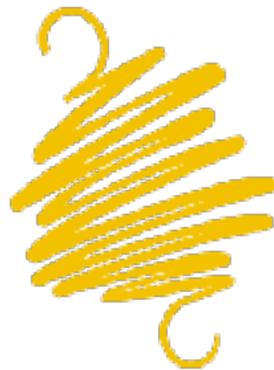


Building Biomechanics

Rotation-By-Rotation



Freestyle Trampoline

A s s o c i a t i o n

What is Rotation?

As mentioned in "Building The Freestyle Community," the FTA's approach to coaching Freestyle athletes is geared around '*building*' athletes ***Degree-By-Degree, one degree at a time, along pathways, slowly but surely.*** So now it's time to dive into the mechanics of how rotation works so we can understand how to start the building process. There is one simple rule in all of acrobatics no matter if you are traditional or Freestyle:

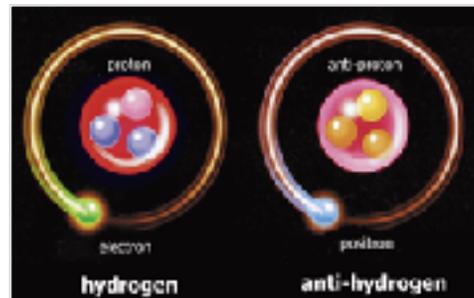
The Rule is simple:

Where The Mass Goes, You Go!

One repeating theme of this educational package is that traditional and Freestyle acrobatics are the same and the athletes have the same biological structure even if they behave in slightly different ways (*secondary behaviours*). The only differences are based on the specific environment each athlete lives in. The traditional athletes live in a real world structure with a hierarchy that leads up to the Olympic Games. The Freestyle athletes also work their way up to Influencer status but this hierarchy is online and with that comes different freedoms, but also different challenges as well.

When discussing rotation, we will be doing away with the differences between traditional and Freestyle athletes because mechanics doesn't play politics. Mechanics don't discriminate and mechanics most certainly do not care about your history. Mechanics are the branch of applied mathematics dealing with motion and forces producing motion. They work predictably and have done so since the beginning of time.

Based on overwhelming evidence, during the "*Big Bang*," particles began to collide and then combine together in different ways. There was an asymmetry between normal particles as we perceive them and the mirror image of these particles which we call "*antimatter*" (*matter consisting of*



elementary particles which are the antiparticles of those making up normal matter). It is unclear what created this asymmetry but what is known, based on astrophysics and particle physics is; without a 1 billion: 1 billion ratio and one asymmetrical ratio between antimatter and matter, the universe we see today could not exist. It would literally annihilate and cancel itself out. All rotations need an imbalance in the system to create a rotation. The universe needs it and so do athletes.

Universe ~ all existing matter and space considered as a whole; the cosmos. The universe is believed to be at least 10 billion light years in diameter and contains a vast number of galaxies; it has been expanding since its creation in the Big Bang about 13 billion years ago.

If there was a perfect balance, all particle electrical charges would cancel out and you would be left with nothing. This is true with all rotations. This rule of rotation, which I call **The 1% Rule**, governs every rotation inside and outside of your body and governs the existence of the universe, which is why it is the beginning of our story.

It is important to start off by remembering that even though we say phrases like “stand still” or “don’t move” it is physically impossible. Whether you are on Earth, the moon, or out in space, you are always moving in a straight line even though you ‘believe’ you are going up or down or side to side at the ‘local’ level. Before we discuss the human perception of acrobatics we must get to the bottom of quantum physics research and build upwards or we will be already skipping ‘degrees.’ We will start by briefly discussing how rotations are built up from quantum mechanical principals before discussing the human perception of rotation.

If you are on the equator you are traveling roughly 1,600 kph. It also takes roughly 942 million km to go around the sun which equates to 107,000 kph. The sun is also moving at 72,420 kph towards other stars dragging us along with it. We are also moving upwards at 25,266 kph out of the galactic disk. If that was not enough, we are also moving as a collection of solar systems, called a “Galaxy,” at a speed of 885,000 kph in relation to other galaxies. Everything in this universe is spinning and moving at some speed; from the sun to planets to particles that make them up.

