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EDUCATION

Brainstorm: Changing Perspectives on Human Strength — Human Grip

TAGS: human hand, precision grip, power grip, clubbing, human grip, Marilia Coutinho, throwing



Introduction

Questions about who we really are, as a species, involving the equally important shaping factors of nature and nurture, apply to every aspect of our existence. Questions usually come in the form of:

1. "What is it?" (definition)
2. "How does it work?" (mechanisms and interactions)
3. "How did it come to be?" (evolution) and
4. "What shapes it?" (environment, society).

Human strength is no different. As with everything in this stage of knowledge production, we have a small volume of consensual models to address the first question, constantly being reshaped by new research, and the last three are predominantly not consensual, particularly the last two questions.

This version of my essay is published on a strength education platform where a larger part of the readership looks for practical answers to their training questions. As I've been showing for some years, some questions have universal answers. Most don't. And many times, the reasons why something doesn't work is related to the three last questions.



Today I'm going to address one line of scientific inquiry that has a direct impact on our current understanding of human strength: the changing view of the human grip.

Recent data suggest that the unique human hand grip might have evolved more as a consequence of adaptive forces favoring precision grip strength for throwing and clubbing than for manufacturing objects, as previously thought. The implications of this new perspective are far-reaching and include sports.

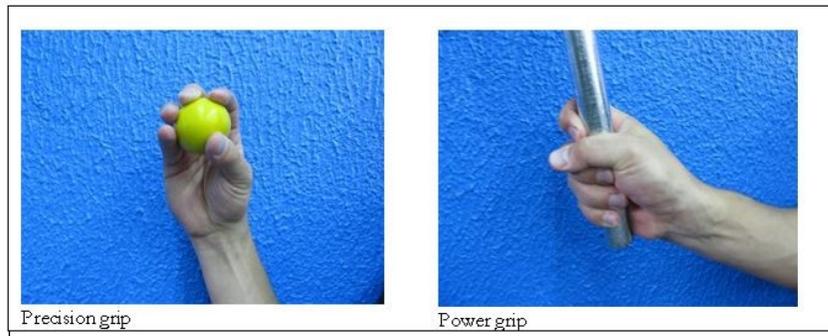
My goal with this article is to articulate several research contributions on the nature of grip and propose a more complex or nuanced view of human strength. Why? Because a new look at an old problem can help solve it.

Grip: Clubbing and Throwing Instead of Precision and Power?

The human hand and grip are evolutionary novelties. Other higher primates and even other orders of the mammal class have well developed manipulative abilities. The unique human hand structure with the oppositional thumb and fingers that flex in discreet internal rotation, its muscular, tendinous, ligamentous and bone arrangement to promote such rotation and the complex central and peripheral neural adaptations that went in tandem with the evolution of these items are exclusive to humans.

The hand grip, then, is one of the first things that characterize us as human.

The first studies about the human grip were conducted by J. Napier in 1962 (Napier 1962). Napier tried to explain the fossil records found in 1960 in Olduvai, Tanzania, dated at 1.7 million years and later classified as of the genus *Homo*. The species was identified as *Homo habilis* (skilled or handy man), the first in our genus. Napier's publication inaugurated the field of research on the evolution of the human hand and grip. Since then, much has been studied and published on the subject. Recent research in biomechanics and robotics confirm that early human fossils displayed human grip's unique characteristics (Marzke & Marzque 2000). Napier's original nomenclature concerning the two basic human grip types remained.



The human hand has always fascinated and intrigued scholars and artists. In 1883, German philosopher Friedrich Engels (Engels, republished in 1975) suggested that work/labor not only characterized Man but, in a sense, created Man as we know it.

Engels was not alone and his claims reflected a shared perception. It focused on this particular evolutionary path, the acquisition of this new trait that shaped the transition between other higher primates and the Homo genus: the availability of the hands for work. That would be the big evolutionary novelty: full bipedalism (for the still controversial discussion on the evolution of human bipedalism, see Tuttle 1981, McHenry et al 2000, Harcourt-Smith & William 2015).

These early thinkers were contemporaries to Darwin, whose "Origin of Species" was published in 1859. Not only that, but they were all evolutionary biology's biggest and most enthusiastic fans. It's not surprising that some simplification and over-generalization, along with heated fights, took place at the time (Hull 1973).

For them, the human hand would have suffered evolutionary adaptations that improved its skilled function almost as to accomplish the creation of Man as we know it (something we call "teleological process", or a process that evolves according to a pre-determined end, which is something that does not characterize evolutionary processes). The human hand would be, for them, not only the "organ" of work/labor but a product of it (Engels 1883).

