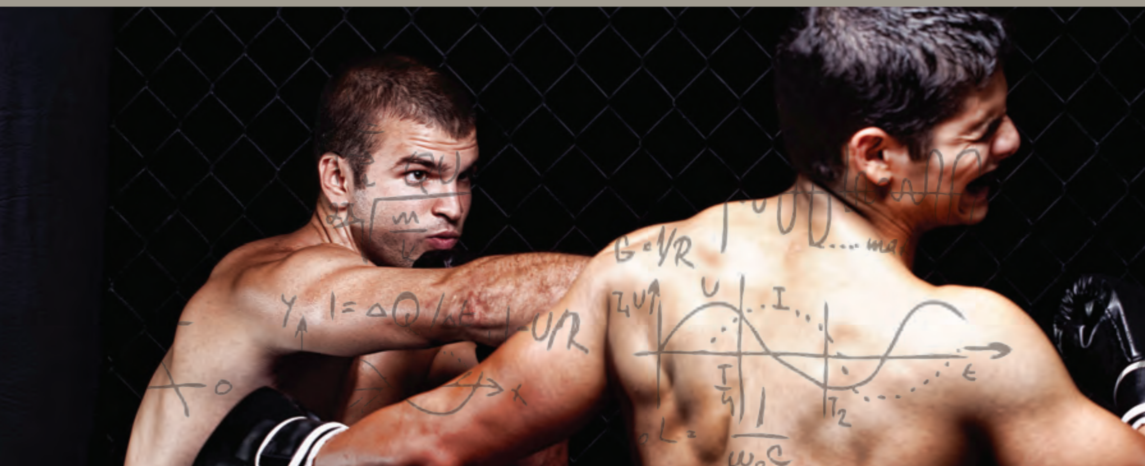
FIGHT LIKE A PHYSICIST

The Incredible Science Behind Martial Arts



Make physics your advantage **in the ring and on the street**

See through the *illusion of safety* provided by gloves and helmets
Reduce traumatic brain injury **in contact sports**
Give the esoteric side of martial arts a *reality check*

JASON THALKEN, PHD

MARTIAL ARTS

B3389

CRUSHES MYTHS. UTTERLY BRILLIANT!

"A cool concept that makes physics tangible for fans of fighting sports." —Jeff Fleischer, *Foreword Reviews*

"I devoured this fascinating book." —Loren W. Christensen, author, martial artist, Master Hall of Fame inductee

"Engaging and entertaining, packed with invaluable information. Wholeheartedly recommended!" —Lawrence A. Kane, author, martial artist

"Martial arts are cool, martial arts science is cooler. Fun and informative for the martial geek in us all." —Rory Miller, author, martial artist

"Answers the question, WHY?" —Michelle Waterson, AMMA, former Invicta FC Atomweight Champion

"Crushes myths, utterly brilliant! Understand more, train smarter, be smarter." —Kris Wilder, author, martial artist

An in-depth look into the physics behind martial arts

Whether you are an experienced martial artist or a curious enthusiast, this book gives you an "unfair advantage" by unraveling the complex science of effective fighting techniques and examining the core principles that make them work. Did you know?

- Momentum is for knocking people over
- Energy is for breaking bones and causing pain
- A haymaker travels 3.14159 times farther than a jab
- You are only an "object" when you are rigid

Fight Like a Physicist blends inquiry, skepticism, and irreverent humor—all while punching holes in myth and mysticism. Highlights include

- Making physics your "unfair advantage," in the ring and on the street
- Examining center of mass, pi, levers, wedges, angular momentum, and linear momentum for martial artists
- Reducing traumatic brain injury in contact sports
- Exposing the illusion of safety provided by gloves and helmets
- Overturning conventional wisdom on compliance during an assault
- Busting up Hollywood action clichés

Fight Like a Physicist reads like a manifesto on the rational practice of martial arts. It's intelligent, fun, and dangerous—and nothing short of iconoclastic.

Jason Thalken has a PhD in computational condensed matter physics, and bachelor's degrees in physics, mathematics, and philosophy, and is the holder of eight patents. He has studied and competed in numerous martial arts styles and has a black belt in hapkido. Jason Thalken resides in Seattle, Washington.

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Praise for *Fight Like a Physicist . . .*

"*Fight Like a Physicist* is a cool concept that makes physics tangible for fans of fighting sports."