The human perception of 'going in this straight line' is called "*falling*" and is given to us by the very nature of the universe, woven into the fabric of space and time. Humans have an inherent velocity woven into the very nature of 'being,' created by the asymmetry of the universe which manifests itself as 'rotation' when we interact with "*Gravitational Quantum Field.*"

Quantum Loop Gravity is an idea that stems from Albert Einstein's Special and General Theory of Relativity published in 1905 and 1915 respectively. The theories basically describe the substance of 'gravity' and equates it to what humans call "*Outer Space.*" The Gravitational Field is the fabric of space and time; also known as "*Spacetime.*"



The Gravitational Field is made of "*Lines of Force*" that creates the notion of gravity as we perceive it at the human level. Michael Faraday (1791-1867) developed this theory and most scientific developments stem from this concept. These lines of force are like beads of atoms stuck together (above right picture).



Space is a Gravitational Field that is made of these strings of beads in which everything sits and can be thought of as a giant cosmic 'net.' (picture above)

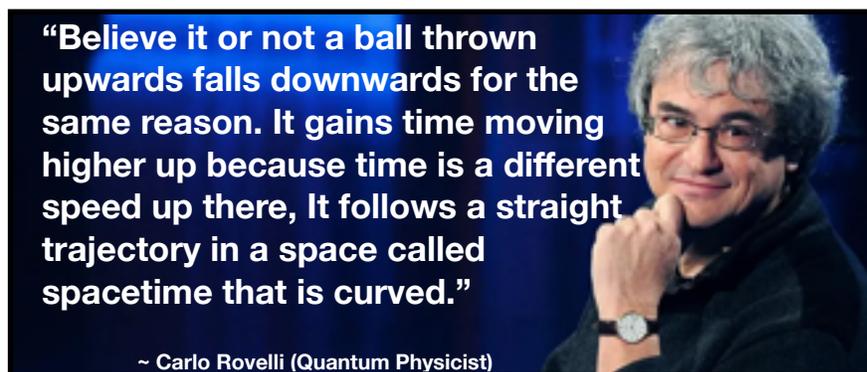
These lines of force are theorized to be made of extremely small particles 10^{-33} meters in size. James Clerk Maxwell (1831-1879), a well known mathematician, used Faraday's abstractions of these 'lines of force' and created Maxwell's Equations that describe "*Electromagnetism.*" The base of every piece of electrical technology you have ever used, such as a phone that has many social media apps use these theories at their base.

Einstein used this concept as *his* base for understanding his equations and realized that the same *lines of force* for the '*Electromagnetic Field*'

were also applicable to gravity. In the universe there are many different 'fields' (*nets*) made of these *lines of force* but they are so small you can't see them. They provide energy to the particles that you can't even see. You would call this an "*Electric Charge.*" These charges that 'stick' molecules together form the world around us and obtain their 'force' (*energy*) from these 'lines' that make up the entire universe. You can think of these lines as a string of extremely small beads woven into a large net that hold up our entire universe.

So far, scientists have identified at least 16 different 'fields' permeating through the universe where different larger atoms pop into and out of existence based on their interactions with these smaller 'beads.' These 'fields' can be thought of as a large cosmic nets of microscopic packets of energy (*beads*) and only when these strings of beads vibrate by interacting with each other do they create the actual larger scale physical atomic structures we see in chemistry. **Quantum physics says that atoms do not physically exist until you interact with them.**

The Earth sits on the *Gravitational Field* and this basically gives us the 'feeling' of gravity as we perceive it. I will spare you the equations and the specifics but you should understand that you are always interacting with the *Gravitational Field*, which makes you feel like you are 'falling' even though you are actually going in a straight line. This causes us to feel the rotation when applied to human beings on Earth.



The notion of gravity is really just a label we created. Gravity is defined the force that attracts a body towards the centre of the earth, or towards any

other physical body having mass. The degree of intensity of gravity is measured by acceleration. This acceleration, or falling, gives you the ability to push off the Earth. This inherent linear velocity you are born with. When pressured by the *Gravitational Field*, it allows you to actually push off the earth creating rotation in the form of acrobatic skills. This has huge implications for the RPF equation shown later in this book.

Everyone is going in a straight line through space but when they interact with “Spacetime” they create acrobatic rotations.

The reason you do not feel you are falling when standing still is actually quite simple: *You have been falling for so long that you are use to it.* You only really notice changes in your interaction with reality, not what reality is actually doing. Rotation requires gravity which is why we have started by looking at what a quantum physicist would say about it. We will see that gravity, along with momentum will create all the different skills we can learn.

