Florida Baseball Ranch

SAVAGE

Power Hitting

Motor Learning Science To Ignite Your Training

Randy Sullivan, MPT, CSCS
CEO, Florida Baseball Ranch
floridabaseballranch.com

CHAPTER 1: GETTING SAVAGE

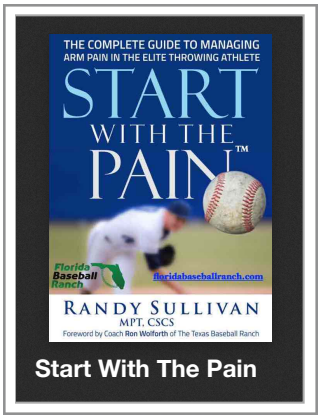
Thank you for your interest in our FBR SAVAGE Power Hitting System. My name is Randy Sullivan, and I am the CEO of the Florida Baseball Ranch®. Since we opened our doors as The ARMory® (our former name) back in 2008, The Florida Baseball Ranch® has emerged as a world leader in safely developing some of the game's highest performing pitchers. Our highly refined process of thorough and meticulous 360-degree assessment, our hyper-individualized training, along with our pioneering application of motor learning and skill acquisition science has helped over 265

"Ranch Guys" break the 90 mph barrier. This process has allowed FBR students to garner over $12.1 million in MLB signing bonuses in 2017 and 2018.

In 2016, after a visit to Kyle and Bret Wagner of Green Light Hitting in Red Land, Pennsylvania, we took our throwing process, retooled it, and began revolutionizing hitter training. Many people don't know this, but I was never a pitcher. Throughout my youth and high school career I was a shortstop, and in college, I became a catcher. Always curious and passionate about teaching hitting to the teams I led over 25 years as a coach, it made sense to direct and apply our incredibly successful motor learning and skill acquisition training principles to hitting.

Start With The Pain

In 2016 I wrote a baseball training book called Start With The Pain: The Complete Guide To Managing Arm Pain In The Elite Throwing Athlete. It presented the first-ever comprehensive guide to assessing, managing, and overcoming arm pain and injury of all levels of severity. In the introduction to this over 40,000-word text, I wrote, "Pain is neither good nor bad. It is simply information -- a beacon that lights the way to dysfunction. If you want to improve your performance as a throwing athlete, you must first eliminate pain or the threat of pain. As my good friend and Houston Astros Major League Pitching Coach, Brent Strom says, "Survival will always trump performance." No progress can be made in improving ability and performance until we address pain.



Teaching hitters is a little more complicated than teaching throwers, but one of the things I love about working with hitters is that I don't have to spend as many sleepless nights hoping and praying that an athlete with arm pain isn't seriously injured. That said, every hitter experiences pain. It may not be physical pain, but it is pain nonetheless. Part of is the pain of failure built into the game. We all know the numbers … if you only fail 70% of the time, you're considered a great hitter.

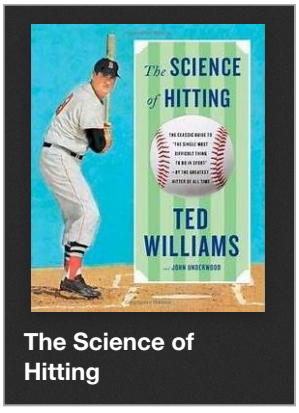
If you or your son/daughter are like most of the families we encounter, you may be experiencing a pain I see among hitters of all ages. Too many hitters perform very well when working off of a batting tee, in their hitting lessons, and during typical bat-

ting practice, but when the lights go on, and they face an actual pitcher, they fail at a rate well above the accepted 70% threshold.

If you your son, or your daughter has reached the high school or college level and is being exposed to the stresses of recruiting or scouting, I'm guessing you're experiencing an additional level of pain that is becoming all-too-familiar to hitters. They make consistent contact, and they get lots of hits, but they don't or can't display the kind of eye-popping power that attracts the attention of next-level decision makers.

They play well.
They win games.
And no one cares.
It's painful for them.
And it's painful to watch.

Way back in 1970, in what has become possibly the most clichéd quote in the history of the game, Ted Williams wrote, "Hitting is the most difficult thing to do in sports." Since the moment his epic book, The Science of Hitting was published, that thought has been the accepted as an absolute by nearly everyone in baseball.



The Science of Hitting

I get it.

Hitting is hard.

Everyone knows it.

But, does it have to be?

Take a step back and consider this thought: Perhaps the way we teach, and practice hitting makes it much more difficult than it should be.

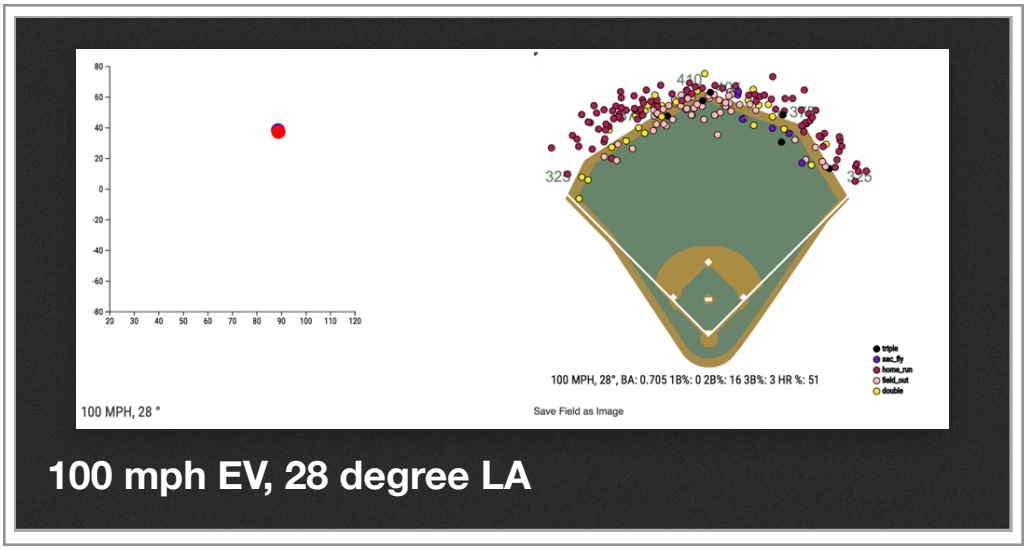
The emergence of data analytics and advances in motor learning science are shining a prison yard flood light on the methods commonly used to teach hitters, and that light is revealing severe disconnections between truths in skill acquisition science and baseball's traditional approach to training hitters.

Let's start with one of the most pervasive training tools in the game – The Batting Cage

Batting cages are corruptive

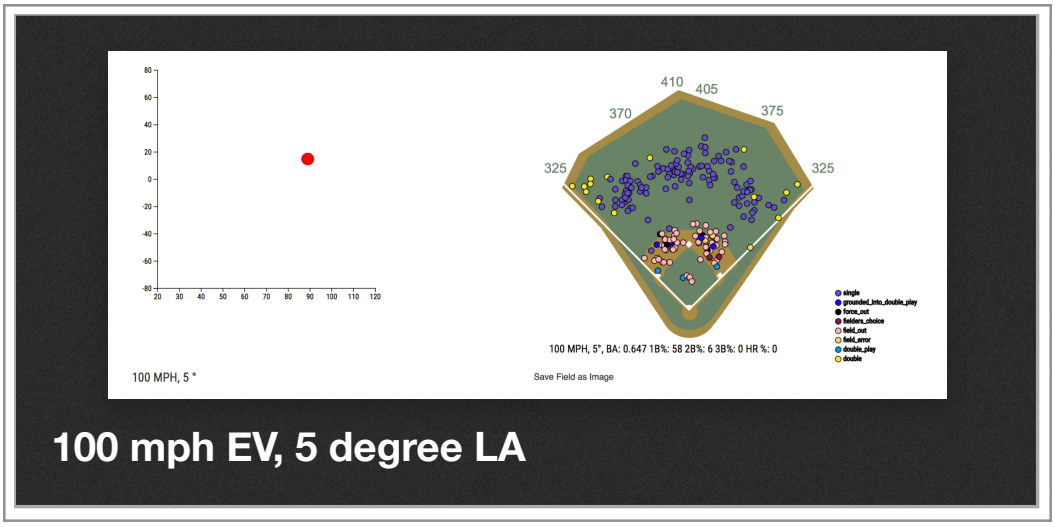
Batting cages are practical, efficient, and potentially corruptive. They're corruptive because they frequently present the illusion that a ball is crushed for an extra-base hit when, reality, that is far from the truth.

According to baseballsavant.mlb.com, since Statcast® began collecting data, balls batted at 100 mph exit velocities with a 28-degree launch angles have generated a batting average of .705 and have led to extra-base hits 70% of the time (51% homers).



100 mph EV, 28 degree LA

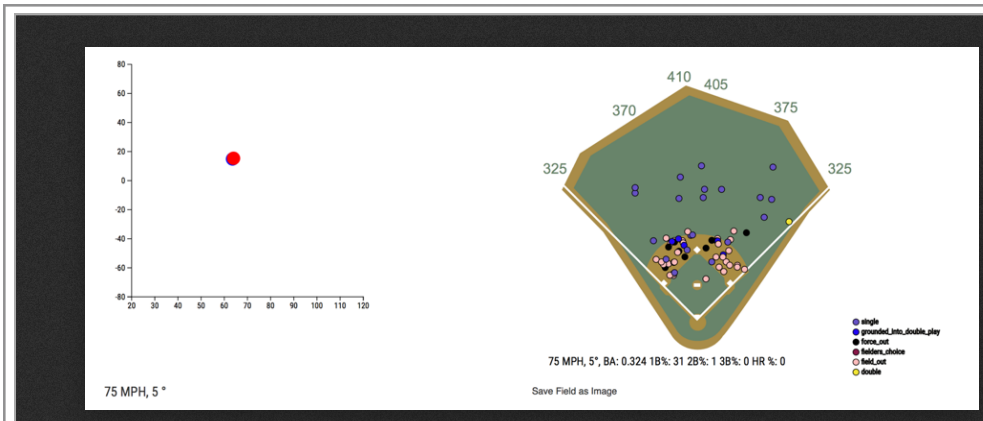
The same 100 mph exit velocity launched at 5 degrees resulted in a .647 batting average but only led to an extra-base hit 6% of the time.



100 mph EV, 5 degree LA

These numbers suggest a simple truth. If you can hit a ball 100 mph, you're going to get lots of hits. Hitting it 100mph at 28 degrees in the air will result in more damage.

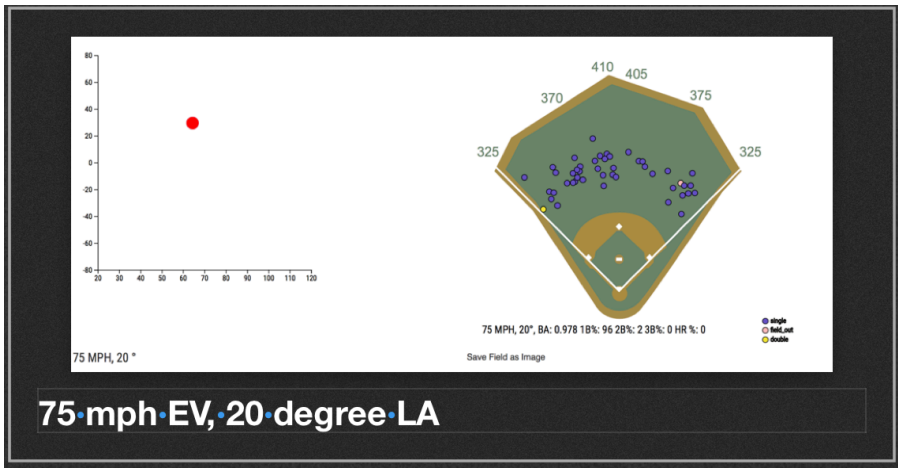
Even young hitters with lower exit velocities can benefit from improved launch angles. Take a look at the results for 75 mph exit velocities at 5 degrees (75 mph is a little below average for a high school player). According to Statcast®, those hits have yielded a batting average of .324.



75 mph EV, 5 degree LA

Only 1% of those hits were doubles (no triples or homers), so one would anticipate, hitting the ball harder is always a good idea.

However, even though the power numbers don't change much, by just elevating the same 75 mph hit to only 20 degrees, a trajectory clears the infielders' heads, leads to an astonishing batting average of .978.



The advantage of a 20 degree launch angle is clear, even when those balls exit the bat at sub-elite exit velocities.

The reason for the increase in success is simple: A twenty-degree launch angle is not a fly ball! It's a line drive over the infielders' heads.

A note of caution here: You can't expect success by merely swinging up to get the ball in the air. The same 75 mph exit velocity hits launched at 30 degrees yields a disappointing batting average of .080.

Our goal is a rising liner over the infielders' heads, not a pop-up or a ground ball.

Now back to the corruptive nature of the batting cage. Let's say you're hitting in the cage and you smoke a ball right past the pitcher's ear all the way to the back net. On our Rapsodo® analysis, a hit to the back of the cage shows around a 5-7 degree launch angle. Many coaches would be pleased with this outcome. However, Ranch Guys want more. When you hit a ball to the back of the cage, even at a high exit velocity, the best you can hope for is a single. And, unless you smoke it at upwards of 100 mph, you're probably looking at a one or two hopper to the shortstop. Good luck, and enjoy your right turn back to the dugout.

Let's say your BP pitcher is throwing in a traditional cage from behind an L-screen positioned 30 ft in front of home plate. To achieve a 28-32 degree launch angle in the cage, you would need to hit the ball to the top of the net, right behind the coach. How many coaches do you know that would consider such a hit a success? Most would view it as a pop-up and would discourage it.