—Jeff Fleischer, *Foreword Reviews*

"I have over five decades' experience in the martial arts but I found myself going, 'Really?' 'Cool!' and 'I didn't know that' as I devoured this fascinating book.

"Thalken is a fresh voice on the martial arts scene, with an easy-to-understand writing style, fascinating insights, and info you can use now."

—Loren W. Christensen, author, martial artist since 1965,
Masters Hall of Fame inductee

"At a time when all too many martial arts authors pretend to be the font of all wisdom, Thalken refreshingly encourages readers to question, assess, and try things out for themselves. In fact, he outright challenges us to 'break everything,' testing assumptions and limits on our own terms. More importantly, he lays out how to do just that, examining biomechanics, injuries, myths, and martial pseudoscience in depth. Written in an unusually engaging and entertaining manner, this book is packed with invaluable information. I wholeheartedly recommend it for anybody who is serious about martial arts!"

—Lawrence A. Kane, martial artist, best-selling author of
Surviving Armed Assaults

"Martial arts are cool, but martial science is cooler. In *Fight Like a Physicist* Jason Thalken exuberantly unpeels some of the science behind this fun, beautiful, complex, scary, and dangerous thing called fighting. Fun and informative, *Fight Like a Physicist* appeals to both the science and the martial geek in us all."

—Rory Miller, author of *Meditations on Violence*

"The book answers the question of why. Oftentimes fighters look for an answer to justify why we do certain things. Once you understand the physics of the technique the fighter is able to enhance their ability to produce a more desired outcome."

—Michelle Waterson, American mixed martial artist,
former Invicta FC atomweight champion.
Known as the "Karate Hottie."

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"Make physics your advantage in the ring and on the street. See through the illusion of safety provided by gloves and helmets. Reduce traumatic brain injury in contact sports. Give the esoteric side of martial arts a reality check."—Cover.

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Summary: An in-depth, sometimes whimsical look into the physics behind effective fighting techniques and examining the core principles that make them work: momentum, energy, center of mass, levers and wedges. It also exposes the illusion of safety provided by gloves and helmets, aiding the reader in reducing traumatic brain injury in martial arts, boxing, and other contact sports.—Publisher.

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INTRODUCTION

Fight Like a Physicist

"A black belt only covers two inches of your ass. You have to cover the rest."

—Royce Gracie

What is physics?

If someone had asked me to define physics during my senior year of high school, I would have confidently answered, "The study of mechanics and electricity." If someone had asked me that same question as an undergraduate, I would have added a few more topics to the list, such as optics or quantum mechanics, but the confidence would be gone. By the time I was doing my own research and working on my dissertation, my answer would have been a very confused and defeated, "I don't even know anymore."

The truth of the matter is physics is better defined by approach than by subject matter. A physicist is someone who uses observation and mathematics to unravel the structure behind this complicated universe, and then uses that understanding to make predictions about how the universe will behave in the future. Physicists will always venture into new areas (martial arts, for instance), but you can spot them by their search for structure, their love of mathematics, and their skeptical-yet-curious approach to learning something new.

When it comes to physics, the universe doesn't care about your degree.

The single most beautiful thing about studying physics and mathematics is that the truth comes from the real world, and not a textbook or a teacher. No matter how well renowned a scientist may be, the truth of his claims comes from testing and verification in the real world, and not from his reputation. Anyone, even an amateur scientist, can make a big discovery, and anyone, including the most famous scientists, can be proven wrong. The point is no degree, no authority, and no social status can ever make a scientist "right." Testable and reproducible results out in the real world hold all the power.

Michael Faraday is an exemplary case of an amateur who found success in the sciences. Faraday was born into a lower-class family in 1791 in London, had only a rudimentary education, and took it upon himself to develop his mind. From the age of fourteen he started an apprenticeship at a bookbinder's shop, and he took full advantage of the situation by reading at every opportunity. When given tickets to attend lectures hosted by renowned chemist Humphry Davy, Faraday took detailed notes and compiled them into a three-hundred-page book he sent to Davy, along with a request for employment. Davy was impressed, and later hired Faraday to work in his lab. Over the course of many years, Faraday's own accomplishments far surpassed those of Humphry Davy. Faraday was the first scientist to draw lines of force describing electric fields, and he built the first electric motor, transformer, and generator. He was one of the most influential scientists of his generation and did it all without any formal education or even an intermediate understanding of mathematics.