[More Information on Quantum Mechanics and Particles/Waves:](#)

[Quantum Physics](#)

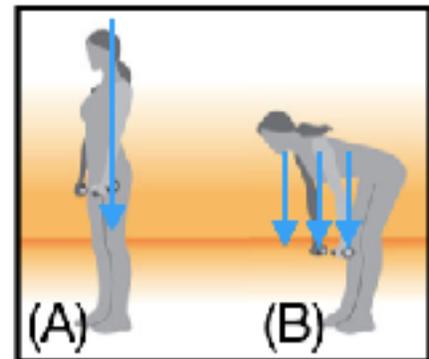
Creating New Rotations:

Based on the fact that you have always been rotating and falling, I suggest you do not look at a flip as if you are starting from zero and “*creating*” a flip out of thin air; this is incorrect. You are ‘borrowing’ the energy in some sense, by creating a new rotation. When you are done using the energy, you will land and that energy will translate to another person or object, such as the mat you land on or the athlete who absorbed your bounce in the case of a double bounced skill. You are simply using pre-existing energy from these different fields (*nets*) to change the direction your collection of particles (*your body*) is moving in relation to that object at that particular moment in time. Energy can’t be created or destroyed, it can only be reallocated in different ways.

How you use energy in some instance of time to move your ‘collection of atoms’ (*your body*) on Earth is called “Rotation.”

In a literal sense, you are simply borrowing energy from your previous movements to fuel the next interactions within the environment, whether it is walking or flipping. You have never ‘stood still’ and neither have your particles without rotating and ‘falling’ around some kind of axis. You will never be able to do that based on the quantum laws of the universe and the way our human form has been developed to perceive it and interact with it within these fields.

Energy and mass are the same by Einstein’s equation: $E = MC^2$, so you can look at the balance of either energy or mass in the system when thinking about creating a flip. For our purposes, we will simply refer to mass instead of energy. If you are standing perfectly upright, all the gravity acting on your body that keeps you standing upright is passing through the body in a linear fashion downward (A). If you were to be ‘unbalanced,’ meaning more mass or energy was on the front side of the body compared to the back side, gravity would pull those molecules on the frontside of your body towards the ground (B). The reason those same molecules do not get pulled to the ground when you are standing perfectly upright as in (A), is because other molecules of your body are literally in the way.



This means you become a little compressed; but not so much you would notice. It should be noted that older generations actually are known to ‘shrink’ a bit due to gravity acting on their joints over time. When you are leaning forward, those molecules are not ‘in the way’ so you are pulled to the ground. Biomechanists call this *rotating*. Someone not trained in gymnastics would probably call it *falling*, but in reality you are actually rotating around the axis, which in this case is your feet.

When leaning forward, more mass is in front of you and you actually rotate around whatever part of your body is touching the ground. When walking,

you are actually rotating around the heel bone at each step. The heel bone is the axis and depending on which side of the body more mass is on, you 'fall' or rotate in one direction or another, which when done in a repeating pattern gives you a walking 'direction.' In this way, you have never really walked in a 'straight line,' but have created a series of rotations, one after another, that human beings have labeled *walking*. The theme of depth and labeling is quite important to note as many conflicts in human behaviour are directly caused by a labeling malfunction, often due to a lack of understanding when analyzing a situation. Rotation is the primary behaviour and the secondary behaviour is called "walking."

All human movements are literally a series of internal rotations from the particles to the bones within the body, performed in different orders that cause full body external rotations outside of the body in the environment on our rotating planet, solar system and galaxy.

A human body that does a "*flip*" has internal muscles that pull on the bones of the body into a certain direction to cause them to rotate in a series of internal patterns. These cumulate together to place more mass on one side of the body compared to another. The internal rotations between the joints will make your entire body unbalanced. This allows gravity to pull you 'around' an external axis which is why we say, "where your mass goes, you go."

I can rotate my shoulder joint and my hip joint in different ways to change the shape of my body, which moves my mass in either small or large amounts, which in turn reacts to gravity slightly differently. The internal rotations of the bones are the only way to create external rotations outside in the environment. If you couldn't move your body, you would have as much acrobatic freedom as a rock that only moves only if something hits it. In reality, it could be hypothesized that humans are in fact much like rocks; we only move when an external stimulus 'moves' us.