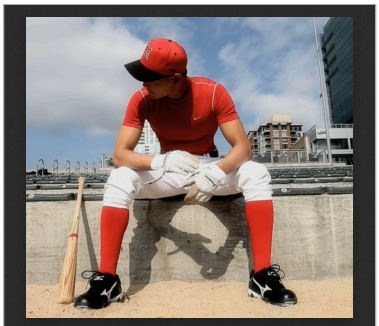
Yes, the evidence is clear. Batting cages can be corruptive. However, understanding that batting cages are an unavoidable part of any hitter's training my advice to any caged athlete is to try to hit balls to the top of the cage, just beyond the pitcher's position.

And then there's the corruptive nature of the typical pre-game batting practice. A few hours before each game, field crews pull out the turtle and coaches spend an hour getting 12-15 guys about 20 mindless hacks against what I call "40-40-40 reps." That's a 40-year-old dude throwing 40 miles an hour from 40 feet away. The only thing that kind of "practice" might be good for is a pregame exhibition to get "cheeks in the seats" or as a severely inefficient/ineffective warm up.

40-40-40 batting practice

We've all seen the 5 o'clock monster that becomes a mouse when the lights go on at 7:00 pm.

Take note parents and coaches, if that describes one of your guys, it may not be the player's fault. Traditional batting practice exposes the hitter to the equivalent of predictable 60 - 70 mph straight balls (notice I didn't even call them fastballs). Yet, in the games, he might be facing guys pushing 100 with nasty 90 mph changeups and wipeout sliders.



Baseball is developing a generation of frustrated hitters

The reason 40-40-40 is so corruptive is that it violates a critical concept in motor learning and perception-action coupling called "representative design."

To give an athlete the highest likelihood of transferring the learning from batting practice to actual high-level game performance, the design of the training should mimic the conditions of the game as much as possible. A coach's practice design should present a wide variety of perceptual experiences similar to those demanded by the game. Of course, there is a place for easy "confidence rounds", but that can't be the norm in your practice session.

Researchers in motor learning have shown that variable practice is much more effective than blocked practice when actual performance involves a response to random stimuli. Therefore, blocking pitches into all fastballs, then all curveballs, etc. is not good representative design (1).

One of the problems in creating an optimal representative design in batting practice is that none of the coaches I know (myself included) can throw hard enough or long enough from actual game distances to get anywhere near simulating what hitters will see in a game.

Pitching machine manufacturers have tried to bridge this gap. At the Florida Baseball Ranch®, we recently procured a Sports Tudor® Home Plate pitching machine that we can program to perform any sequence of random pitches. We're excited about it, but it's still not optimal.

When hitters face actual pitchers, they begin collecting information to organize the appropriate swing as soon as the pitcher starts moving. Hitters search for thousands of little visual cues in the pitcher's movement. They combine those cues with ball flight information to organize a swing that will coincide with the anticipated arrival of the pitch.

They actually start their swing before ball release.

When facing pitching machines, hitters must base their swing movements solely on ball flight information. In a 2007 study by Renshaw, et al. researchers noted significant changes in the swing mechanics of cricket batsmen when facing a bowling machine instead of an actual bowler. Pitching machines are great for simulating game-like ball flight characteristics and for exposing the hitter to high velocity, but if used too frequently, the absence of information from the movement of a pitcher can lead to training corruption that negatively impacts performance.

Batting Cages – corruptive
Pitching machines – corruptive
40-year-old dudes throwing 40 mph – corruptive.
Not enough arms to throw live from 60'6" all the time.

Conclusion: Batting practice as we know it today is corruptive, and it is creating an army of frustrated and disappointed hitters who can't adapt to game time demands.

That all changes with Florida Baseball Ranch® SAVAGE Power Hitting. SAVAGE hitting simplifies and solves all the problems currently presented by traditional hitter training.

CHAPTER 2

THIS IS FBR SAVAGE POWER HITTING

"Make things as simple as possible, but not simpler.""

~ Albert Einstein

SAVAGE is an acronym for Specific Adaptation thru Variability, Attractors and Goal-directed Experiences. It started as a strengthening program, but as we have learned more about dynamic systems theory and human movement behavior, we have begun to realize that the concepts behind SAVAGE Training apply to every aspect of our practice. In the rest of this text, I will reveal to you exactly how SAVAGE Training is interwoven into the foundations of our hitting program. When you finish reading the information, I'm sure you'll agree that we've created one of the best hitter training programs in the world and you'll understand why over half of the teams in Major League Baseball have sought our expertise in helping them develop their hitters. After we explain our process, we'll offer you an opportunity to join the hitting revolution that is changing the game and helping thousands of Ranch Guys achieve their dreams.

CHAPTER 2

FBR SAVAGE POWER HITTING

First, let me make it very clear that it is not my intention to disparage or criticize anyone. I have the utmost respect for any coach or instructor willing to use their knowledge and experience to help players chase their dreams. We're all trying to do the best we can, and I certainly don't claim to have it all figured out. However, as I compare the teaching methods of even the most progressive and successful hitting instructors to the emerging research on skill acquisition and motor learning, I see several significant disconnections that I believe are making hitting way more difficult than it needs to be.

For starters, I think we're getting lost in "The Swing."

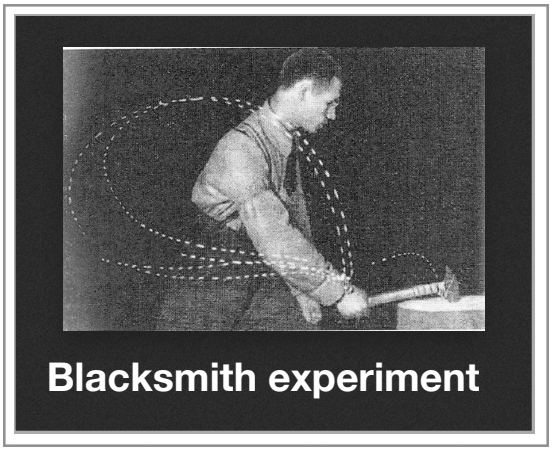
It's like we're on this Holy Grail crusade, searching in infinite detail for the characteristics that define the "perfect" swing. We study the swings of elite professionals in the hopes of finding an "ideal model." We post video and still photos of high performers on Twitter and Instagram inferring that if we can teach our players to move like the experts, they'll be able to achieve similar results. But, there's a problem here.

The "perfect swing" doesn't exist

The ideal model does not exist.

For the record, we believe there to be great value in searching for commonalities in the swings of long-term highly performing hitters. Such a pursuit is integral to our approach to identifying critical "attractors" at which we can target our training. However, trying to find one shining example and attempting to have trainees mimic that swing will always be futile and fruitless.

As I have often discussed in pitching, a closed skill, where the demand for a reaction to external stimulus is comparatively low, ideal models do not exist and "repeatable mechanics" are unattainable. In motor learning science it's a concept known as "the degrees of freedom problem," and "motor redundancy." It was first illuminated by Dr. Nikolai Bernstein, a Russian neurophysiologist known as "the father of motor learning." In 1938, in what has become known as "The Blacksmith Experiment." Dr. Bernstein gathered a sample of Russia's greatest blacksmiths (world class hammer swingers). He put them in a dark room, placed small lights at strategic places on their arms and used serial photography to track the paths of their arms as they each performed the singular task of hammering a nail into a log with one swing. Every blacksmith was able to accomplish the goal without fail, but interestingly, no two blacksmiths demonstrated the exact same swing path on any of the trials investigated. This finding confirmed that for any complex movement, the mythological "ideal pattern" is indeed an impossibility.


Blacksmith experiment

More importantly, when Dr. Bernstein and his team examined the arm paths of single blacksmiths from trial to trial, no subject ever repeated the same pattern twice.

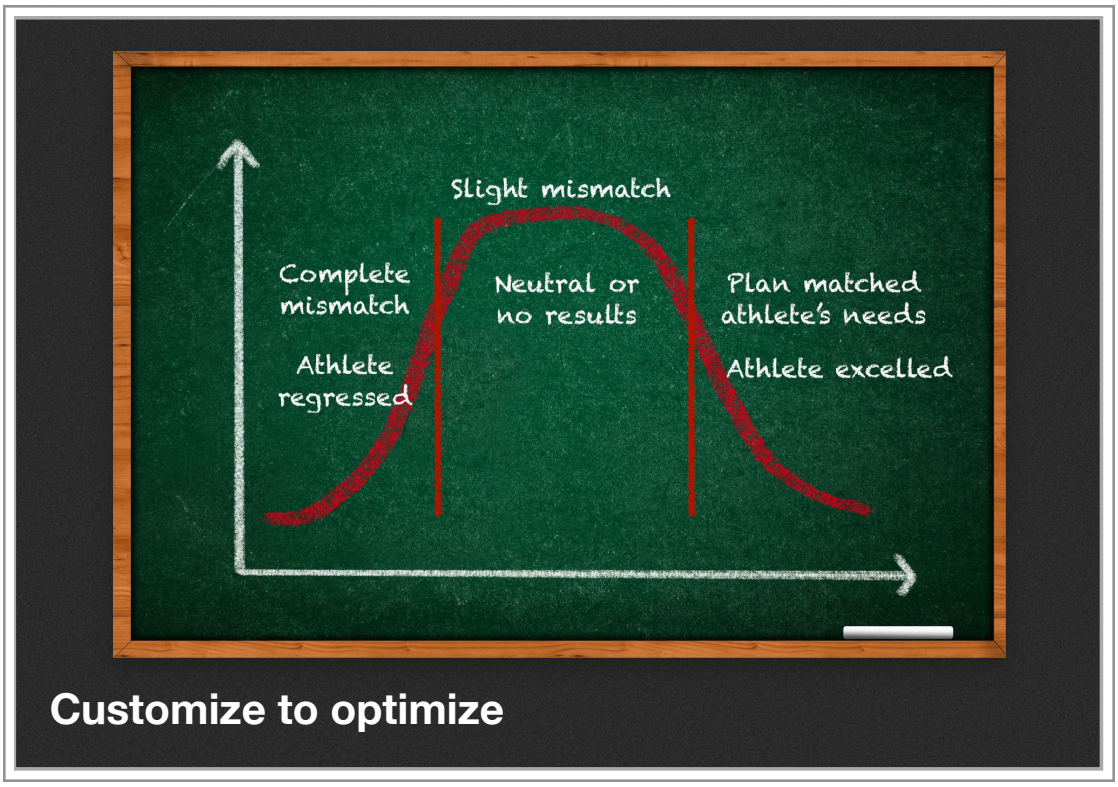
Bernstein's results turned the motor learning universe on its ear, and today they continue to shout loud and clear that any attempts to achieve either an ideal or repeatable swing will always fail.

Every hitter is different. Every pitch is different. Every swing is different.

It's impossible for our athletes to repeat the same swing twice. Instead of trying to force hitters into one-size-fits-all, repeatable swings we should be striving to develop swings that are both powerful and adjustable. To maximize both power and ad-

justability, we must help every athlete develop a training plan to gain the necessary mobility, strength, power, and coordination to maximize his/her productivity.

That plan cannot be derived from a universal, "everyone does the same thing" approach. It must be customized for every athlete based on his or her unique physical, physiological and neurological attributes and limitations.



One-size-fits-all training plans can only yield bell curve results.

In statistics, a bell curve indicates that the results happened by random chance. In other words, the training plan had no real impact on the outcome. In any such a program, a small percentage (perhaps 10-20%) of participants will see some improvement out of sheer luck. A much larger group (60-70%) will work just as hard as anyone in the program, but the interventions will not quite match their needs, and they'll stay the same. And for an unfortunate number of the participants (10-20%), the plan will be a complete mismatch and will turn out to be the worst thing they could have done. These unlucky members will regress in ability and will walk away confused and disappointed. When you do the math, one-size-fits-all programming results in as much as an 80% failure rate. At the Florida Baseball Ranch®, such results are unacceptable.

CHAPTER 3

THE ASSESSMENT:BODY, BAT, BALL

"The individualization of learning fundamentally redefines the role of assessment".

-Sebastian Thrun

The only solution to optimize return on training time for our students is hyper-individualization of all intervention across the entire spectrum of the training experience. The only way to accomplish true customization is through thorough and meticulous assessment of every individual, and that is precisely what we do here at the Florida Baseball Ranch®. It's one of the qualities that separates us from the norm in the baseball training world.

Amy Marsh, CFO/COO

My business partner for the last 20 years is a fantastic lady and a dear friend named Amy Marsh. She is the Chief Financial Officer and The Chief Operations Officer of both of our businesses. In addition to our baseball training enterprise, for the last 25 years, we have co-owned a thriving physical therapy practice called Sullivan Rehab Services, Inc. In our medical practice, if we were to prescribe treatment without thorough assessment standards of practice, as well as state and federal law would consider that malpractice and fraud. Yet, in the baseball training industry, where the consequences of failure are no less dire, it seems anyone can recommend or even demand training interventions with little or no information available.

CHAPTER 3

THE ASSESSMENT

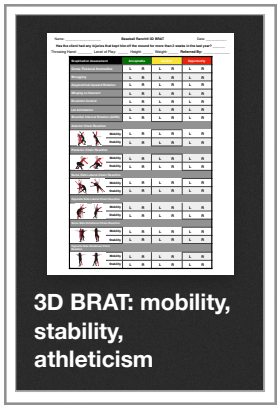
At the Florida Baseball Ranch®, we assess first and only then do we begin to begin our training. Our unequaled assessment process allows us to screen our athletes for red-flags that might suggest injury risk, but more importantly, the assessment serves as the template for individualization that is the hallmark of the SAVAGE Power Hitter Training process.

The Assessment: Body, Bat, Ball

Every FBR SAVAGE Power Hitter, regardless of age or experience level, starts with the most comprehensive, thorough, and multi-faceted assessment in the baseball training industry. During the initial evaluation, we gather information from three critical sources:

1) The athlete's body and his capacity to efficiently and powerfully move,
2) The power, speed, and path of his movement of the bat, and
3) The ultimate results he produces in ball flight characteristics.