On the other side of that coin is a story from the later years of Einstein's career. Albert Einstein had earned his place as one of the most highly esteemed physicists of all time. He is still a household name today, nearly sixty years after his death. He was so well respected that when he wrote an unsolicited letter to Franklin Roosevelt in 1939 about the possibility of the Germans developing an atomic bomb, the president of the United States took Einstein's advice and launched the Manhattan Project to make sure US forces achieved that capability first. Despite having what was possibly the greatest academic reputation of all time, Einstein was strongly opposed to some of the fundamental principles behind the newly emerging field of quantum mechanics. His famous quote, "God does not play dice with the universe," refers to his distaste for the inherent randomness of quantum mechanics, and he took that opposition with him all the way to the grave. In the end it didn't matter what Einstein thought. Quantum mechanics gives us results we can test in the real world. Results that ultimately enabled the development of technologies like the very small transistors in the CPU of your computer or smartphone, scanning tunneling microscopes, and MRI machines. The universe didn't care about Einstein's reputation. He was wrong.

When it comes to martial arts, the ring doesn't care what color your belt is.

Combat sports and self-defense training both share something very special with physics and mathematics: the effectiveness to their techniques and training lies outside in the real world. Anyone can make up a new technique, and even the greatest grandmaster's favorite technique can be found useless. Just as in physics, no authority, no belt, and no status can make a martial artist's techniques effective. Testable and reproducible results hold all the power.

While *vale tudo*, or "no-rules" martial arts matches featuring fighters from different styles have been around for nearly a century in Brazil, something very special happened during the Ultimate Fighting Championship tournament (later renamed UFC 1) in 1993. In addition to selling tickets to watch the tournament live, the promoters made the event available on cable via pay-per-view, and, most importantly, released the footage on video. What they had unknowingly started was a culture of video record keeping for fights, and it would change martial arts forever.

For the entirety of human history before that event, anytime two martial artists fought, either in private or as part of a public exhibition or tournament, each fighter, referee, reporter, and spectator in attendance would leave the event and then embellish, exaggerate, and outright lie about the details of the fight. Whether it was done to protect an ego or to sensationalize a story, the prevalence of these fight lies made it nearly impossible to know what really worked and what did not in a real-life scenario.

The success of UFC 1 led to a continued UFC series, and soon there were multiple televised and recorded vale tudo leagues throughout the United States, Brazil, and Japan. After struggling to gain acceptance for years, the sport of mixed martial arts (MMA) finally took off in the early 2000s, and the UFC's popularity (and paycheck) grew enough to not only attract some of the best fighters from around the world, but also spawn a whole new generation of athletes training specifically for MMA. By this time not only were there more than ten years of recorded and documented fight histories across several different vale tudo circuits, but the UFC's presence was so strong, anyone claiming to have exceptional skill or technique would be obliged to answer the question, "If you're so good, then why aren't you fighting in the UFC right now, or training one of the top fighters?"

CHAPTER 1

Your Center of Mass

Where is my center of mass, and why do I care?

Your center of mass is typically located about an inch below your belly button, halfway between your back and your front, and it acts as a central location for all sorts of external forces, like gravity or push kicks. Contrary to popular belief, large breasts (either real or fake) tend to weigh less than two pounds each, and they are not heavy enough to cause a noticeable shift in the center of mass and make a person "top heavy." Muscles, on the other hand, can be very heavy, so professional body builders with extensive muscle mass near the top of their frame may have a higher center of mass by a few inches.

One interesting property of the center of mass is that it tells us where we are balanced. If you want to balance yourself across a horizontal pole like a handrail or a swing, you need to place your center of mass directly over it. The same is true for inanimate objects. If a waiter wants to carry a tray of food in one hand, he

Figure 1-1. The center of mass for some common household objects. Babies are born with their center of mass up in their chest because of their gigantic heads, but it slowly approaches their belly button (where yours is) by the time they start walking.

needs to place his hand underneath the center of mass of the tray and all the food resting on it.

A lesser-known property of the center of mass is that it also determines whether an applied force pushes an object back or rotates it. If you strike or push an object far away from its center of mass, the object will spin. If you strike or push directly into the center of mass, the object will not spin, but it will move in the same direction as the applied force.