Simply put, if I am doing a front flip, I would need to rotate the correct bones the right number of degrees, in order to have more mass on the front side of my body compared to the back side. As the mass 'goes' towards the front of my body, I go with it. Unless I am stopped by some physical force or object, I will rotate forward. In this way, creating flip is as

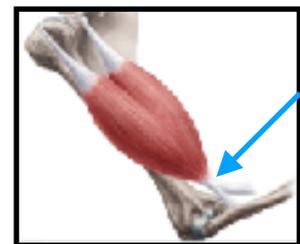
easy as leaning forward on a trampoline and is just a matter of how much to lean forward, how much force to generate (energy) and how high to jump, that determines how many flips you are going to do. **This is why in reality doing flips is easy, controlling them takes a lifetime!**

Similarly, if I am doing a backflip, I need more mass on the backside of my body compared to the front. You must have more body mass towards the side you are rotating on, compared to all other sides of your body, where gravity can take over. The same principal works for all other flips, including side flips and twists, no matter what position you are in during the take-off or what surface area you are taking off from. As long as that position has more mass on one side of the body than the another sides, you will rotate in that direction naturally.

All axes work in this fashion, no matter what direction you face, where you are looking, where you live or what your Instagram tag is. As long as you learn what internal bones to rotate, then you can make any full body movements you want in the 'real' world Degree-by-Degree. This basic reality will set us up for inventing new rotations which is what Freestyle acrobatics is all about.

In the same way the universe has to be unbalanced with matter and antimatter, the body has to be unbalanced to create full body movement. In "Building The Freestyle Community" we discussed how flattening out the hierarchy takes away the necessary drive to move up the hierarchical ladder. The need for an in balance, in order to create movement, is inherent in the primal state of the universe. If everyone was the same, we couldn't have leaders. If your body was perfectly balanced, you wouldn't be able to create rotation.

Not even muscles or tendons are balanced in the middle of the joint between two bones. Muscles attach to bones in a "1% Rule" kind of way, or you wouldn't be able to move the bones to create overall body movements. As you can see to the right, the bicep does not attach in the middle of the joint, but at a "1%" deviation. The Freestyle community is all about demonstrating an athlete's unique 1% variation. Even



though this may seem a bit abstract, I hope you can see that there are in fact basic fundamental behaviours of the universe that we can use as a base for training.

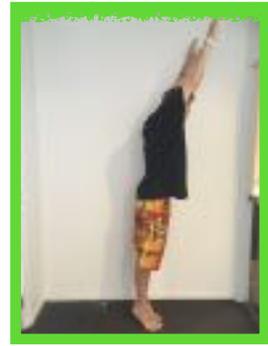
If rotation is as easy as closing your eyes and leaning in some direction, why do athletes need to train for 15,000 hours? This is simply because it takes 15,000 hours to control the amount of imbalance you create and apply it effectively. The more complex the movements become, the more you have to focus your mind on creating a specific series of potentially millions of micro-movements.

Assuming you start from a 'stand still,' the more mass *you place* on one side of the body, the faster you will flip because more molecules can be openly 'targeted' by gravity, which you interpret as "*faster rotation.*" If you have more mass than you can handle, you may then end up flying off the trampoline or aiming your body to land somewhere you may not want to. If you do not lean enough, you may under rotate and "neck" it.

Rotation will not be created if momentum is applied directly to the center of the mass; only horizontal sliding movement called "*Translation.*" The farther away you push from the center of mass, the more momentum you have during your rotation because more molecules can be targeted by gravity.

Take-Off Positions

This is why a good trampolinist or traditional gymnast will initiate all feet take-off's with their heels or toes in a kicking motion (*like a soccer ball*) and not simply an arched back. When an athlete arches the back to rotate backwards they still have more mass on one side of the body compared to another so they will rotate, but the length of your lever (*your full body*) is shorter so less molecules can be pulled gravity meaning you rotate slower.



You can see above that this exaggerated backbend will make the athlete shorter in height compared to no backbend; which creates a shorter lever. By being longer you have a longer lever, which makes it easier to rotate. If you shorten your lever, by bending your body, you will not have as much rotation.

