theory-based hypotheses*.

In 2003 I wrote that if natural selection acted to enhance throwing and clubbing, this "leads to the prediction that the human hand should be adapted for throwing and clubbing" [p. 165], a forecast now fulfilled (Chapter 9). Fossils from *A. afarensis* [Drapeau, et al., 2005)], *Ar. ramidus* [Lovejoy, et al., 2009e, f], and *A. sediba* [Berger, et al., 2010a; Kivell, et al., 2011a, b] described since that prediction are consistent with it. I also predicted that selection for throwing and striking could account for the unprecedented ability of modern humans to throw missiles and swing clubs with power and accuracy" [p. 166]. This too was confirmed, as was the prediction that these motor behaviors have a strong genetic basis [Young, 2009, 2010] (Chapters 10, 13). Selection for upright stance and dynamic upright balance to enhance bipedal use of weapons was predicted to shed new light on the origins of bipedal locomotion. It "would have made upright locomotion more efficient, leading to its increasing use and eventually culminating in habitual bipedalism" [Young, 2003, p. 166]. This prediction has been examined in detail [Young, 2010] (Chapter 14) and shown to be compatible with current evidence. In what follows, additional features of human evolution are considered and twenty predictions about the outcome of future research are presented.

Predictions Concerning Ontogeny

PREDICTION: Evidence of the ontogeny of striking (scanty at present) will reveal that striking develops with a pattern similar to that of throwing, including the gender disparity and biomechanicalfeatures of the motion.

PREDICTION: Research on the development of accuracy in throwing and striking will show that it matures with the same development pattern as these motor behaviors and with a similar gender disparity.

Predictions Concerning the Central Nervous System

PREDICTION: The retinal image centered on the fovea will prove to be the center of the central nervous system=s aiming mechanism for throwing and club-swinging.

Comment. Aiming is a crucial part of throwing and striking. An aiming mechanism calculates the target's direction, size, distance, and movement. It is predicted that sensory input from the high-resolution visual center in the retina, the fovea centralis of the macula, defines the target for the CNS aiming system.

PREDICTION: Comparative anatomical studies will show that non-human primates

lack specialized neural structures and central control systems comparable to those that regulate the human throwing and club-swinging motions.

Comment. The human brain contains a widely distributed network of neural pathways that control these motor patterns (Chapter 15). Since the human throwing and club-swinging motions are unique, there should be some distinctive aspects in neural organization of the human CNS that are lacking in other primates.

PREDICTION: Neurophysiological studies of the lower limbs and pelvis during the act of throwing will be shown to be part of the same motor behavioral system that activates the upper body, with a similarly wide distribution in the brain.

Comment: This means the lower body will prove to be controlled by neuromotor commands that take into account torques (muscle, gravity, interaction, velocity-dependent) in a manner that generates a controlled pulse of energy that begins in and passes through the lower body before it is transferred to faster-moving, elements of the upper limb (Chapter 13).

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