In order to put all this together, let's imagine a scenario where you are running around like an idiot, not watching where you are going, when you run right into a fence. If that fence is as tall as your center of mass or taller, it will bring you to a stop. If it had been a high horizontal pole instead of a fence, some of the impact would have rotated your body, creating the clothesline effect we see in slapstick comedies and horrible action movies. If the fence

CHAPTER 2

Energy, Momentum, and the "Hit Points" Myth

In the early 1970s Dave Arneson and Gary Gygax began working together to develop a fantasy role-playing game that would later become the very famous Dungeons and Dragons franchise. They took inspiration from miniature war games played with armies and adapted the rules to apply to an individual character customized by each player. Because the players became attached to their characters, Arneson and Gygax realized instant death was far too dire a consequence for losing a die roll against an opponent. As a solution to this problem, they created "hit points," a number representing the general health of the character, which would diminish with each additional injury until the character eventually died. Today we have video games with incredibly lifelike graphics, extensive online multiplayer participation from around the globe, and sprawling maps with seemingly endless choices for your gameplay experience, but with very few exceptions, we still follow the same "hit point" philosophy laid out by Arneson and Gygax more than forty years ago.

To some degree we all internalize a "hit point" concept when we think about fighting. Fights are too chaotic to plan the purpose and intended outcome of every single punch and kick, so adopting the philosophy of "each punch I land gets me closer to my goal" makes dealing with the uncertainty of a fight more manageable. The problem with thinking in terms of "hit points" comes when we start to ask questions about what makes individual techniques effective, or what it really takes to end a fight.

In real life a punch is a complex and intricate process. At the point of impact, your fist will compress, as will your opponent's body, and depending on the relative speed and rigidity of both you and your opponent at the location of impact, your opponent's body may continue to compress locally, or it may begin to move on either a local or a global scale. Depending on your technique, as well as the resistance provided by your opponent's body, your muscles might apply additional force after the moment of impact. There is a lot going on every time you send your knuckles on a journey, and no single measurement can be taken to determine how many "hit points" a punch will take away. In later chapters we will take some empirical measurements and look into the details of some specific punches, but for now we will skip over all the complications that occur at the moment of impact, and instead we will focus on two separate quantities you transfer to your opponent every time you hit him: momentum and energy. If you can develop an intuitive feeling for what each of these does to your opponent, and you learn how to throw a high-momentum punch versus a high-energy punch, you will give yourself much more control over the outcome of your fights.

Momentum is for knocking people over.

Let's imagine a friend of yours throws his car keys right at your chest. It might hurt, and you might even get a small cut or bruise, but one thing those keys will definitely not do is knock you over

CHAPTER 3

The Number Pi and Glancing Blows

The number pi, represented by the Greek symbol π, is defined to be the circumference of a circle (the distance all the way around the outside) divided by the diameter of that circle (the straight-line distance right through the middle). π is a fundamental constant of the universe we live in, with an infinite number of decimal places that never ends or repeats. Somewhere, buried deep within the digits of π, you can find your phone number, your birthday, and any other combination of numbers you can dream up. Even though it is impossible for us to ever know the exact value of π, we can use the first few digits to build an understanding of the relationship between linear and circular motion.

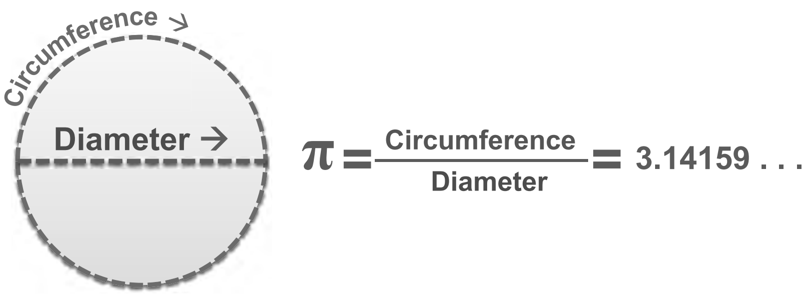

Figure 3-1. Definition of the number pi. Pi is a constant ratio for all circles regardless of size, and it is an irrational number that never repeats and never ends.

A haymaker travels 3.14159 times farther than a jab.

The shortest distance between any two points is a straight line, so it is no surprise to hear that a jab is faster than a classic reach-back-and-swing-around haymaker, but if we want to know just how much faster, we can figure it out using the definition of π.