You can see that by standing up straight and leaning forward with a long straight body you will still get the rotation because you are off balance (*moving your mass*). The difference between the height of the red line and the green line is noticeable for all athletes. Being as long as you can with a slight lean in the direction you want to rotate will be large factor in your rotation, be it forwards, backwards or sideways. **It will not be the only factor though!**

When looking to maximize your rotation from a static take-off position, try to think of every take-off as a straight (*laid out*) flip at first, then as you leave the bed 'kick' your feet in the direction you wish to rotate and then 'snap' into a position once you are in the air to increase rotation to the desired amount. The first 1/4 of every flipping and twisting rotation ideally would be completely straight with the body to maximize the leverage of the momentum upon take-off. As in the diagrams above, the longer the body, the longer the lever, which in turn makes you flip faster because more molecules can be targeted by gravity. This is why traditional coaches will tell athletes to take-off for their skills with their "arms up," giving them the longest possible lever and thereby utilizing gravity and a long lever to create more rotation for the flip.

The downside of this is that it does not allow the athlete to utilize arm momentum which also increases rotation in many different instances. A long lever is part of the equation, but creating momentum with the arms is even more powerful in many circumstances. This is why a Freestyle Flipper will tend to start with their arms down and 'swing' them into the direction they want to go similar to how a traditional trampolinist will 'snap' their feet into a rotation. You could think of it as an active take-off compared to a passive take-off that simply allows gravity to pull the body. The same can be done with the legs when doing a back or stomach take-off.

Generally, when doing a forward take-off from the feet even if you are Freestyle, you will want to have your arms up and straight as possible to get the longest lever. From an arms up position, any athlete can throw the arms down into a tuck to initiate forward rotation. Hypothetically, if the shoulder joint was structured in such a way that allowed athletes to 'swing' into a forward take-off, it would be even better than a passive arms up take-off. Currently, our human form doesn't allow this kind of mobility.

If the athlete wanted to do a side flip, the same mechanics would apply. If you can swing the arms into the side flip (*which most do*), then you should do that instead of the passive, arms up technique seen above. Even if you are trying to flip on an obscure angle somewhere between a front flip and a side flip, the same mechanics apply. It is up to the athlete to decide if they can swing the arms or not, depending on the overall movement they are trying to do. If you can't effectively swing the arms, such as in many forward flipping skills, try to make the lever as long as possible at all times with straight arms and body with a slight lean.

However, if the athlete wants to do a unique position that requires the arms to be at some odd angle on take-off to even get into a position they may need to abandon the arms up technique. Freestyle athletes are free to do that but they simply need to understand that it means the rotation will be effected. The specific effect is dependant on many factors, such as: height, weight, power, intended position, equipment and mental state.

Many Freestyle athletes will start with their arms down on a backwards take-off and swing them up into the backwards rotation as they tuck. This is 'taboo' in traditional trampoline but is common in Freestyle Trampoline

because it does increase the rotation to a larger degree than starting with the arms up and then bringing them down into a tuck. It makes a lot of sense when you think about it because it swings the arms into a tuck like how traditional athletes use the feet to 'kick' into a tuck increases rotation.

If an athlete wants the most rotation, they will want to lean back slightly (1%), think about kicking the feet over their head and start with their arms down and swing them up at the same time into a tuck position. When flipping with extreme rotation such as four or five flips, you will think about the first 1/4 rotation with a straight body but in reality you will end up going somewhere in the middle. You can think of it like starting at a lean with the arms down and swing them up into a tuck so that by the time you get to the first 1/4 rotation of the flip, you are in a tight tuck but having the legs kick out as much as possible.

Back Flip With Extension Video:

Back Flip Extension Video

This would be the most powerful way to create rotation on a trampoline. However, each take-off will be different depending on the skill being attempted. A Freestyle coach should not be in the business of telling the athlete the 'right' take-off. They simply need to educate the athlete about the effect different take-offs will have on their rotation.

Traditional acrobatics will claim that there is only one 'right' way, but this is not true and never has been true. Sure, if all you do is one specific skill, years of repetition will teach you what mechanically tends to work the best for that skill. However, in Freestyle communities that are eagerly creating new skills, the 'right way' is only seen as a limitation and not a mechanical benefit in many cases where creativity overrides the need for mechanical efficiency.

As discussed in “Building The Freestyle Community,” a Freestyle coach really needs to show the options, and give helpful guiding points and really depend on fun and creative challenges that will gently push the athlete to explore the effects of different take-offs, not simply force them to do the one ‘right’ way.

Twisting Rotations:

Twisting is unique in some sense because you can’t create twist around the vertical axis with simply leaning the body; you literally need the arm swing discussed earlier. The only reason for this difference is the way we live and move on the Earth in relation to gravity. If you want to twist to the left you can’t simply stick your hand out to the left and make a twist, because gravity will make you “flip” sideways instead, like a cartwheel. You will have to create momentum in that twisting direction around the vertical twisting axis first, with more mass going towards the side that you want to twist to. Traditionally this is called a “*Contact Twist*” and every skill in acrobatics requires it to some degree.