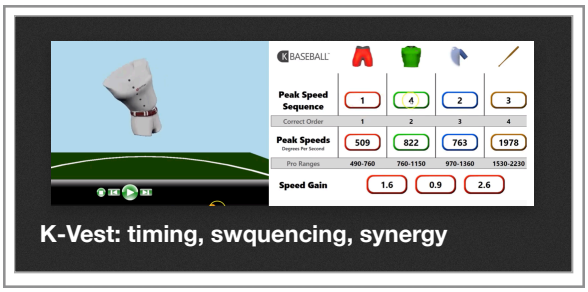
Assessing the body



3D BRAT: mobility, stability, athleticism

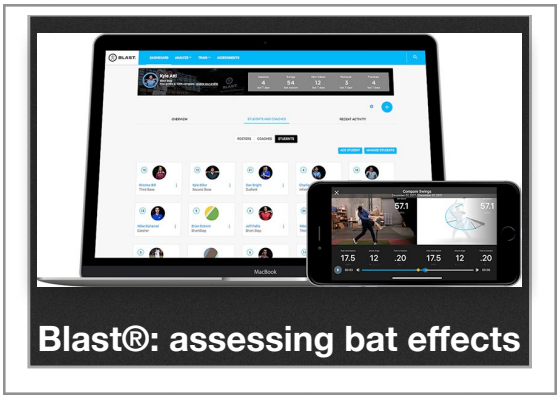
We start with a head-to-toe physical assessment using our innovative 3D Baseball Ranch® Assessment Tool (3D BRAT). Blending the ideas of several existing and highly regarded functional and medical assessments such as FMS, SFMA, and 3D MAPS, our in-house team of physical therapists, skill coaches, and strength and conditioning specialists developed the 3D BRAT. It allows us to establish the mobility, stability and motor control qualities of 66 different joint motions in the context of real three-dimensional athletic movements. The 3D BRAT serves as the template for creating individualized training plans with built-in progressions for developing the fundamental building blocks of athleticism, agility, and power necessary to achieve high-level performance.

K-Motion® K-Vest analysis gives us knowledge of the athlete's timing, sequencing, synergy and power production within the kinetic chain. It reveals any leaks in energy that can be addressed in his training to optimize power and adjustability.



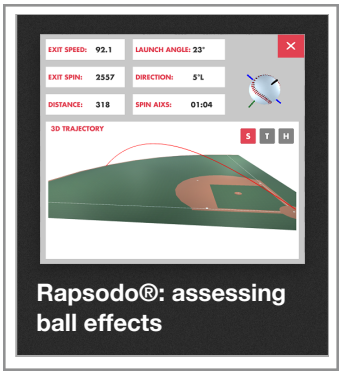
Assessing the movement of the bat

BLAST® technology allows us to evaluate the hitter's ability to produce key swing characteristics like bat speed, attack angle, bat path, and time to contact.



Assessing ball effects

We use our Rapsodo® hitting module to collect and evaluate the athlete's ability to produce ball flight characteristics such as exit velocity, spin axis, launch angles, trajectory, and distance.



As the final piece to the puzzle, we conduct a detailed video analysis of the athlete's swing. Our analysis is grounded in the unique application of a leading-edge skill acquisition science and Dynamic Systems Theory. It's a novel, practical, and highly effective way to view and analyze swing mechanics.


Video analysis

Dynamic Systems Theory In Hitting

A significant flaw in the current approach to hitter training lies in the failed assumption that we can find linear relationships in complex systems. In the last 5 years, baseball has experienced a tectonic shift toward science-based, data-driven training methods. I'm all for using science and technology to support training plan development, measurement and modulation. However, in complex systems like ecological environments, economies, political systems and the complex biological system that is the human body, the scientific method falls short.

As my good friend, Dr. Ed Fehrenger has noted, "Science hates variability, and humans are infinitely variable." The scientific method attempts to change only one factor at a time while controlling all other variables and then it makes conclusions about direct cause and effect relationships or strong correlations. However, in complex systems, linear relationships rarely exist. Science assumes it can ignore many variables as insignificant noise, but in complex systems, there is no "noise." All variables matter.

Linear systems adhere to a concept known as The Superposition Principle which states, "For all linear systems the net response at a given place and time caused by two or more stimuli is the sum of the responses that would have caused each stimulus." However, whenever parts of a system interfere, cooperate, or compete, the superposition argument fails spectacularly.

Analyzing and predicting the behavior of elements of complex systems requires a deeper kind of investigation. Our best hope is to draw from our knowledge of anatomy, physiology, neurology, medical science, biomechanics, exercise science, behavioral psychology, motor learning, and dy-

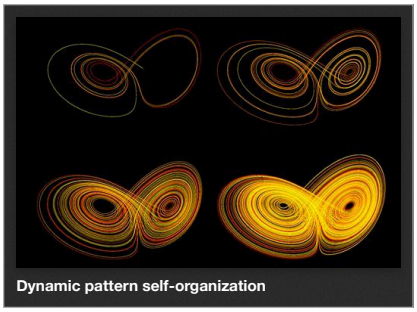
namic systems theory (which finds its roots in differential calculus). All of this data must be viewed through the lens of common sense and the experiential knowledge of master teachers.

We must synthesize this data into a process that sifts through the complexity of the dynamic system and compresses it into simple, actionable and highly effective training practices. Finding order in the chaos of a dynamic system is complex. As coaches and instructors, our job is to wade through the complexity and find what Oliver Wendell Holmes called, **"simplicity on the far side of complexity.** However, we must also heed the words of Albert Einstein, **"Everything must be made as simple as possible, but not simpler."** As you'll soon see, the application of Dynamic Systems Theory to hitting through the FBR Power Hitting System makes an incredibly complex task as simple as it can be, but not too simple.

"Mathematics is the language in which God has written the universe."-Galileo Galilei-

On the surface, complex systems may appear chaotic and uncontrollable. However, all dynamic systems in nature self-organize into predictable patterns. These patterns can be visualized graphically by sifting their data points through well-established differential calculus equations. As I began to study and discover Dynamic Systems Theory, I became increasingly regretful that I hadn't paid better attention during the Calculus II class I took my freshman year of college. If had been more locked into the learning, maybe we wouldn't have needed to hire a full-time mathematician at The Ranch.

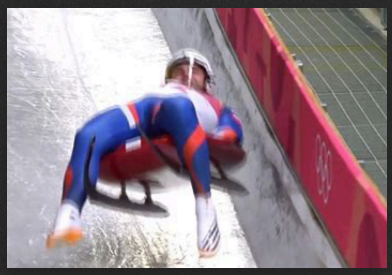
According to experts in the arena of behavioral psychology, complex systems like the human body follow a few simple rules and eventually organize into dynamic patterns that resemble a 3-dimensional butterfly. In every dynamic system, many of the solutions to these equations begin to cluster in groups. These clusters of data are known as "attractors." They provide the boundary parameters and create stability within the system.


Dynamic pattern self-organization

However, some of the solutions to those equations don't yield the attractor clusters. These variable parts of dynamic systems and human movements are known as fluctuations. They offer the system and the athlete an array of options for accomplishing a goal. **As attractors are stabilized, the body begins to minimize fluctuations**.

Since I can't get my head around the concept of a 3D-butterfly, I prefer to think of dynamic system movement as a luge traveling down the chute in the winter Olympics. If the pilot's attractors are stable, his line stays true, he is more efficient, and he moves faster. his system wobbles or "fluctuates", he loses efficiency and slows down. As the attractors of a dynamic system become unstable, fluctuations abound. The bandwidth of his deviations becomes untenably large, and he is unable to produce quick, efficient and powerful movement. On the other hand, if the attractors in his system are too stable, and he eliminates all fluctuations, his progress down the chute becomes rigid and unalterable. When presented with any variability or perturbation (such an unexpected rut in the ice or a sudden gust of wind), lacking the necessary fluctuations for adjustability, his luge careens wildly and uncontrollably off the track.

Attractors: stable parts of movement



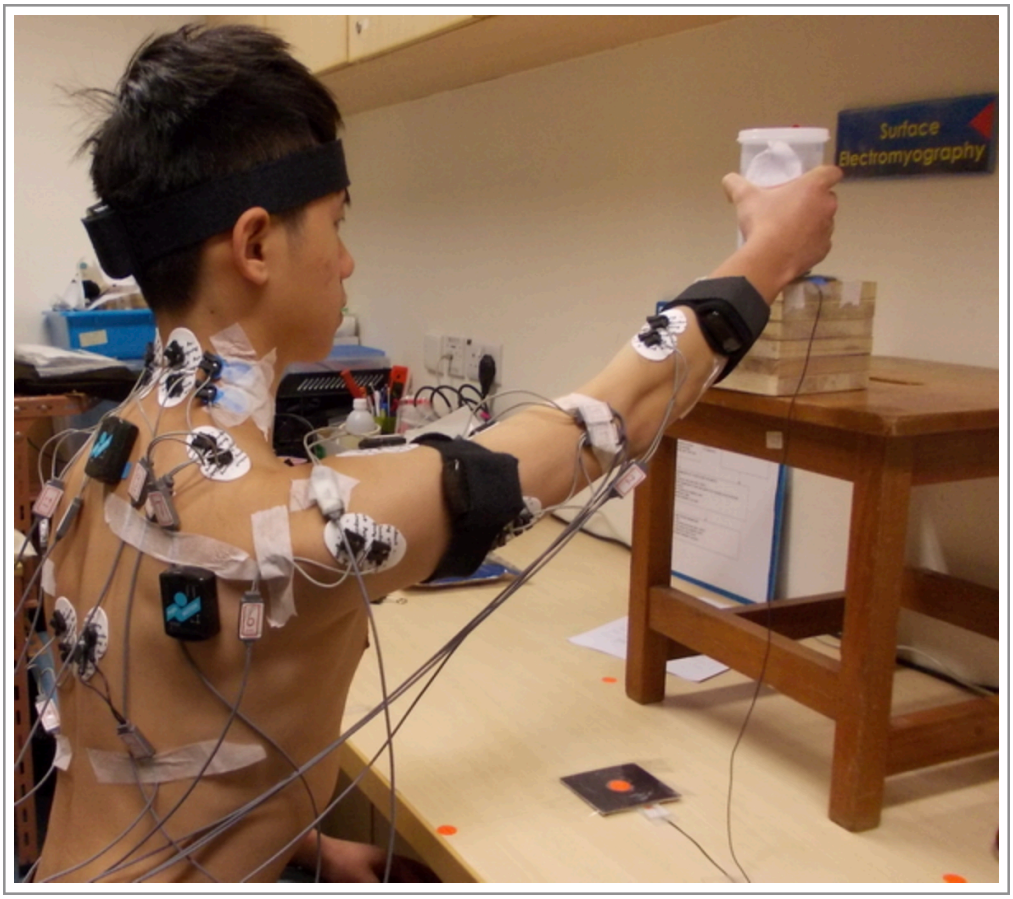
Fluctuations: variable parts of movement

As true as this concept is in a dynamic system, so it is in two areas of concentration for the Florida Baseball Ranch® -- hitting and pitching.

As the athlete's attractors are stabilized the movement pattern becomes more efficient in power production and barrel accuracy. However, if the attractors are too stable, and he eliminates all fluctuations, he lacks the adjustability necessary to react to variations pitch location, movement, and speed. So, the key is to identify and stabilize critical attractors while maintaining just the right number of fluctuation options to simplify and optimize adjustability.

How To Identify Attractors

Ultimately, precise objective identification of an individual athlete's attractors would require embedded EMG sensors in key musculature to determine the timing and magnitude of peak muscle activity. That information would need to be coordinated with data about joint kinematics from a wearable biomarker 3-dimensional motion capture system, and with ground reaction forces recorded from force plate sensors. After testing thousands of athletes across a wide swath of ages, anthropometrics, experience, and ability levels we could use machine learning computations to identify key data heat maps to reveal the ranges of measurements in which high performers in various categories fall. Those areas could be labeled as attractors and targeted in our training.



Unfortunately, at this time, the technology and the degree of athlete participation necessary for such a project is neither affordable or practical. Nor is it necessary. We can get close enough for practical application by looking at our SAVAGE body, bat, and ball assessment data, and combining it with high-speed video analysis.

CHAPTER 4

IDENTIFYING ATTRACTORS

"No lens is quick enough to track the movement of the human body. The molecules are always moving." - Roger Rees

Applying our knowledge anatomy, physiology, neuroscience, biomechanics, and dynamic systems theory, we can observe movement characteristics that serve as what we call "dashboard indicators" to shed light on what is happening inside the engine (the body).

Therein lies the foundation of SAVAGE Training.

Visual observation of an athlete's movement patterns with high speed video, when coordinated with analysis of other objective assessment data can tell us if the athlete possesses the necessary mobility, joint stability, strength, and coordination to move his/her body efficiently to and through biomechanical positions that optimize length-tension advantages and encourage co-contraction to remove muscle slack in key attractors.

CHAPTER 4

IDENTIFYING ATTRACTORS

To some, the preceding statement might seem like a mouthful of mush and confusion, so allow me to explain.

Mobility

"Mobility" refers to the athlete's ability to move his joints (in isolation and in coordination with all other parts of the body) through the range of motion necessary to accomplish the task (in this case, hitting). This was an area that had been severely overlooked when we first entered the baseball training industry. These days, more coaches and instructors are becoming aware of the relationship between joint mobility and movement. However, I have noticed some instructors taking the idea a bit too far.

Mobility: prerequisite for stabiity

When it comes to mobility, more isn't always better. It's not necessary for our hitters (or pitchers) to have the flexibility and joint mobility of world-class gymnasts. They need only to demonstrate enough mobility to move their bodies through the most advantageous biomechanical positions.

In fact, in many cases, too much mobility could be corruptive. Increased range of motion without motor control can negatively impact the quality of movement, and it could be a risk factor for injury. I would rather have an athlete with a less range of motion, but full motor control of that motion, than an athlete with an abundance of joint mobility that he cannot control.

Adequate joint mobility is a mandatory prerequisite for the expression strength through coordinated, powerful movement, but we must always remember, enough is enough. There are a lot of incredibly powerful professional athletes who aren't models of mobility/flexibility.