A jab covers a distance of half a diameter (one radius), while the haymaker covers half a diameter on the reach back, and then half a circumference on the delivery. If the circumference divided by the diameter is π, then half the circumference divided by half the diameter must also be π, so the haymaker punch travels 3.14159 times the distance of the jab. If we include the reach back, this number becomes $\pi + 1$, or 4.14159.

You could throw four straight punches by the time the haymaker finds its way to you, but that assumes your fist and your opponent's fist are both traveling at the same speed. If we consider a more likely scenario where your jab is traveling twice as fast, there are now eight straight punches to one haymaker. This eight-to-one ratio is why most martial artists don't spend very much time training for haymaker defense; it is just too easy for them to waste their time on. This is also why so many martial artists, when sharing stories about applying their skills in real-life situations, start

CHAPTER 4

Levers, Wedges, and Free Lunches

There are no free lunches.

All of the matter and energy around us can be neither created nor destroyed under normal circumstances, but it can change form. Matter changes into energy under immense gravitational pressure in the giant fusion reactor that is our sun. That solar energy is converted to chemical energy in the leaves of a plant and stored as sugar, the chemical energy from sugar is turned into mechanical energy in your muscles, and that mechanical energy is used to punch people's faces. While it may be awesome that every punch you throw harnesses the power of the sun, the whole process also puts some very real limits on what we are capable of.

When it comes to energy, there really are no free lunches. No matter how hard you try, it is impossible to create or destroy energy. The universe is not a mint that can print free money. It is more like a currency exchange. You can change your dollars into

Figure 4-1. Lunch. This is not free.

euros, euros into yen, and yen back into dollars, but no matter how you change it, you never have more money than you started with. You can change one kind of energy into another kind of energy all day long, but making new energy out of nothing is not possible in our universe.

Levers give up distance for more force.

A lever is a rigid arm that can rotate around a fixed point called a fulcrum, and it allows you to apply a force at one location on the lever and use that force to move an object at a different location on the lever.

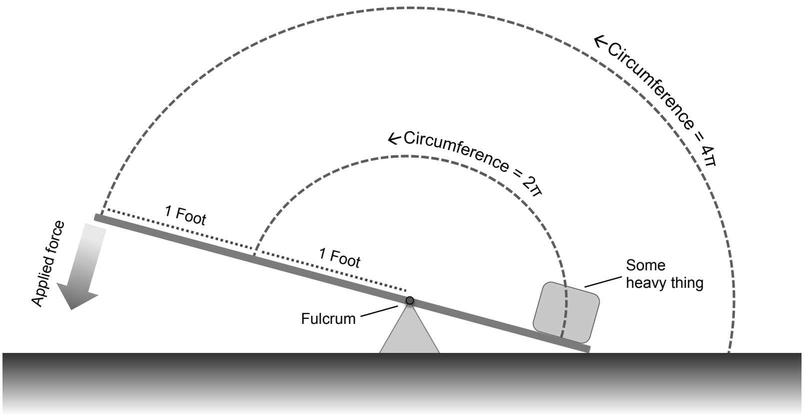

Figure 4-2. Diagram of a simple lever. If you apply a force two feet from the fulcrum, and some heavy thing sits one foot from the fulcrum, the heavy thing moves half your distance, but with twice the force.

Assuming you apply a constant force, you can calculate the energy spent pushing on the lever with the equation $E=F\cdot x$ (energy equals force times distance). Even though we tend to only move a small distance when we use levers, you can see in figure 4-2 that we are actually applying our force along the circumference of a circle. In chapter 3 we learned the circumference of a circle is π times the diameter, so if we apply a force, F, to a lever 2 feet away from the fulcrum (4-foot diameter), and we apply that force over 1⁄12 of the circumference of the circle (30 degrees), our total energy spent is

$$E = F_{applied}\,\frac{4\pi}{12}$$

Since the lever does not bend, we know if we moved 1⁄12 of a circle when we applied our force, every point on the lever must have also moved 1⁄12 of a circle, including the part of the lever supporting the heavy thing. If we want to calculate the energy spent moving the heavy thing, which is located one foot from the fulcrum (2 feet in diameter) we can write it as

$$E = F_{heavy\ thing} \frac{2\pi}{12}$$

Since we cannot create or destroy energy (no free lunches!), then the energy spent pushing on the lever must be equal to the energy spent lifting the heavy thing.

$$F_{applied} \frac{4\pi}{12} = F_{heavy\ thing} \frac{2\pi}{12}$$

Solving that equation for the force pushing up on the heavy thing gives us

$$F_{heavy\ thing} = 2F_{applied}$$

So when we push on a lever at a distance twice as far from the fulcrum, we can apply twice the force. If we push on a lever at three times the distance from the fulcrum, we can apply three times the force. We can use the this force-distance tradeoff to lift heavy things, like using a car jack to lift a car, or to break sturdy things, like using a crowbar to tear open a padlock or using a bottle opener to open a beer.