For them, machines and all technology that shapes civilization would be expressions of human will over nature, by the human brain, created by the human hand. The hands would be the structures that can transform knowledge into objects and thus, transform nature.

This perspective didn't change much until recently and the human hands were considered "the brain in action" and the brain would be "the thinking hands". Bottom line, the human hand is "made for" work, a structure evolved "for" the manufacture of objects. Therefore, for precision (Hills 1992).

Reality, however, is a bit more complicated. First: nothing evolves "for" anything. Evolution doesn't have an "arrow of time". Nothing is "more evolved" than anything else, in the present or the past. Living beings are more or less "derived" (from their common ancestor) and features arise and disappear as a result of selective pressure, which is

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random. Everything looks just right and amazing as if it evolved to reach this point. But it didn't: add or subtract a few million years and that structure won't be adaptive anymore and the organism won't exist.

This perspective of evolution (random mutation and contextual selection) is consensus among biologists since at least 1943 (Smocovitis 1992) but the "skilled human hand" view persisted until at least 2003, when it was shaken by an article published in the "Hypothesis" section of the Journal of Anatomy (Young 2003).

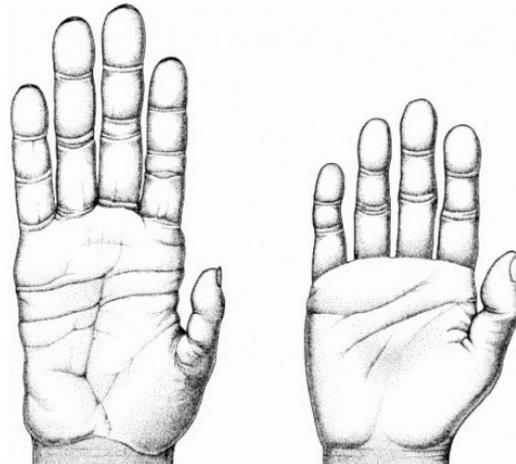
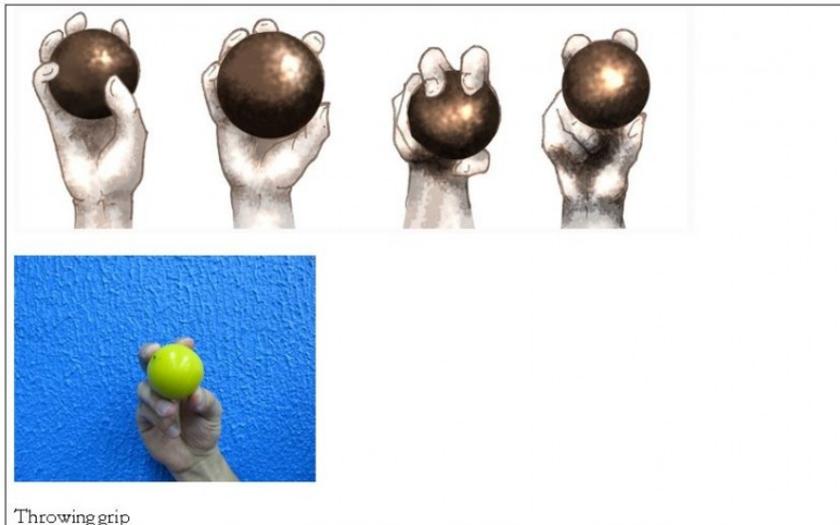
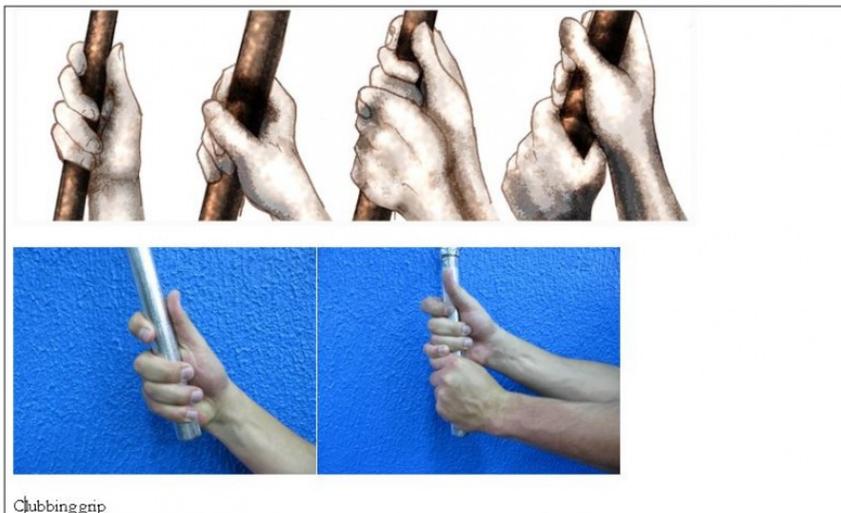


Fig. 1 Chimpanzee hand, a model for the hand of the hominid ancestor (left), and the human hand.