Another vital point about joint mobility:

The amount and quality of mobility observed when joints are tested in isolation in either lying or sitting positions doesn't always match what we see when the athlete is on his/her feet and the joints are asked to work in coordination with the rest of the body. That's why the bulk of our 3D-BRAT tests are done with the athlete on his/her feet, navigating the body through space in 3-dimensional functional movements.

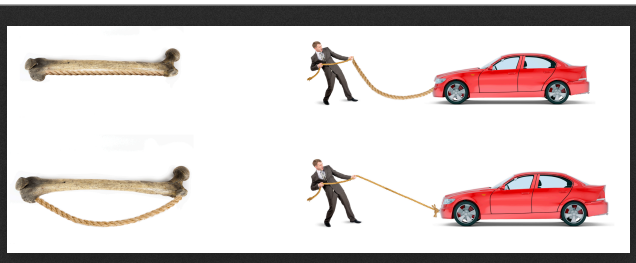
Length-tension advantage

Every muscle or group of muscles has a length at which they are optimally strong. For example, let's say I'm trying to carry a plastic bag full of groceries. When my elbow is fully straightened, my biceps muscle is weak, because it's too long. When my elbow is in the most bent position, the muscle is weak because it's too short. But, in between those two points, there is a position at which it is optimally strong. This position allows me to enjoy the "length-tension advantage" of my biceps while I bring the groceries into my house.

Biceps at optimal length

Co-contraction and muscle slack

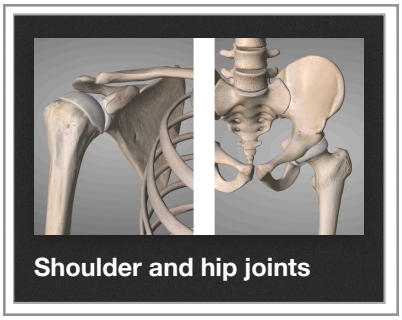
Muscles don't sit on bones tightened and ready for the immediate force production. Instead, they sag off like the rope hanging in this picture. Just as the car in the image cannot be moved until the slack in the rope is removed, the body cannot produce adequate force or power until the "slack" in the system is removed.



Muscle slack

The best way for an athlete to remove muscle slack is through "co-contraction." That is, isometric tensing of all the muscles in a limb or body part.

The ability to remove muscle slack in a timely and efficient manner while moving dynamically through physical activities is one of the fundamental building blocks of what we commonly refer to as "athleticism." Muscle slack removal is facilitated when joint mobility and motor control qualities allow athletes to accomplish movements that put affected joints in anatomically stable orientations. For example, anatomical stability is achieved when the head of the femur is positioned in the center of the hip socket (acetabulum), or when the head of the humerus is centered on the shallow glenoid fossa of the shoulder joint. It should be noted that these positions of stability are dynamic, not static.


Shoulder and hip joints

Stability is not lack of movement, it is control of movement.

When joints are in stable positions, the surrounding muscles are moved into in optimal length-tension relationships. This facilitates coordinated co-contraction which removes muscle slack and allows the expression of power.

If muscle slack is not removed, power cannot be expressed.

If muscle slack is not removed coordination and control of movement cannot be attained.

*Dynamically removing muscle slack through well-timed co-contraction also provides the control necessary to attenuate stress on at-risk connective tiss*ue.

The building blocks of athleticism

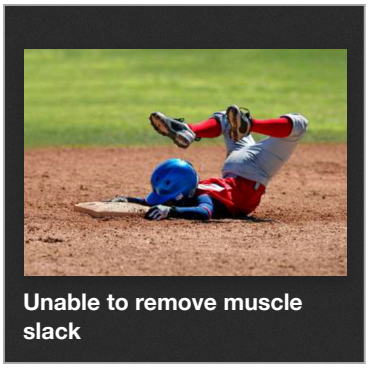
For years, coaches, parents, and educators have curiously recognized that some kids seem to be more "athletic" than others. These children are able to control their bodies better than their peers. They react quickly to emerging stimuli, and they transition rapidly, powerfully, and gracefully between positions while deftly accomplishing goal-directed tasks.

Other children appear to have less motor control and seem "floppy" or "jerky" in their movements. They demonstrate slower reaction times, they have difficulty changing direction. They fail to achieve positions of anatomical stability and are unable to express power in the same manner as their more highly performing peers.

"Athleticism"

In the absence of a clear understanding or explanation for the nature of this disparity, we label the first group as "gifted" or "talented." In the baseball scouting community, these athletes are sometimes labeled as "fast twitch guys."

We mark the less impressive athletes as "slow twitch," and we assume that their ability to achieve "athleticism" is limited by their genetics. But as information about muscle slack and human performance emerges, it becomes clear that the more "athletic" players are not necessarily "gifted by God." Through their experiences, they have developed adequate mobility to find anatomical joint stability, and they have learned to rapidly and efficiently remove muscle slack. Now that we understand this previously unappreciated truth, we can assess the athlete's ability to achieve co-contraction and thus stabilize his own dynamic system attractors.

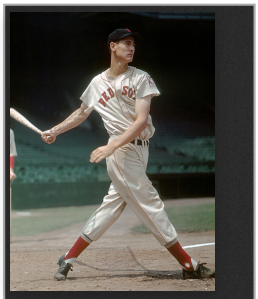


Unable to remove muscle slack

Since we can't evaluate attractors directly, we must establish a few logical rules to define and identify attractors. These rules should draw from the entirety of our multifaceted understanding of human movement. Our basis for attractor identification should also be universally relevant to any human movement and should be viewed and created through the prism of common sense and the experiential knowledge of master coaches and teachers. And, despite the complexity required to arrive at their selection, these rules for attractor identification must be simple enough to be understood and readily applied by any reasonably intelligent and desirous parent, coach or instructor.

It is within this context that we established three simple criteria to define attractors in any human movement:

1) If a preponderance high-level performers execute a part of the movement similarly, that part of the action should be considered an attractor. Here, look for commonalities among Hall-of-Fame-caliber athletes that have demonstrated long term elite performance with no significant injury history. We are disciplined in avoiding the temptation to be misguided by a "flavor-of-the-month" type of athlete whose performance fades due to diminished ability or injury.

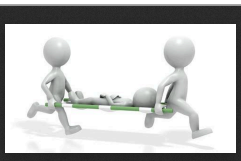


The greatest hitter that ever lived

2) If time pressure is such that inefficiently or ineffectively executing a part of the movement would lead to a disruption that makes the athlete either early or late in his/her kinetic sequencing, that part of the action should be considered an attractor.

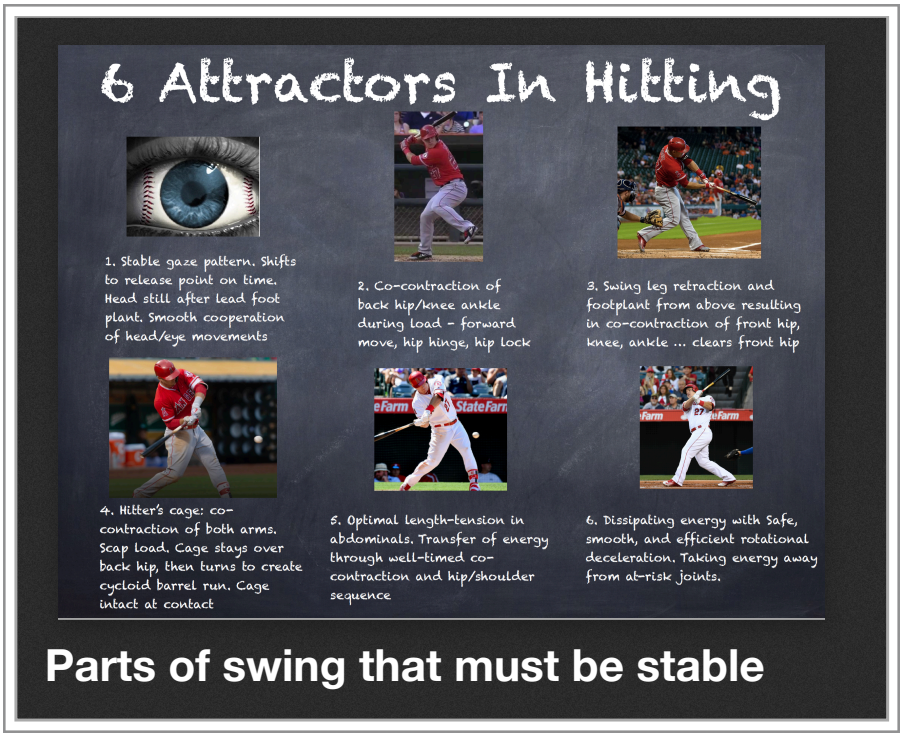
Time pressure identifies attractors

3) And finally, if the inefficient or ineffective performance of a part of the movement would result in significant risk of injury, that part of the action should become an attractor.



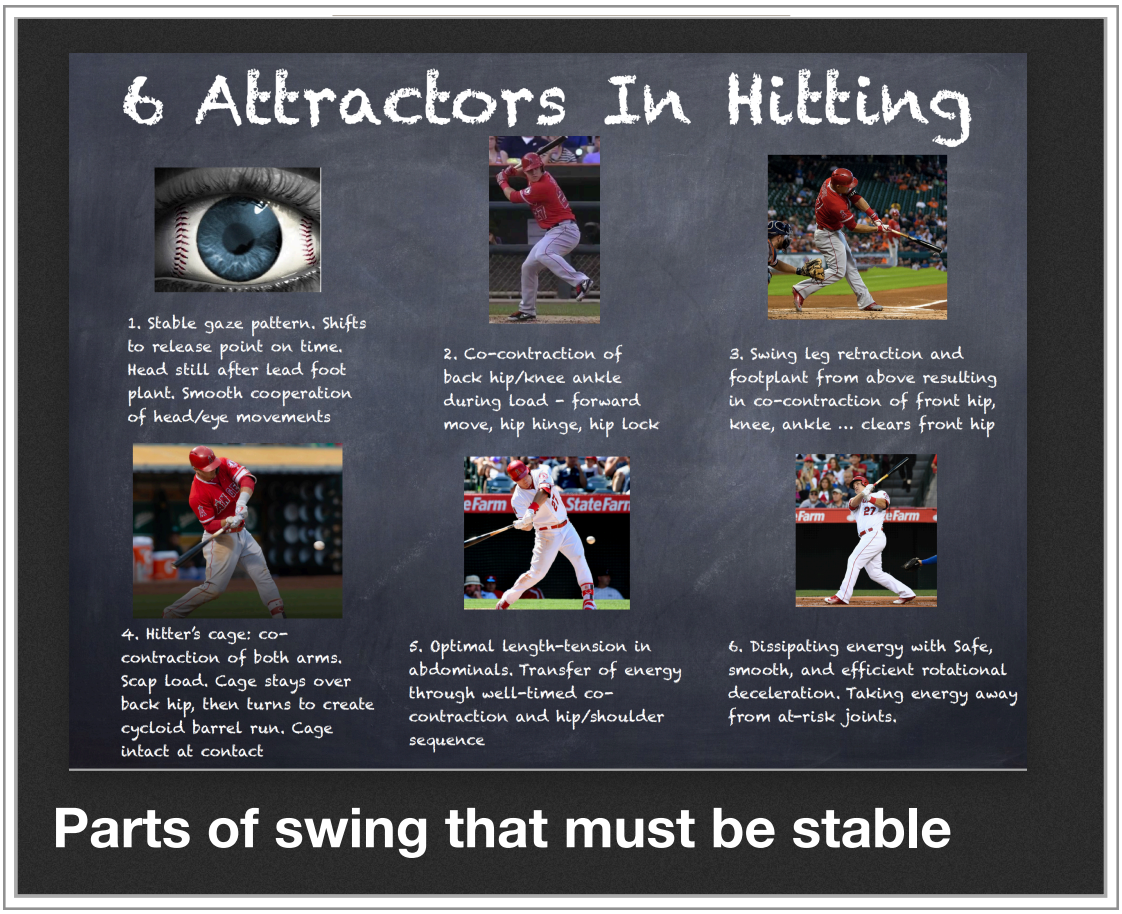
Injury risk identifies attractors

Based on these principles, we have identified six attractors for hitting in our FBR SAVAGE Training System.



CHAPTER 5

THE SIX ATTRACTORS IN HITTING



Attractor number 1 involves focus and stability of the hitter's vision -- a trait we can't actually observe. Attractors 2-4 include co-contraction in key body parts to remove muscle slack, allowing for power expression. In attractor 5, the hitter takes advantage of the elastic properties of the abdominals and chest muscles before co-contracting to transfer energy. And, in attractor number 6, the athlete safely, smoothly and efficiently dissipates that energy.

CHAPTER 5

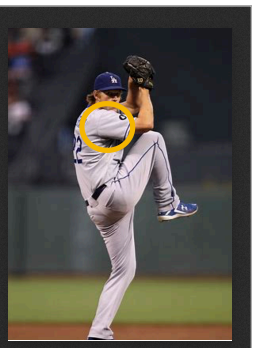
THE SIX ATTRACTORS IN HITTING

1) The Gaze Stabilization Attractor

The first hitting attractor involves the stabilization of the athlete's gaze (what he is looking at) as he makes his swing. My friends Martijn Nijhoff, Talent Coach for Dutch Baseball has access to an exciting piece of technology called "Eye Tracker." High tech goggles follow the movements of the athlete's eyes and produce a video image from the vantage point of the participant. A computer synchronized to the device displays an image of crosshairs moving dynamically with the exact target of the athlete's vision.

Hitter's eyes

Their investigation in comparing the gaze characteristics of elite and sub-elite performers across a wide range of sports skills has provided valuable insight into the visual habits of superior performers.



Soft gaze

Most hitters tend to start their visual process with a soft gaze at some area of the pitcher's body.