The first lesson to learn here is anytime you are applying leverage to your opponent, whether you are controlling his head in a muay Thai clinch or submitting him with *juji gatame* (the classic grappling arm bar), you should do your best to put as much distance as possible between your applied force and the fulcrum. A second, slightly less obvious lesson we can learn is the natural path of any lever is circular, rather than linear, where the distance from the fulcrum determines the size of the circle. The circular path of leverage is incredibly important for small-joint manipulation. If you grab two of your opponent's fingers and pull them back, you may annoy him or cause him to move his arm, but if you twist those same two fingers around in a tight circular path with a fulcrum at the base of the fingers, the pain can drop him to his knees

CHAPTER 5

Knockouts and Brain Damage in Athletes

Brain damage is an invisible killer.

Professional fighters, American football players, hockey players, and even members of the military are all at high risk for a relatively enigmatic disorder called chronic traumatic encephalopathy, or CTE. CTE is a neurodegenerative disorder (meaning your brain slowly degrades over time) caused by repeated blows to the head. Dr. Harrison Stanford Martland first identified it as "punch drunk" syndrome in 1928, when he noticed many retired professional boxers displayed similar behavioral symptoms (Martland, 1928). "Punch drunk" eventually became the more formal sounding *dementia pugilistica* (Millspaugh, 1937), but very little was known about the disorder. The name "CTE" had been around since sometime in the 1960s, but it did not really catch on until some fairly recent autopsies performed on American football players revealed that athletes in all collision sports are at high risk for the same neurodegenerative disorder originally identified in boxers (Omalu,

Figure 5-1. Brain damage in action.

DeKosky, Minster, Kamboh, Hamilton, & Wecht, 2005; McKee, et al., 2009).

Even today CTE is still not very well understood. The only way to diagnose CTE is through autopsy because the damage is not visible on traditional CT scans or MRIs, and the symptoms vary from individual to individual. The injury occurs at a subconcussive level, meaning you could develop CTE even if you have never been knocked out or received a concussion. In addition, most athletes and fighters do not even start to develop symptoms until five or ten years after retirement. Fortunately, scientists have been making significant progress toward the ability to diagnose CTE in living patients. New MRI techniques, called "diffusion tensor imaging" (Mayer, et al., 2010), may help us better identify changes in the brain after injury, and new PET scan techniques using special molecular markers (Small, et al., 2013) may be able to detect the buildup of tau proteins in the brain, a telltale sign of CTE. Diagnosing CTE in living athletes will open doors, allowing us to perform analysis over the course of a career, across sports, and more, but for now, we will have to deal with the fact that this disorder is very difficult to identify while the athlete is still alive.

CHAPTER 6

Foam or Knuckles—Navigating the Illusion of Safety

It is difficult to say when boxing gloves made their first appearance. A relief called *Boxing Boys* from Thera, Greece, provides evidence for gloved boxing as far back as 1600 BCE, but we usually credit Jack Broughton, the bareknuckle champion of England throughout the 1730s, with the introduction of modern Western-style boxing gloves, which he called "mufflers." Mufflers were ten-ounce leather gloves padded with horsehair or lamb's wool, and they were intended to keep the wealthy students who attended his boxing school from getting black eyes or bloody noses. In 1867 John Graham Chambers, a Welsh sportsman and journalist, attempted to clean up the image of boxing, which had become tarnished from decades of gambling, corruption, fixed matches, and riots. With the support of the Marquess of Queensberry, he published a set of formalized rules, which included the mandatory

Figure 6-1. Boxing gloves, MMA gloves, and bare knuckles.

use of gloves. Even then many boxers did not embrace the "Queensbury rules" until 1892, when "Gentleman Jim" Corbett finally knocked out the longtime undefeated world bareknuckle boxing champion, John L. Sullivan, a.k.a. "The Boston Strong Boy," in a gloved match under the Queensbury rules. While protection from black eyes and bloody noses played an important role in the adoption of boxing gloves, this sensational knockout of a legendary fighter legitimized gloved boxing for participants and spectators alike.