In this way twisting requires a bit more energy to rotate around that particular axis because you are in some sense ‘battling’ gravity instead of letting it just pull you down in a cartwheel motion. Once in the air it is easier to do more twists because the width of your body is narrow compared to standing up straight and flipping. You will need to start with your arm across the body on the opposite side (*right*) and swing them to the left creating momentum towards the twisting direction. If you do this hard enough, the molecules that are attached to your arm and the rest of your body will ‘go along for the ride’ so to speak and you will “*spin*” in that direction when you leave the ground.

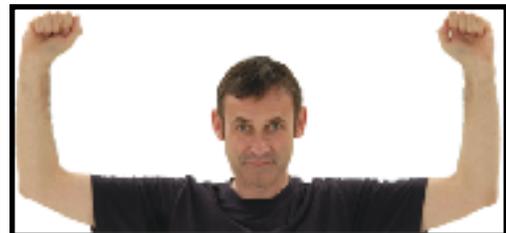
Going from (A) to (B) will create momentum to twist to the left. This momentum strategy works to create a twist with no flip. The general idea is that you should have your momentum lever (*arm*) away from the body as far as possible between moment (A) and (B) to gather the most momentum possible.



Having the arms come out as far as possible from the centre of the body means it is moving faster with more momentum as demonstrated with the take-off pictures above. It is a different axis, but the mechanical principal is still the same. We will not get into complicated angular velocity equations because they are unnecessary but it is important to understand the wider the radius (*longer the lever*), the faster the momentum of that contact twist.

In the same way, the longer the body position the more rotation you will generate. In the same time frame (*A*) to (*B*), the molecules of the arm you use to twist are going a further distance, therefore it must be going faster than the center of your body that is only traveling a very small distance. The Coriolis Effect works under the same principals and because of the spin of the Earth, winds travel at different speeds at different parts of the earth which creates the Coriolis Effect.

If the radius is cut in half because the arms are not fully stretched out (*bent arms*) during the initiation of the twist, you only achieve half the twisting rotation that you could achieve. This should all sound familiar to flipping rotations on the last page.



All mechanics follow the same rules no matter what axis it is on. Starting with your “*arms up*” when flipping is the same principal as starting with your “*arms out*” when twisting. In reality, just like in flipping rotations, the specific skill will alter how straight or bent each arm is on the take-off. For example, when doing quint Cat Twist (*or Lightning Twist*), the arms will tend to be very bent as the athlete is in a rush to get into a ‘pencil-like’ straight position with arms in to speed up rotation.

A Lightning Twist uses the same mechanics but in a slightly different way. A cat Twist initiates twists primarily from the arm swing and a Lightning Twist creates a single leg ‘Kaboom’ which bounces the bodies mass off the trampoline away from the center of mass creating a twist as well. If you can combine the rotation from the leg and arms at the same time you can get many twists.

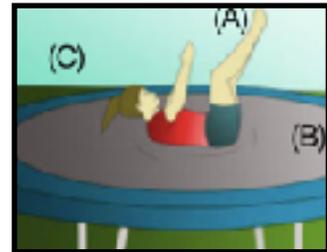
See Lightning Twist Video:

World Record 9 Twists On Trampoline

Currently, the FTA is conducting biomechanical research to determine which take-offs truly provide the most rotation in these extreme examples. At this point it will suffice to say that the more twists an athlete adds, the more they will tend to bend their arms and ‘cheat’ on the take-off. The same is true for flipping rotations.

Different Landing Positions:

There is no difference between landing on your feet, stomach, backside or any body surface for that matter. In mathematics, human beings do not exist at all, only rotational patterns of particles do. The pattern to remember here is that to flip off your back you must still have momentum (*mass*) on one side of the body to create a flip in that direction. If the feet are at point (A) you will stay on your back because you are balanced. If they go to point (B) then you will flip forwards and if they go to point (C) you will flip backwards.



Some landing positions are limiting, such as *Seat Drop* or *Stomach Drop*. By landing on these surfaces you immobilize your ability to move body parts into certain positions or shapes effectively, which will reduce the amount of control you have to create the momentum into the future. That is why you rarely see someone do a Stomach Drop into a Front Flip with 3.5 twists (*I have seen it though*). The arms are not able to create the twisting momentum very effectively because the trampoline blocks your arms.