As the pitcher begins to show the ball, the hitter shifts his/her gaze to the release point and locks onto the ball.

High performing hitters get their eyes to the release point precisely on time, while poor hitters tend to be late with their focus.

Locking onto release point on time

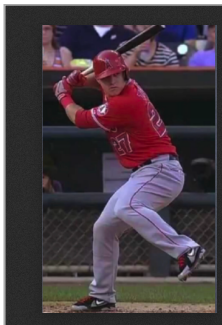
Another critical piece to optimizing the gaze stabilization attractor is that the head should stop moving at the moment the hitter reaches full weight bearing on his lead leg. The head should remain still during rotation of the hips, torso, and shoulders and should only be released after impact with the ball. Stabilizing initial and final gaze efficiency is vital to helping our hitters couple perception with action in training and performance, and in allowing the opportunity for adjustment.

MOVIE 5.1 Head Remains Still

Head stabilizes after weight bearing foot plant ... Video credit: pastimeathletics.com

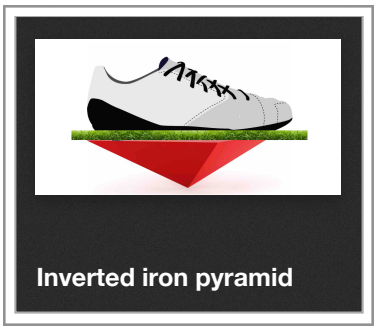
2) The Back Leg Attractor

Stabilizing the back leg attractor is vital to power production and adjustability. As the hitter gathers energy through the back leg, he must position himself to remove muscle slack efficiently. In a hitter's back leg, muscle slack is removed when the lead hip is dynamically placed slightly higher than the trailing hip (hip lock), the butt is behind the heel (hip hinge), and the weight is distributed evenly across the entire foot. We refer to this as the "Inverted Iron Pyramid." We ask our hitters to imagine they have an iron pyramid attached to the bottom of their back shoe. It is the length of their shoe and the width of their shoe and reaches an apex approximately four inches below the center of the arch of the foot. We ask them to force their imaginary pyramid into the ground until it's base if flush with the ground as they gather to a power position. Evenly distributed force across the entire sole of the foot promotes symmetrical co-contraction of all the leg muscles working up the kinetic chain.



Co-contraction of back leg

Co-contraction on the back leg facilitates power production and allows the hitter to manage a controlled forward move. This provides a margin for adjustability to pitch speed, shape, and location (more on that later).


Inverted iron pyramid

Many hitting coaches demand that hitters keep their heads and bodies locked in one position throughout the swing. They force the hitter to rotate around a stationary vertical axis without any positive forward movement. This reductionist idea is grounded in the false assumption that by eliminating moving parts, a hitter can create "repeatable mechanics (more on that later). Demanding rigid adherence to some mythological model robs the hitter of both athleticism and adjustability. We'll discuss the forward move as a cog of adjustability later.

***Please note that we are not advocating a wild, aggressive, or uncontrolled forward move. If the back leg does not achieve co-contraction control of the pace and distance of the forward move is disrupted.**

Also, note that the length of the forward move will vary between individuals.

We have three other important factors to observe when assessing the stability of the back leg attractor and the quality of the forward move:

a) The "iron pyramid" on the back leg should not be released before weight bearing foot plant on the lead leg.

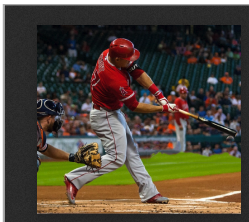
MOVIE 5.2 Iron Pyramid Not Released

The back leg iron pyramid is not released until the front foot is on the ground. Video credit: pastimeathletics.com

b) The athlete should not move backward (away from the pitcher) before going forward. This is known as counter movement and creates muscle slack on the back leg. The hitter's forward move should be initiated directly from the iron pyramid and a co-contracted back leg.

c) The athlete should stop moving forward and his/her head should stabilize at the moment his front foot hits the ground (see the gaze stabilization attractor).

3) The Lead Leg Attractor



Co-contraction of the lead leg

The lead leg attractor's role, while in flight during the forward move, is to set the stage for co-contraction and muscle slack removal upon landing. It should not reach independently or open prematurely. It should lock into a stable position and ride along until the back hip rotates internally (toward the pitcher) and places it on the ground. We are big fans of a controlled leg kick since it locks the lead leg into a stable position, sets the lead hip slightly higher than the trail hip (facilitating back leg hip lock), and affords the hitter an additional option for timing adjustability.

Swing leg retraction/foot plant from above

MOVIE 5.3 Elite Sprinters Foot Plant From Above

In elite sprinters, the swing leg retracts creating foot plant from above. Video credit: Axel Industries

As it approaches landing, the hitters lead leg should demonstrate what is referred to by Frans Bosch as "swing leg retraction and foot plant from above." As Frans reports in his seminal strength training book called Strength Training and Coordination: An Integrative Approach (the inspiration for our FBR SAVAGE Training System), when we examine the swing leg dynamics elite sprinters, we note that as the foot approaches the ground the hamstrings pull the lead hip into slight retraction (extension, to be anatomically correct). The foot does not "slide into" the ground in such a manner as to drive the toes into the end of the shoes. Instead, it "lands from above." This places it in a position to functionally grab the ground in a clawing motion that creates a rearward force and propels the runner forward.

We can observe the same phenomenon in top-level hitters and pitchers. Just before landing, the swing leg retracts and lands from above. This subtle move places the

MOVIE 5.4 Swing Leg Retraction in Hitters

Swing leg retraction, foot plant from above, negative Y. Video Credit: Baseball Swingepedia

leg in a position that produces a rearward force as the pelvis rotates toward the pitcher.

Swing leg retraction and foot plant from above facilitates the co-contraction necessary for removal of muscle slack, stops the forward movement of the head, and allows for maximum force production.

Clearing the front hip

Immediately after co-contraction, the lead leg must be positioned to clear the lead hip, facilitating rotation of the pelvis and separation of the lower body from the torso. We would prefer a stride that takes the hitter's lead foot directly toward the pitcher, but perfect alignment is not necessary as long as the hitter is able to clear the front hip.

This may be accomplished using one of four strategies commonly demonstrated by world-class hitters:

Striding with foot open to clear front hip
Image credit: MLB Network

1) The hitter can stride with the front foot open, so the hip is already cleared when the front foot lands. This is the method advocated by MLB slugger, Josh Donaldson and is the probably

the easiest learning option for young hitters. When we hosted a camp with Chas Pippitt of Baseball Rebellion, I noted that this is the approach he recommends.

2) The hitter can slide his lead foot across the front of the batter's box as he "scissors" his back leg, as demonstrated by prolific Houston Astros hitter, Jose Altuve.

MOVIE 5.5 Clearing The Front Hip With A Scissors Move And Sweeping of The Front Leg

Jose Altuve clearing the front hip. Video Credit: MLB.com

3) The hitter can also stride with his toe closed and pivot on his heel to clear the front hip as shown in this video of a Khris Davis home run. In this option, the magnitude of the pivot may vary with pitch location.

MOVIE 5.6 Clearing The Front Hip With A Pivot

Khris Davis pivoting on the heel to clear the front hip. Video Credit: Baseball Swingepedia

4) Finally, the hitter can roll his ankle toward the outside of his foot to allow space to clear his hip. As in the heel pivot option. The amount of ankle roll may vary with pitch location

MOVIE 5.7 Clearing The Front Hip With An Ankle Roll

Joc Pederson rolling the ankle to clear the hip

4) The Hitter's Cage Attractor

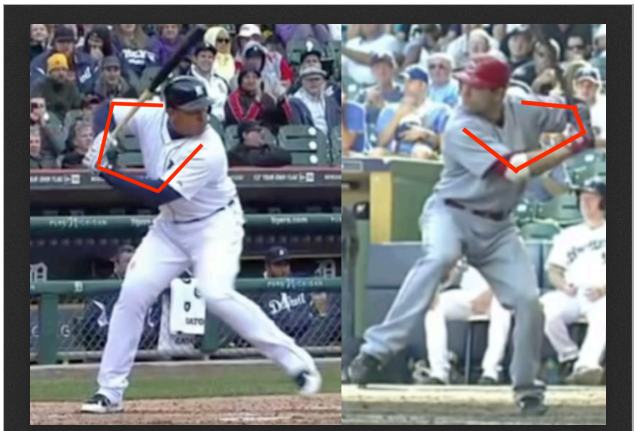
Hitter's cage freezes degrees of freedom

Another common flaw in hitting instruction is in promoting active movement with the hands. Hitters are taught to direct the knob of their bat toward the ball and to "take their hands straight to the ball." In elite hitters, the hands are only minimally involved. As former American League MVP, Josh Donaldson said in a MLB Network interview. "I never think about my hands when I'm hitting. The only time ever I think about my hands is if it's an emergency swing, and I'm just trying to foul a ball off."

In the SAVAGE system, the hands and arms lock into what we call the "Hitter's Cage" (credit to our friends at Bardo's Diamond Sports for this idea). To feel the hitter's cage, hold a bat in your back hand and with your elbow of your swing bent exactly 90 degrees, raise your upper arm to a position such that is is parallel to the ground and projecting directly forward at 90 degrees. Your forearm will be perpendicular to the ground, and the pinky side of your forearm will be oriented away from your face.

Now grasp the bat with your lead arm and hold your lead forearm at an exact right angle to your back forearm. Your lead forearm should now be parallel to the ground, and the pinky side will be oriented away from your face.

Isometrically tense the muscles in both arms, removing all the muscle slack. Now, maintaining the tension in both arms, move them together up and down and side to side. Note that when the lead elbow moves upward, the back elbow moves downward and vice versa. In the SAVAGE swing, the arms co-contract into this cage position as the hitter gathers to achieve co-contraction on the back leg. We call this



Building the hitter's cage

Back arm pinched, front arm long

movement "building the cage."

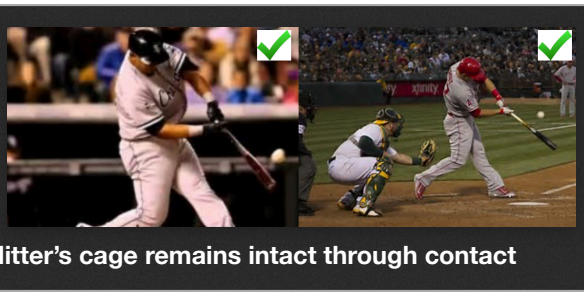
The cage can be disrupted if the back arm is pinched in toward the ribs or if the lead arm is excessively barred.

MOVIE 5.8 Hitter's Cage Movement

Back elbow moves under the hands. Video credit pastimeathletics

Highly performing hitters maintain the integrity and positioning of the cage by retracting their backside scapula (shoulder blade) toward their spine and downward

toward their back pocket. As the body begins to rotate the back elbow moves directly under the back hand and the lead elbow works up the midline of the body (at varying degrees depending on the location of the pitch). Both arms remain co-contracted and work together.


Hitter's cage remains intact through contact

The hitter's cage remains stable and intact through contact with the ball. The arms are not released and extended until after contact.

The rear scapula must remain loaded (retracted and depressed toward the back

MOVIE 5.9 Hitter's Cage Scap Load

The rear scap loads via retraction and depression. Video credit: *pastimeathletics*

pocket) until the hips and torso have rotated.

If the rear scapular load is released too soon, muscle slack appears. The cage and the hands drift forward toward the middle of the body, compromising power and removing a key adjustment option.


Hitter's cage scap load lost. Hands drift forward.

Control of the hitter's cage through co-contraction freezes degrees of freedom in the upper extremities and simplifies the adjustment strategies for pitch location, shape, and speed. More on that later.

Stability in cage attractor construction and movement produces a cycloid barrel run that creates early bat speed and allows the bat to enter the hitting path from deep in the back of the zone. This affords the hitter more time for adjustability and increases his odds of getting on plane with the pitch to create solid contact.

MOVIE 5.10 Cycloid Barrel Run

Bat enters hitting path from deep in the back of the zone. Video credit: Hitting Performance Lab

In the traditional "hands straight to the ball" swing, the bat enters the hitting zone from above which requires the hitter's timing to be perfect if he is to achieve solid

MOVIE 5.11 Traditional Hands/Knob To Ball Swing

Bat enters hitting zone from above. Video credit: MLB.com

contact.

Anti-cycloid barrel run critics suggest that by adding distance or "a loop" (as they call it) into the swing, we will slow the hitter's bat speed and increase his time to con-

tact, making him chronically late in his timing. They note that since the closest distance between two points is a straight line, the quickest route for catching up to high-velocity fastballs is to take the hands and the knob of the bat, on a linear path, directly to the ball. Unfortunately for these doubters, the physics of angular momentum doesn't support their position.

In the following video, you'll see a demonstration known as "The Brachistochrone Problem." The researchers will simultaneously drop three colored balls to roll down three different kinds of ramps.

The white ramp and ball represent the traditional "hands to the ball" swing. The red ramp/ball suggests the shallow cycloid swing we advocate in SAVAGE Power Hitting, and the yellow ramp/ball is an example of a deeper pop-up or fly-ball swing. Notice which ball reaches the finish line first.

MOVIE 5.12 The Brachistone Problem

The fastest swing is not straight to the ball. Video credit: EPA productions

Even though the cycloid route covers more ground, the shallow cycloid ramp actually gets to the ball to the finish line first. Surprisingly, even the ball on the loopier "pop-up ramp" arrives before the ball on the straight ramp. That's because the ball picks up energy on the turn. The same thing occurs with the cycloid barrel run of a high-level swing. The bat head travels backward slightly before turning and entering the hitting zone from the back. As the barrel is turned, it picks up speed early in the swing, and it actually gets to the ball quicker. Maintaining cage integrity and position creates a quicker and more powerful swing that facilitates being on time and on plane, no matter what the pitch.