Sometime around 1929 King Rama VII of Thailand, who had attended Eton College and Woolwich Military Academy in England before serving six years in the British army, drew inspiration from the Queensbury rules of boxing, and developed a new set of rules and weight classes for muay Thai. These new rules included the use of Western-style gloves, and they transformed the sport considerably. The style of fighting prior to these changes, now called *muay boran*, varied regionally within the country and featured a low, wide stance and a broad range of techniques. Fighters dropped many old techniques as they adopted the new rules, and the stance (and hands) of the fighters shifted higher to the modern stance we see today. It is interesting to note that the stance (and hands) of Western boxing underwent a similar transformation as its practitioners adopted the Queensbury rules and donned boxing gloves. Even today most Americans can imitate an "old timey" bareknuckle boxing stance if you ask them to.

CHAPTER 7

Brain Damage—Do Helmets Even Help?

As of the writing of this book, the National Football League is facing a $765 million lawsuit filed on behalf of more than 4,500 former players regarding the concussions and potential CTE sustained during their careers. Similar lawsuits are underway against the National Collegiate Athletic Association as well as the National Hockey League, and football helmet maker Riddell recently faced lawsuits over claims about the effectiveness of its helmets in protecting athletes from concussions. It seems CTE and headgear are important topics to athletes in a large number of sports, so for the purposes of this chapter, we will expand our scope beyond the world of martial arts and investigate the ability of various helmet types to protect us from diffuse axonal injury, which eventually leads to CTE. We learned in chapter 6 that boxing gloves provide us with protection from superficial injuries but they simultaneously increase opportunities for diffuse axonal injury. If we want to understand how headgear protects us (or doesn't), we will need to

Figure 7-1. Muay Thai/boxing headgear, baseball helmet, football helmet, and the human skull.

take a similar look into the physics behind the rotational motion of the human head with and without helmets.

Helmets are great at preventing skull fractures.

Almost all headgear, no matter what sport you play, is composed of a hard shell and a soft, compressible lining. The soft materials compress on impact, absorbing some of the energy of the blow, while the hard materials spread the impact energy over the surface of the shell, effectively increasing the surface area. We saw these same two principles at work during our examination of boxing gloves, and we saw there was no difference in momentum transfer, but the gloves were able to absorb and disperse some of the energy of impact. Since diffuse axonal injury is a result of momentum transfer to the brain, neither a hard shell nor a foam lining reduces the likelihood of CTE, but that does not mean these helmets are useless. Rigid shells and compressible materials are still very effective at protecting us from the types of injuries we tend to associate with localized tissue damage. This means they reduce the number of cuts, broken bones, bruises, "cauliflower ears," and other localized trauma. This also includes skull fractures, which should be considered a serious injury, even if the brain is not damaged with it.

In 1974 the National Operating Committee on Standards for Athletic Equipment (NOCSAE) defined its safety standards for helmets using a "linear drop test" (Gwin, Chu, Diamond, Halstead, Crisco, & Greenwald, 2010). The test, which the NOCSAE

CHAPTER 8

Guns, Knives, and the Hollywood Death Sentence

In order to become a successful screenwriter in Hollywood, you need to watch a lot of movies so you can learn from the screenwriters who came before you, and so you can get a feel for what else is out there and popular today. Unfortunately, this important part of a screenwriter's education is also how Hollywood ends up propagating and recycling incredibly stupid ideas over and over again to the point where the audience just accepts them without question. One such horrible inaccuracy occurs when a character is knocked out by a single punch and then wakes up in a different location. If you asked a competitive martial artist, he would probably tell you the most likely result of a knockout punch is only a few seconds of unconsciousness, and if you asked a football player, he may be able to share stories about teammates who lost consciousness for a few minutes or more, but if a character has been knocked out long enough to wake up in the next scene, that scene should probably take place in a hospital, and the rest of the movie should

Figure 8-1. This is a BB gun. Shots fired from this gun can break the skin, but you probably won't need to call an ambulance.

probably be devoted to that character's very slow (and only partial) recovery from traumatic brain injury. These sorts of inaccuracies run rampant in Hollywood because everything a screenwriter knows about knockouts comes from watching some other screenwriter's characters get knocked out in the movies. For the most part, these sorts of inaccuracies end up being little more than comical bits of trivia, but when it comes to gun violence, a little Hollywood fiction can mean the difference between life and death in the real world.