Young suggested that the two original grip types identified by Napier as "precision" and "power" could be better described as "throwing" and "clubbing".



Throwing grip



Clubbinggrip

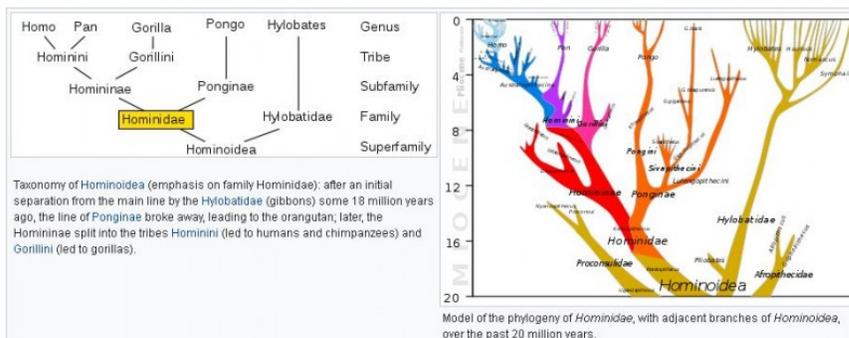
He suggested that hominids derived from a group of primates that were selected for the advantage of successfully throwing rocks and clubbing each other (or other animals).

The reproductive advantage is related to increased access to limited food resources (higher hunting success) and, for males, successful access to females. For females, it would result in an improved ability to defend progeny.

On this line, Lombardo and Deaner (2018a, 2018b) suggest that the throwing feature emerged as an adaptation to exerting threat and fighting and later incorporated into hunting. Their research, relying on data from “the sex differences in throwing speed, distance, and accuracy; sex differences in the development of the throwing motion; inability of training or cultural influences to erase the sex differences in throwing; sex differences in the use of throwing in sports, combat, and hunting; and sex differences in anatomical traits associated with throwing”, suggest that throwing is a male adaptation. Apparently, not only throwing dexterity but upper body strength and ability to use the hands to succeed in hunting tasks is more highly developed in males and might have been evolutionary adaptations at the neural, anatomical and general physiological levels (Apicella 2014).

As expected, this is a controversial claim and we certainly don't have the full (genetic, neurologic and physiological) story since human females also exhibit high throwing dexterity.

We might have to go back even a few extra million years to get a better grasp of this: Carrier and Cunningham (2017) suggested that hominids, or great apes, have feet in which the heel supports body weight during standing, walking and running (this is part of the development of full bipedalism in humans). According to them, one possible advantage of this plantigrade foot posture is that it may enhance fighting performance by increasing the ability to apply free moments (i.e. force couples) to the ground. The collected data supports their hypothesis (Carrier & Cunningham 2017).



Modern physiological and biomechanical human features suggest peripheral and central neural adaptations for the suggested grip skills. Throwing requires a high degree of accuracy and 1-millisecond delay in indicator finger extension generates a 2.2° deviation in a projectile direction.

Clubbing requires anatomic-physiological adaptations for shock absorption, adaptations for driving the path of a club that are perfectly compatible with the muscular, ligamentous and tendinous structure of the hand, as well as the cortical structures and responses to object manipulation (Young 2003).

Hand grip and full bipedalism would have co-evolved as biomechanical and neural adaptations for throwing and clubbing (balance, coordination, and agility in the erect position, with new core control features), rather than tool manufacturing.

The anatomical fossil record of the throwing and clubbing adapted human hand predates the archeological record of hand-made artifacts (tools).

For example, the hand of *A. afarensis*, which is dated at 3.2 Mya, shows many features of the modern human hand, yet antedates the earliest identified stone tools (2.6 Mya). The hand bones assigned to *Ardipithecus ramidus kadabba*, the earliest known hominid (5.8 Mya) are similar to those of *A. afarensis*.

The delay between the first archeological records of tool-making activity and the paleontological record of a fully skilled human hand are the strongest evidence in favor of the hypothesis of the sequence of evolutionary adaptive forces consisting of “threatening and fighting”, “hunting” and “tool making”.