The cycloid barrel run produced by stability in the back leg, front leg and cage attractors also eliminates the fear of being late, thereby amplifying a hitter's confidence

and his overall production -- especially in two-strike counts. If the hitter has the confidence that he can be late and still have the bat speed and bat path to do damage, he will less likely to cheat forward to catch up to fastballs.

When a non-SAVAGE hitter employs a traditional "knob to the ball" swing, the sharp angle at which he enters the hitting zone lowers the likelihood of getting on plane with a pitch. And, because the time to contact is slower, the hitter will tend to move forward prematurely and uncontrollably in an attempt to catch the ball in front of the plate. This could make him vulnerable to off-speed pitches resulting in ugly, unstable swings incapable of power production.

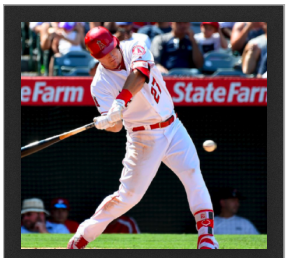
In 2010, Coach Ron Wolforth of our sister company, The Texas Baseball Ranch®, coined and trademarked the phrase "Start With The Pain" as a critical starting point for managing arm health in our throwing athletes. Ted Williams, in a 1995 interview with legendary broadcaster Bob Costas, stated, "The inside half of the plate. That's where history is made." (6)

The number one source of "pain" for most hitters is their fear of being jammed or being blown away by inside heat. When SAVAGE hitters learn to organize swings that feature the cycloid barrel runs, they minimize the fear of being late. Consequently, they are able to attack those history-making pitches on the inner half without losing the stability of their attractors. They are also more equipped to manage pitches on the outer half, and they possess biomechanical tools to make the adjustments necessary for off-speed pitches. Early bat speed allows SAVAGE hitters to be late and still do damage.

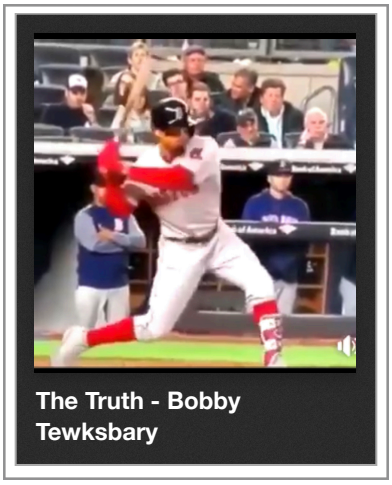
Our 2-strike mantra

When our hitters find themselves in 2-strike situations, we ask them to try to be late on all fastballs. As such, we must accept that occasionally they will be a bit too late and will appear to be blown away by a fastball. Our mantra as SAVAGE hitters in 2 strike counts, is, "Better late than ugly."

5) The Trunk Attractor


Trunk attractor

After energy is gathered and stored via co-contraction in the back leg, the lead leg, and the hitter's cage, the hitter must now use the elastic properties of abdominals and chest muscles to transfer that energy to the bat and ball. Efficiently managing the trunk attractor demands a training environment that encourages the body to self-organize optimal abdominal and chest muscle length and co-contraction. A lot is made of the need to create torque, or what some call "hip to shoulder separation" to maximize power output.


The Truth - Bobby Tewksbary

As the highly regarded hitting instructor, Bobby Tewksbary, first revealed, most great hitters find a way to get to this position he calls "The Truth."Notice how Mookie Betts' hips are opened toward the pitcher, while the shoulders remain closed. Notice also that he maintains scap load keeping the structure and location of the hitter's cage intact. As the hips turn, the hands remain over the back calf. Moving through this position keeps the trunk and the hands loaded for power, yet fully adjustable for deviations in pitch location, shape, and timing. Well timed, synergistic abdominal lengthening and co-contraction can be vital to overall performance. However, we must always remember that more separation is not always better.

MOVIE 5.13 Not Necessarily "Hip-To Shoulder Separation"

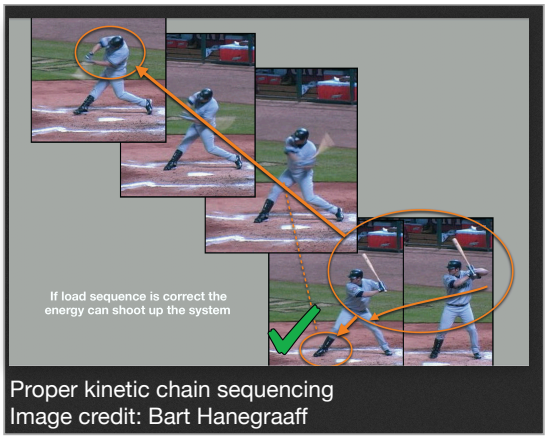
Optimizing abdominal length for co-contraction. Video credit: pastimeathletics

Too much hip-to-shoulder separation could actually increase muscle slack and render the abdominals insufficiently prepared to reach the co-contraction required for optimal force production and energy transfer.

The SAVAGE Power Hitting System uses innovative motor learning strategies to help each athlete discover his individual optimal length-tension relationship and then to produce timely abdominal co-contraction from that foundation. This adds bat speed and power and assists with adjustability.

Proper Sequencing

The most efficient, powerful and adjustable swings demonstrate the following kinematic sequence: foot down, back hip rotation, then the hips and pelvis turn, followed by the abdominals, the chest muscles, the shoulders, the hands and finally the bat.



Proper kinetic chain sequencing
Image credit: Bart Hanegraaff

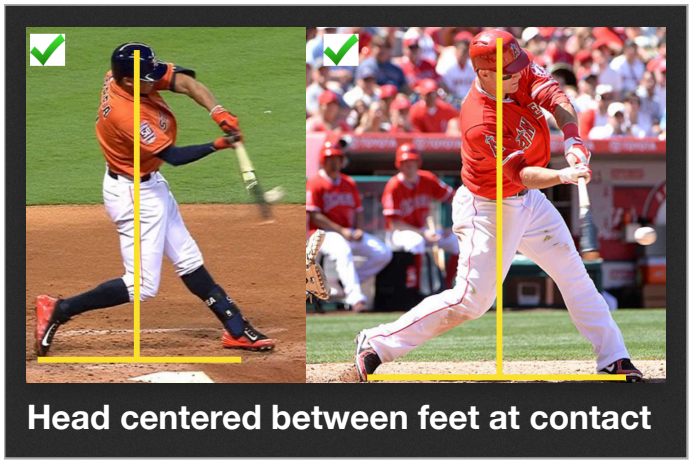
In the traditional "hands to the ball swing," the hands, hips, and trunk tend to move together, thereby inhibiting the force multiplying synergy that maximizes performance.

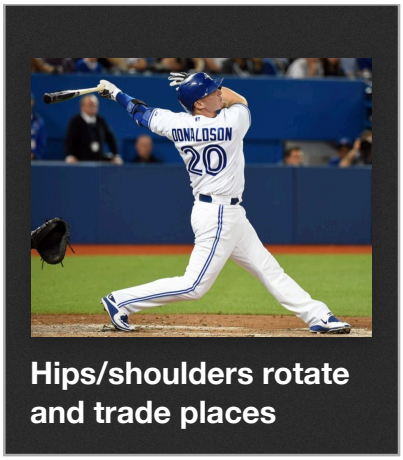
6) The Deceleration Attractor:

Dynamic systems hate sudden stops. Continually subjecting a body part to the sudden "bangs" and "rebounds" that often present in sub-par deceleration patterns can result in cumulative trauma to the connective tissue in the body. Any adaptation requires stress in some form. However, if that stress is produced too rapidly and/or is not adequately dissipated, tissue injury or subconscious inhibition of bat speed may occur.

Proper deceleration dissipates energy

At contact, we look to see that the head is centered between the feet to improve the foundation for optimal length-tension relationships and co-contraction to remove muscle slack. After contact, we ask the athlete to continue rotating as long as possible, even to the point that the back of his jersey is facing down the baseline. Continued rotation of this type allows all joints to stay connected to the spine and disperses the energy away from at-risk joints. Inefficient deceleration patterns can lead to injury or to subconscious inhibition or slowing down of the swing, as the body attempts to protect itself from persistent trauma.


Head centered between feet at contact

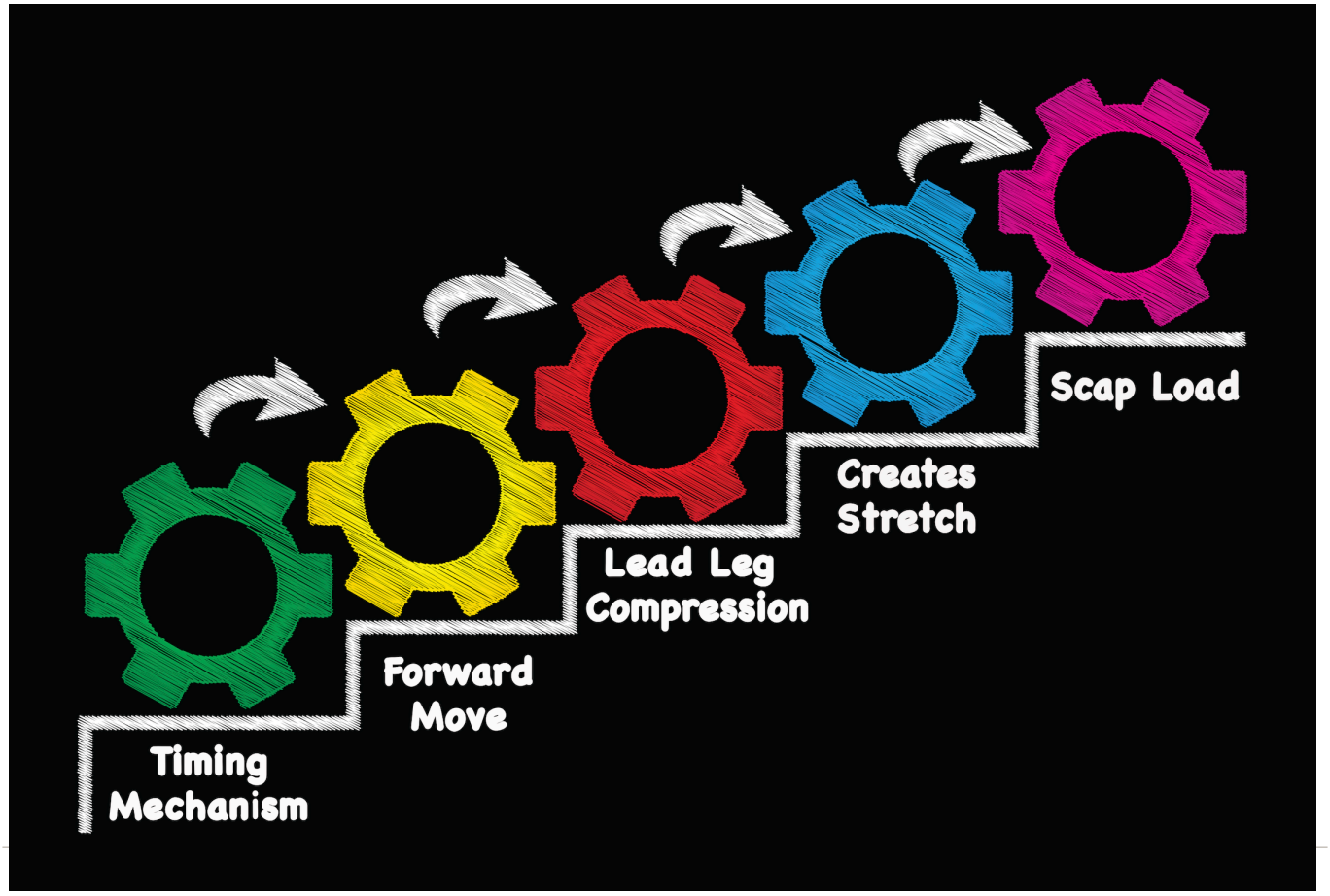


Hips/shoulders rotate and trade places

Before we can expect to make significant progress with a hitter, we must first identify the stability (or lack thereof) in each of the six attractors. We use a"Green, Yellow, and Red" evaluation scale for each piece of our "Body, Bat, Ball" assessment process. A green score is considered acceptable and the athlete is ready to accept challenges in that area. A yellow score indicates that we might be able to add load or variability to that attractor, but we must take caution that the athlete's system isn't overwhelmed -- a situation that could lead the athlete toward corruptive shortcuts as he searches for movement solutions. A red grade presents a significant opportunity for improvement and means that we must work to stabilize the attractor through our movement enhancement exercises, our skill development training experiences and in our SAVAGE strengthening programs. Adding load to dysfunctional movement is not permitted in our system. By assessing the stability of each of the six attractors, we create the template and the laser focus we need to deliver innovative, individualized and highly effective training intervention. Stability in the attractors automatically builds in the physical swing characteristics that afford the athlete just the right number of options for adjustment to pitch speed, location, and movement.