Animals don't understand how guns work.

Hollywood gunshot wounds typically result in an instant death, where the victim grabs his chest and collapses to the floor, lifeless. This is, of course, nonsense. Unless the bullet has actually entered the brain, the only way someone is going to die from a gunshot wound (or from getting stabbed) is loss of oxygenated blood to the brain. This can happen as a result of bleeding out externally, bleeding internally, circulatory shock (inadequate levels of oxygen in tissues throughout the body), or cardiac tamponade (pressure from fluid in the sac enclosing the heart), but no matter what the specific process is, the basic premise is always the same: blood

CONCLUSION

You're Only Getting Started

"I think I can safely say that nobody understands quantum mechanics."

—Richard Feynman

This book is only one piece of the puzzle.

Even though I intended this book to be your unfair advantage in a fight, it is, by itself, incomplete. The knowledge and understanding you take away from these pages will help you learn faster while you train, get more out of your training, and better apply your training in a real, stressful situation, but all of that is meaningless if you don't train. There is a reason most undergraduate physics classes have labs as well as lectures: when you read something in a book, you might remember it, but when you apply what you have read in a hands-on scenario, you own it.

Traditional martial arts can benefit from science and sparring.

A profound statement can be difficult to distinguish from a painfully obvious one, particularly in hindsight, so it is not surprising to hear the most important lesson science has to offer martial arts is the need for realistically stress-testing your skills. While the majority of martial arts schools do include sparring, it is often with the assumption that your instructor provides wisdom to you, and sparring sessions serve as chances to validate your instructor's guidance. A more scientific approach (which sometimes appears in styles that train for competition) would be to view sparring as the source of wisdom, while your instructor's guidance merely provides you with the tools you need to better extract and interpret that wisdom.

Brazilian jiu-jitsu has earned a good reputation in mixed martial arts, and a large part of that success is a direct result of its scientific approach. By narrowing its scope to exclude many of the potential sources of serious injury (i.e., no punches or kicks), practitioners of Brazilian jiu-jitsu have the ability to provide genuine resistance during training, and gain a level of experience unattainable in other styles. In Brazilian jiu-jitsu it is common to train for contingent scenarios, like, "If you can control the arm, go for technique A, but if he won't let you get the arm, do technique B." It is also common to train techniques for situations where you have already screwed up and ended up in a bad position, such as escapes once you've been mounted. This approach to training comes from an appreciation for the chaotic nature of a fight, and it would not exist without personal stress-testing experience. Of course, not every style has the option of limiting the scope to the same extremes as Brazilian jiu-jitsu, but every style does have the option to take a pragmatic approach to martial knowledge and constantly learn and relearn what works and how things can go wrong.

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ABOUT THE AUTHOR

JASON THALKEN has a PhD in computational condensed matter physics from the University of Southern California, and bachelor's degrees in physics, mathematics, and philosophy from the University of Texas. He is the inventor on eight patent applications for data science and modeling in the financial services industry, and one patent application for protecting the brain from trauma in such sports as boxing, MMA, and football. Jason has studied and competed in numerous martial arts styles since 1995 and has a black belt in hapkido under Grandmaster Ho Jin Song.

Jason grew up deep in the woods of Massachusetts, where he cultivated an early love of the natural world and had already decided to become a scientist by the time he was seven. After moving to the suburbs of Dallas, he started taking taekwondo, and he fell in love with the complex chaos of fighting when he broke his foot at his very first competition.

Once, when Jason was still an undergraduate competing on the University of Texas judo team, he ended up a half pound too heavy at the weigh-ins, and was instructed to try again in one hour. The entire UT judo team immediately stripped down to their underwear, gave Jason their clothes, and cheered him on as he ran laps around the parking lot, did jumping jacks, chewed gum, and spat, all while stuffed inside a hot, restrictive cocoon of layered shirts and pants. At the end of the hour, he had lost a half pound of spit and sweat, thanks to the support of his mostly naked cheerleaders.

Jason Thalken has spent the last fifteen years in Austin, Los Angeles, and New York City, and currently resides in Seattle, Washington, with his family.

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