However, this interpretation is far from consensual. The same co-evolving process could support an entirely different argument, as presented by Whiten and Erdal (2012). The big question is how did hominids, until then competing for a mostly herbivore trophic niche, transition to a foraging strategy that included large mammals, competing with specialized carnivores? Whiten and Erdal suggest that Hominids' hunting efficiency would be the result of the:

“evolution of a new socio-cognitive niche, the principal components of which include forms of cooperation, egalitarianism, mindreading (also known as ‘theory of mind’), language and cultural transmission, that go far beyond the most comparable phenomena in other primates. This cognitive and behavioral complex allows a human hunter-gatherer band to function as a unique and highly competitive predatory organism.”

Other authors ask an even simpler question: who says tool making evidence is restricted to stone tools? What if tools that can't leave an archeological record were being produced much earlier or if there is indirect evidence of tool use, such as stone-inflicted-marks on bones of what were presumably prey animals (Kivell 2015, McPherron et al 2010)?

Worse: What if the missing archeological evidence is found (Harmand et al 2015)? Harmand and collaborators' finding is 3.3 Mya, contemporary to *A. afarensis*. One could always hold on to the “fighting/hunting came first” hypothesis based on 5.8 Mya *Ardipithecus ramidus kadabba* but the argument gets weaker.

Concluding Remarks

Science does not evolve linearly and the mechanisms by which leaps are made are the object of controversies that you truly believe will never come to an end. From Kuhn's paradigm shift (Kuhn 1962), Latour's “science in action” (Latour 1987), or even waiting for a crucial experiment to falsify everything but one model as Popper (2014, collected works) would predict (or recommend) science is always a messy provisional truth (Pickering 1992).

As of now, a group of us is favoring a view of science in which not only it is not paralyzed by controversy and uncertainty, but it must and does go on, generates practical guidelines for society and progresses in a state of “mess”, transdisciplinarity and diversity (Funtowics 2018, Nowotny 2004, Gibbons ed 1994).

A subject as crucial to the concept of Man as the human hand and grip was taking too long to attract heated controversy. It did and controversy won't go away that soon.

A critical analysis of the literature on the human hand, grip, and implications to health and training show one thing above all: it is one of the very poorly understood subjects in human movement. Human grip strength is highly correlated to general health and causal relations are still unknown (Hairi et al 2010, Rantanen et al. 1999, Rønningen & Kjekens 2008, Tietjen-Smith et al 2006, Mathiowetz et al 1985, Guralnik et al 1994, Fukumori et al 2015, Bentley et al 2018); grip strength may be a predictor of athletic performance variation (Kurz 2001) and a predictor in athletic performance at least in the martial arts (Iermakov et al 2016); the amount of scientific information on grip training is negligible. Yet, any coach knows it is feasible.

What does the nature and evolution of the human hand and grip mean to sports scientists and educated sports enthusiasts?

- That it's a good idea to appreciate how poorly understood the human grip still is. In spite of all the protocols concerning grip training, much less is known concerning transference, inhibition and trainability in general than for other sports-relevant human gestures.
- That given the critical evolutionary role of the human grip, we should expect evidence concerning its implications on health, on sports and social life to significantly grow.
- That it is possible that fighting is the one basic human feature that defines us as a species and that this is retained on our genome. What this means is speculative. To me, it means an even greater appreciation of combat sports.
- That humans are probably hard-wired for strength and also for aggression. Both can be domesticated, turned into culture and beauty.

The reading of Young's (2003) article deeply changed my concept of human strength and Humanity itself. I have no idea what it will do to you, my reader. I hope whatever impact it causes leads you to a better, deeper understanding of your own strength and about us, as a species.

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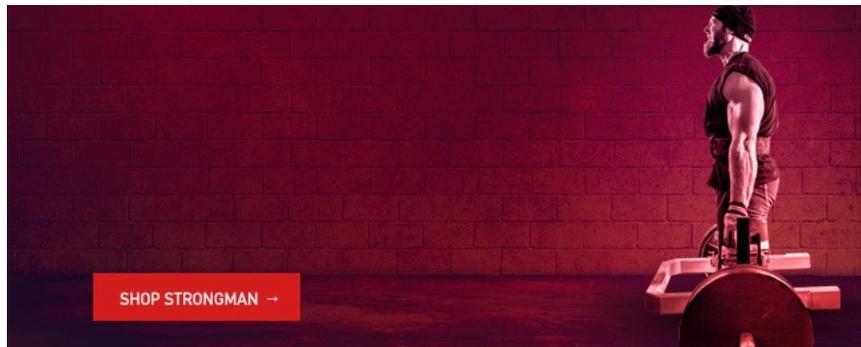
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Acknowledgments

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