CHAPTER 6

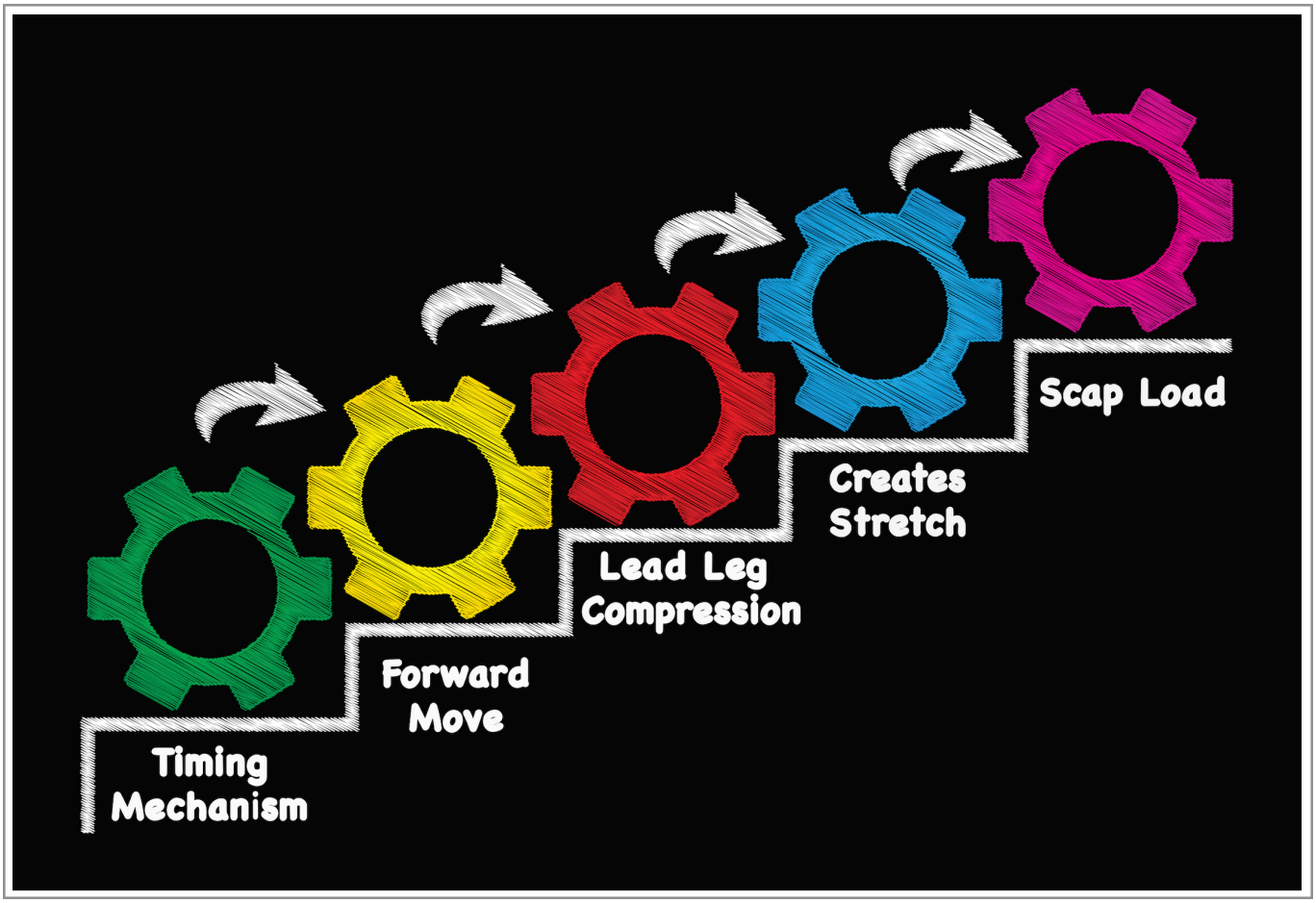
THE COGS OF ADJUSTABILITY



The final step in the video analysis is to look for several physical key swing components necessary for adjustability. These key components, allow for adjustment to pitch location, movement, and speed. Our attractor- based evaluation helps us identify the presence or absence of swing traits we call "The Cogs Of Adjustability" – a term I'm, pretty sure I first heard from Bobby Tewksbary. Without these components the hitter becomes a robotic "pinball flipper." Unable to adjust his swing pattern in flight, he is relegated to "guessing." He'll only find success on the rare occasion that he guesses right and that, even though the odds are stacked against him, he is on time and on-plane.

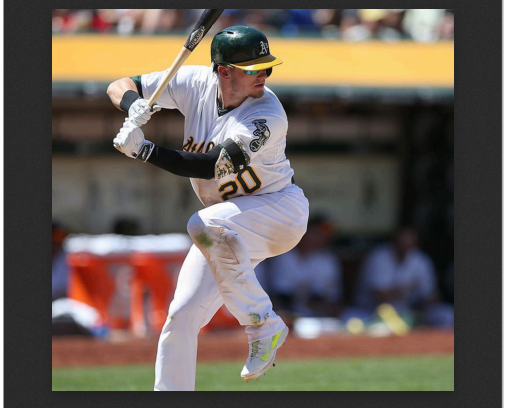
CHAPTER 6

THE COGS OF ADJUSTABLITY



Timing Mechanism:

For the first cog, we want to see some sort of timing mechanism such as a leg kick, a toe tap, or another timing mechanism that serves to trigger the swing. We're big fans of a controlled leg kick since it also facilitates the positioning of the lead hip higher than the trail hip -- a key component of hip lock.



Leg kick aids timing, facilitates hip lock

Forward Move:

Next, we examine the presence and quality of the hitter's forward move. As discussed in the back leg attractor segment, a controlled forward move affords the hitter time and space to make adjustments to pitch location, movement, and speed. If the back leg attractor is unstable, controlling the pace and distance of the forward move will be difficult.

Controlled forward move aids adjustment
Image credit: Bart Hanegraaff

Lead Leg Compression

The third cog is more of a movement option than a physical swing trait. Many elite hitters, when they're early on a pitch employ a strategy of compressing the lead leg into the ground and bending the knee to get back on time. Forcing momentum downward stops it from continuing forward. We'll show you a great example of lead leg compression in a bit.

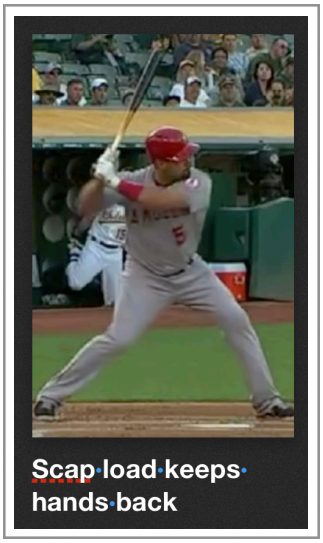
Lead leg compression

Creates Stretch (optimal length and co-contraction)

Finding and maintaining optimal length in the abdominals and chest muscles can be an excellent tool for producing power. However, it also presents a strategy for adjustment. When a hitter finds optimal length and holds it, he can delay torso rotation just enough to get back on time/plane and he can deploy other cogs. Without stretch, the hitter loses stability in the trunk attractor.

Abdominal stretch allows adjustment

Scap Load:



The final physical cog of adjustability is seen in maintaining proper scap load until the barrel is released. It's quite common for coaches to advise players to "keep their hands back" when attacking off-speed pitches, but what does that really mean? In the SAVAGE swing, keeping the hands back means holding the abdominal stretch and maintaining scap load until the appropriate time. If scap load is produced and held, the hitter's cage will remain stable. The hands will hover over the back calf and the swing can be delayed for a few milliseconds but still preserve length-tension relationships necessary to optimize bat speed attack angle and ball exit velocity

Making The System Robust: Simplifying Adjustment Strategies

Remember that in a dynamic system, as the attractors become more stable, fluctuations are automatically minimized. While a movement can never be truly repeated, the bandwidth of the deviations are minimized when attractors are stable. The key in any athletic movement and specifically in hitting and throwing is to make the attractors stable, but not so stable that the athlete's movement becomes rigid and unadjustable. The athlete must maintain enough fluctuation options to make the movement ***robust*** (i.e., resistant to perturbation). Potential perturbations are presented by the pitcher on every pitch as he tries to use location, speed and movement to disrupt the hitter's swing. By stabilizing the six-hitting attractors, the athlete effectively freezes the degrees of freedom in his swing such that fluctuations and adjustment options are minimized and simplified. SAVAGE hitters with stable attractors and the cogs of adjustability built into their swings need only retain fluctuation strategies for three types of adjustments:

1) Inside and outside adjustments
2) Up and down adjustments
3) Early and late adjustments

Inside And Outside Adjustments

When a SAVAGE hitter moves with stability in all six attractors ***and is on time with the pitch,*** managing adjustments to horizontal pitch location becomes a matter of training and maintaining one simple fluctuation. He adjusts to inside and outside pitches by managing the degree to which he opens the hips

For pitches on the inner half of the plate, they hips will open significantly.

MOVIE 6.1 Inside And Outside Adjustment

Inside adjustment: hips open significantly

For pitches over the middle of the plate, SAVAGE hitters open their hips less.

MOVIE 6.2 Inside And Outside Adjustment

Middle adjustment: hips open less

And, on the outside pitch, the hips open very little.

Movie 6.4 Inside And Outside Adjustment

Hips open very little

Up And Down Adjustments

In addition to in and out adjustments, hitters must be able to handle perturbations in vertical location. If the SAVAGE hitter's attractors are stable and ***he is on time,*** his strategy for managing up and down adjustments becomes a matter of modulating the lateral tilt of his trunk.

Movie 6.3 Up And Down Adjustment

Trunk tilts very little

For high pitches, the SAVAGE hitter shows very little lateral tilt.

Movie 6.5 Up And Down Adjustment

Middle hieght: trunk tilted a little more. Video credit: MTC

For belt-high pitches, he tilts a little more..

Movie 6.6 Up And Down Adjustment

Low pitch: more extreme lateral tilt. Video credit: MTC

And for low pitches, he deploys even more lateral tilt.

One can easily imagine the complexity and difficulty of making these adjustments with unstable attractors. It would be like swatting flies with chopsticks. By stabilizing the attractors, we can limit some of the unnecessary, unwanted fluctuations while maintaining a few easy options to manage pitch location adjustments. It should be noted here that every pitch offers a unique combination of "in and out" and "up and

down" management. Therefore, once the athlete demonstrates a reasonable ability to manage pitch location with one of the aforementioned fluctuation strategies, his training should incorporate as much variability as is contextually appropriate so he can implicitly learn to manage the strategies in blended combinations.

It should also be noted that the theoretical "in and out" and "up and down" adjustment strategies discussed in this chapter assume the athlete is on time with the pitch. Within each strategy, the hitter must be able to execute a stable, yet effectively adjustable movement within the context of varying degrees of timing perturbations. Hitters will need to self-organize nuanced variations of the hip rotation and lateral trunk tilt adjustments that change subtly as their timing finds them either early or late on a pitch.

Adjustments Early and Late Timing.

Speaking of timing, the final adjustment a SAVAGE hitter with stable attractors and the cogs of adjustability built into his swing will need to learn to manage is the most common timing strategy we see among high level hitters -- **front knee flexion**. When a SAVAGE hitter is early on a pitch, he can flex his front knee to varying degrees.

MOVIE 6.7 Early Timing Adjustment

Front knee flexion can help a hitter get back on time

By flexing his front knee the hitter forces his momentum downward momentarily. This allows him to resist the tendency to continue to move forward. If he were to continue to drift forward, he would likely lose the stability of his front leg attractor, and subsequently the hitters cage and the trunk attractor would unravel.

CHAPTER 7

PERCEPTUAL ADJUSTABILITY

Once the attractors in the swing are stable, and the fluctuation strategies for adjustability are simplified, we can begin ***coupling perception with action*** into our practice design. By exposing a hitter to a training environment rich in perceptual variability, we can hone his ability to make rapid subconscious interpretations of perceptual information. By frequently changing the task, the environment, or the physical/mental state of the athlete, the SAVAGE hitter with stable attractors can learn to predictively self-organize and blend the simplified adjustment strategies we discussed in chapter 6.

CHAPTER 7

PERCEPTUAL ADJUSTABILITY

Optimizing Hitter Practice Design

The biggest separator of the Florida Baseball Ranch® in comparison to other training facilities is our deep understanding and application of the principles of motor learning and skill acquisition science. Many hitting instructors and coaches, tend to rely too heavily on cognitive and verbal cues to direct the swing changes we desire. We tell them how to swing. We watch them swing. Then we tell them how to swing better.

"On your next swing, I want you to think about _____."

"When you make your swing, I need you to focus on _____."

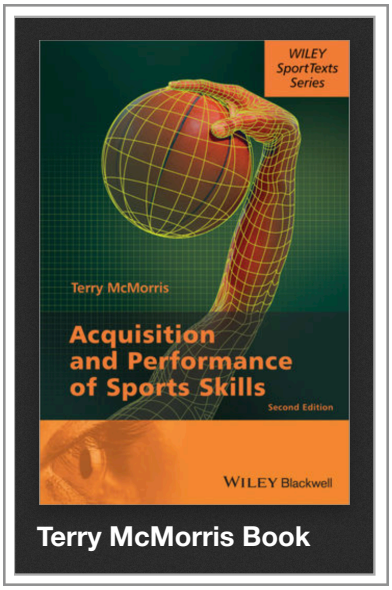
Here's the flaw in this approach:

We have established that an elite swing must be adjustable. Well, those adjustments have to occur in real time in response to a pitch. We can measure the time it takes for a neurological impulse to travel from the brain to the muscles and then for sensory information to be transmitted back to the brain where that information is interpreted before sending a message of adjustment back down to the muscles. When you do the math, it becomes clear that there isn't enough time in a swing for any of those adjustments to happen by way of conscious thought. That presents a major corruptive problem in the conventional approach to teaching hitting.

Our students are being asked to perform a skill that doesn't allow them enough time to think about what they're doing or how they're doing it. But, we're training them with an approach that frequently demands conscious thought.

Skill acquisition experts call this method "explicit learning," and it is highly ineffective in teaching skills that are characterized by time pressure or psychological stress. And, I think we can all agree that attempting to hit 100 mph fastball or a 92 mph slider in front of 40,000 hostile fans offers both time pressure and psychological stress.

As described by skill acquisition expert, Terry McMorris, in his book Acquisition and Performance of Sport Skills, "To most people learning a skill is explicit, i.e., we consciously set out to perform something that we have seen or are told to do. However, learning can also occur implicitly or subconsciously. We often acquire skills without instruction, by simply setting out to achieve a goal. Concerning motor skills, this involves the individual learning to carry out a skill without understanding how they perform that skill. They cannot articulate any rules. The learning is subconscious." McMorris goes on to note, "Research has shown that skills learned implicitly withstand stress better than those learned explicitly. This is probably because of the lack of involvement of the prefrontal cortex in this type of learning may make them less vulnerable to stress."



Terry McMorris Book

In other words, athletes trained implicitly are less likely to be paralyzed by thought. Implicitly trained athletes are therefore highly adaptable and immune to psychological pressure.

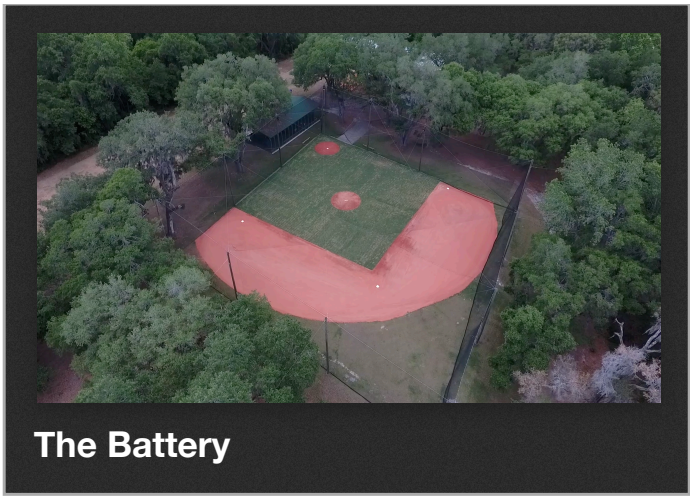
Ranch Guys are trained implicitly. Since we limit cognition in their training, they learn faster, the training transfers better to the game and here's the best part ...

Ranch Guys Don't Choke!


Implicitly learned skills withstand pressure

Adherence to the motor learning principles of implicit learning, representative design, and perception-action coupling will be crucial to overcoming the corruption of traditional hitter training. Because of this unyielding desire to help frustrated players, and against the advice of many trusted advisors and baseball traditionalists, we went to great expense and overcame significant engineering challenges to build a "batting cage" that allows for ball flight that provides instant, accurate feedback about the nature of the hit.

Our passion and commitment to change the landscape in hitter training is intense and unalterable. Guiding SAVAGE students toward the discovery of talent that eliminates the pain of chronic failure is our unwavering focus. We will revolutionize the hitting universe just as we transformed the world of pitching instruction. Soon SAVAGE Power Hitters will dominate the landscape at the highest levels of the game.


The Battery

We call it The Battery®.

It's a 100' x 100' diamond with 40 ft high net walls and a net roof. It features a regulation size infield with about 15 feet of outfield grass. With the emergence of Statcast® data and other well-publicized metrics, some coaches are beginning to warm to the goals of hitting balls hard in the air. However, even if they happen to be aware of the value of optimizing exit velocities and launch angles, or the importance of a swing that includes a cycloid barrel run and the cogs of adjustability, most traditional instructors would resort to the same tired verbal cue and cognition-laden teaching techniques they've always used. Perhaps they would revise the vision of what they consider the "new ideal swing." They would continue to direct athletes toward an internal focus on the position and movement of their body parts. Their approach would continue to impede real learning and it would create yet another generation of hitters who despite many long hours of "practice," would frequently taste the bitterness and feel the sting of failure.

Constraints led approach for SAVAGE Hitters

We believe we have a better idea. In SAVAGE Hitter training sessions, instead of telling the athlete how to modify his swing to achieve a preferred launch angle, we place a wall of 10' high screens at 37.5' from home plate. Balls hit just over the screen wall measure at 15-degree launch angles. Shots that hit the top of the net are 36-40 degrees.

With this practice design, any swing pattern that would result in a ground ball is discouraged by the wall of screens. A swing that would result in a pop-up is discouraged by the net roof. This type of training is known as a constraints-led approach (CLA) and is reported under dynamic systems theory to be superior to traditional explicit teaching.

Thirty feet up the back walls, just above the shortstop and second baseman positions, we hung two customized windscreens that feature our company logos, surrounding a vicious-looking red bull charging toward the hitter. The caption reads, "Hit the bull, win a steak."

External focus, goal-directed training experiences

We ask them to focus their attention externally on the goal of clearing the screens and hitting the bull.

In addition to using CLA to guide our SAVAGE Hitters toward more stable, powerful, and productive swings, we deploy a large and diverse toolbox of innovative strategies for maximizing results. Here's a look at seven ways to influence movement patterns without using mind-numbing verbal or cognitive cues.

Knowledge of Results

Motor learning researchers divide feedback into two general categories : Knowledge of Performance (KP) and Knowledge of Results (KR). Knowledge of performance is subjective and includes value judgements as to the quality of the movement. When using KP, hitting coaches tend to talk about what the swing looked like . Comments like"Good Swing." or "You let your hands leak forward," would be examples of KP.

Knowledge of Results feedback is objective. It makes no value judgement as to the quality of the swing, but instead reports the objective results. When given intermittently during practice (about every 4-6 swings), KR has been shown to be more effective than KP in learning and retention of motor skills.

During every training session, we provide frequent objective feedback using Rapsodo®, KVest®, and BLAST® technologies. Immediate KR allows SAVAGE Hitters to modulate their training experiences in real time as needed. This ensures a better return on their training time.

All of this data and leading-edge skill development has produced incredible improvements in the swings and skill performance of our hitters. According to Statcast® data, 100 mph exit velocity hits at 18-32-degree launch angles result in a .592 batting average and 97% of those hits are doubles, triples, and homers. These are the goals we have chosen for SAVAGE Power Hitters.

I believe anyone has the potential to achieve these goals and more. I think this for two reasons:

1) God doesn't make junk, and

2) Human tissue doesn't have a free will.

It cannot decide not to participate. It can only

respond to the demands we place on it. The information presented during the training experience forces the body to adapt physiologically and neurologically to the demands of the training.

Many coaches or traditional hitting instructors will tell you that hitting for power is a gift for only the chosen few to enjoy. "You'll never be big or strong enough to hit home runs, so let's just work on hitting line drives and backside ground ball." I'll paraphrase my friend and fellow hitting instructor, Coach Jeff Leach, who recently posted a witty and brilliant anecdote that illuminates the ridiculousness of this idea. Imagine you realize your son or daughter needs help with math, so you hire a math tutor. During the first session, the tutor says, "Listen, let's be realistic here. Your son is never going to be able to handle algebra, trigonometry, or differential calculus, so I think we're going to stick with addition and subtraction." Would you accept that? Would you even pay the guy for service under those assumptions? Of course not.

Yet that is precisely the message I see some people conveying to the hitters on a daily basis.

The SAVAGE Power Hitting goals of 100 mph exit velocities and 18-32 degree launch angles are attainable for ANYONE.

You can do it. Others have done it. **You** can do it **too**. We'll show you how.

Call us at 866-787-4533.

Let us evaluate you and design a customized training plan to get you there. We'll give you a comprehensive, multi-faceted training plan that will be simple and actionable. We've labored through all of the complexity, and we're prepared to create a training plan for you that achieves "simplicity on the far side of complexity."

Notice I said the plan would be **"simple."** I did not say it would be **"easy."** On the contrary, the work will be hard … extremely hard. To achieve 100 mph exit velos will require more than just working on the mechanics of the swing, or designing practices that deftly couple perception and action. It will require you to change your body into a coordinated, powerful, and adjustable machine that helps you hit a ball harder. That's where our SAVAGE Strengthening program comes in.

CHAPTER 8

FBR SAVAGE STRENGTHENING

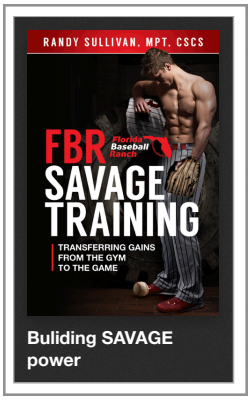
As we said back in chapter 1, SAVAGE is an acronym that stands for , **S**pecific **A**daptation thru **V**ariability, **A**ttractors and **G**oal-directed **E**xperiences. SAVAGE is involved in every aspect of training. SAVAGE is the application of Frans Bosch's integration of strengthening and coordination training concept, specifically geared to baseball.

I frequently ask our students this question, "What is the purpose of the gym?" They usually have the same answer: To get stronger." That's when I say," I think you're wrong. I believe the true purpose of the gym is to make you play better. No one cares how strong you are if you can't hit or throw."


False-hustle

Yet, far too often players, coaches, and parents fall prey to the false hustle of the muscle heads in the gym that by diving deeper into traditional slow, heavy lifts like deadlifts, squats, and bench press is the answer to all their hitting woes. "If you can't deadlift or squat 2 1/2 times your body weight, you haven't earned the right to even think about becoming a power hitter," they say. Well, we all know that isn't true.

Listen, this game is merciless on the weak. **You have to be strong to play baseball**. That is an indisputable fact. However, once you're strong, strong is strong enough. Raising your max deadlift or squat from 400 to 450 pounds doesn't make you a better hitter. Please don't misunderstand me. We pick up heavy stuff and move it.



Buliding SAVAGE power

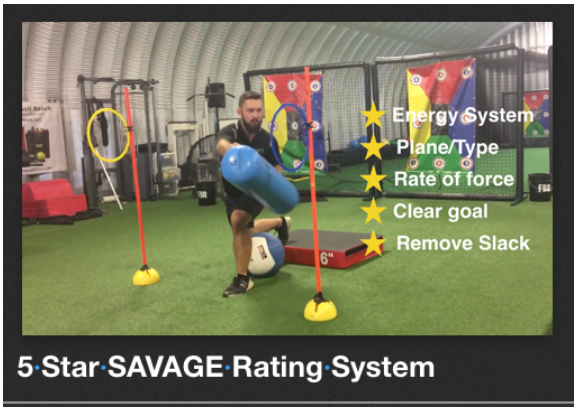
Strength is a good thing, but what we're really after, and what next-level recruiters and scouts are looking for is **POWER**!

Power is recruitable. Power is signable. Power is rare.

Power is what you find at the intersection of strength and speed. But, power is plane specific. Being powerful in the sagittal plane (pushing/pulling), doesn't mean you'll be strong in other planes of motion such as the frontal plane (side-to-side) or the transverse plane (around a vertical axis), which are the planes of movements hitters work in. Power is also leg specific. By that, I mean that if you're powerful on two legs, you may not be powerful on one leg.

After a baseline level of strength and power is established through traditional strength training, we must transition to exercises more specific to hitting. My book

and video, turns traditional strengthening on its ear and uses our original 5-Star Specificity Rating System to design and evaluate exercises as to their potential for producing hitting power.



Our revolutionary application of Dynamic Systems Theory in FBR SAVAGE Power Hitting has yielded incredible results for our students. In the summer of 2018, during our Complete Game Summer Training Program,

SAVAGE hitters increased their exit velocities by an average of 7.6 mph.

If you're ready to develop the kind of power and damage capability that earns college scholarships and pro contracts, register today of one of our **FBR SAVAGE Power Hitting Boot Camps.**

Give us a call at 866-787-4533 and let us set up a Precision Strike 4 hour 1-on-1 SAVAGE Power Training Session.

We can help you achieve your dreams. But, you gotta get here!

Let's Get SAVAGE!

References:

1) Kelso JAS, Mandell AJ, Shlesinger MF, Dynamic Patterns In Complex Systems, World Scientific Publishing Co., Teaneck New Jersey. 1988.

2) Bosch F, Strength Training and Coordination: An Integrative Approach, 2010 Publishers, 2015.

3) McMorris T, Acquisition and Performance of Sports Skills, Wiley Blackwell, University of Chichester UK, 2014.

4) Renshaw I, Davids K, Motor Learning in Practice: A Constraints-Led Approach, Routledge Taylor and Francis Group, London and New York. 2010.

5) Chow JY, Davids K, Button C, Renshaw I, Nonlinear Pedagogy in Skill Acquisition: An Introduction, Routledge, Taylor and Francis Group, London and New York, 2016.

"6) Ted Williams Quotes." Quotes.net. STANDS4 LLC, 2018. Web. 2 Jan 2019. www.quotes.net/quote/19704

About The Author:

Randy Sullivan has been a "baseball junky" since he started playing on the tee ball fields of Yokota Air Force Base in Japan at the age of 7. When his father passedaway at the age of 36 (Randy was 15), his mother and 2 brothers settled in Sumter, South Carolina where he played football, basketball, and baseball at Sumter High School. Randy transferred to The Citadel,The Military College of South Carolina where he became acatcher and a GTE-CoSida first team Academic All-American.

During a 10 year stint in the Air Force, he was a Nuclear Missile Launch Officer before attending The U.S. Army-Baylor University Graduate Program in Physical Therapy. After transferring to MacDill Air Force Base and serving for 3 years as a physical therapist, in 1996, he requested and received an honorable discharge and opened a private physical therapy practice in Brandon, FL.

In 2009. he opened the ARMory Power Pitching Academy andbegan officially training baseball players. In 2016 The ARMory changed its name to The Florida Baseball Ranch® and began a collaboration with The Texas Baseball Ranch®. An insatiable learner and a prolific writer, Randy has now written 7 Baseball Training Books with their associated instructional videos:

Developing The 90 mph Delivery

Engineering The Superhuman Pitching Machine Series

Volume 1: The Fab Four Pillars of Explosive Pitcher Development

Volume 2: Conducting a World Class Pitcher Assessment

Volume 3: Taking Action, Targeting Your Training

Scaptivation: Bulletproofing The Next Generation Of Elite Power Arms

Start With The Pain: The Complete Guide To Managing Arm Pain In The Elite Throwing Athlete

FBR SAVAGE Training: Transferring Gains From The Gym To The Game

Randy's E-books have included:

9 Innings of Truth: Dispelling Baseball's Most Pervasive Myths About Pitching and Mechanics

Throw Out The Damn Towel: The Dangers of a Linear Deceleration Pattern

Why Your Pitching Lessons Don't Work: Hidden Secrets to Turbo Boost Your Training

Instant Hammer: Developing a World Class Breaking Ball in 15 Minutes Or Less

The Elite Pitcher's Ultimate Guide To Recovery: Ice Is For Cocktails

And, he has written over 1000 blog articles and developed over 30 other instructional videos.

You may find all of his published works at floridabaseballranch.com/books