When picking skills to learn, be it any discipline, be aware that certain positions are more difficult because of your biomechanics due to the way human bodies have evolved over the years. It does not mean these skills are impossible, simply harder to create rotation effectively. In Freestyle Trampoline we do not believe skills are “*impossible*,” only that an athlete or

coach may not have the proper prerequisites to accomplish or teach the new 'skill.'

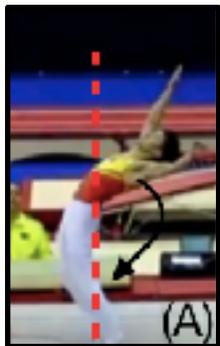
All human beings have limitations but perhaps in a million years we will have stronger legs so we can jump higher or different shoulder joints to allow more skills to be swung into. To live your life with a metaphorical 'limit' for fear of safety is in fact dangerous long term and can hinder your quality of life as well. It does not mean you should go and try things randomly but it does mean that learning never stops unless you choose to stop (*perhaps out of fear*), not because the universe is telling you to. Be careful with the strategy of how you build but nothing is impossible, it is only a matter of building it safely and Degree-By-Degree, internal lever-by-lever.

Flipping & Twisting:

To create any type of skill you simply take the linear momentum given to you from gravity within the universe and combine it with the momentum of the take-off. The momentum of the take-off is determined by what position your body is in during the take-off. As long as overall, there is more mass on one side of the body than another, you will rotate when you go into the air.

Traditional trampolinists will label these combinations of linear momentum and angular momentum as different skills, put them into the FIG "*Code of Points*" and award those who can complete them in the proper sequence. It is important to note that athletes in this situation are fundamentally comparing themselves to others and determining who was closer to the 'ideal' mathematical answer. This creates a narrow window of acceptable techniques because many of the skills are very similar and all aim to be perfectly in the center of the trampoline.

Freestyle athletes on the other hand will look to experiment with their body to create new skills in their own image which will create many different techniques for different creations. Each skill requires a slightly different approach with the human body reacting slightly differently to each combination of linear and angular momentum.



When an athlete is looking to flip and twist at the same time, they will naturally have to 'share' the momentum between the flip and the twist. You can't set your take-off for 100% flip and 100% rotation. You only have a limited amount of energy and it is up to the athlete to decide what angle they will need to take-off on that usually favours one or the other. The important thing to note here is that when you flip and twist on the first rotation such as a Back Flip with a Full Twist (*Back Full*) the body will have to lean backwards slightly to initiate rotation (A) as well as slightly turned to one direction to create a twist (B). Remember, if the body is perfectly straight and is not leaning on the axis, it won't rotate because gravity can't pull the molecules downwards. To be completely straight on a Back Full means that you can rotate, but you will find it hard to twist.

A slight lean in the twisting direction is the most effective way to create a twist. The world's best trampolinists do it naturally and the more twists you want to accomplish, the more you will have to lean in that direction. The more twists you want to do, the more you will lean and cheat on the take off.

[Video Of Building Up Twisting:](#)

Twisting Build Up

Many athletes will lean too much and this is why many coaches will insist on athletes having to be 'straight as possible.' **All athletes should know that, being completely straight would make the skill impossible.** Finding the perfect amount of lean (*1% Rule*) that you need simply takes repetitions and a red cross in the middle of the trampoline helps as well.

For Freestyle athletes, do not get too worried about staying perfectly in the middle. You shouldn't be flying off the trampoline on a Back Full, but traveling a bit is biomechanical and not worth nitpicking in Freestyle communities. When a traditional athlete 'seems' to be perfectly straight,

they are actually leaning in the opposite direction in some way that creates the illusion of a 'straight' rotation but as we know, no rotation is ever straight in a mathematical sense.

When twisting on the second rotation of a double flip, you will need to initiate rotation like you would for any other double flip but when you want to twist you will simply change the shape of the body to change where the mass is displaced. This will take some of the energy from the flip and put it on the twisting axis which will create the twist. For example, you can create a twist on the second flip from a tucked position, by simply opening up and putting more mass on one side of the body with a bit of arm swing.

The mathematics behind the way human bodies move in the air is complicated and any Freestyle athlete will naturally discover these equations by simply bouncing on the trampoline. For this reason, I will keep the concepts simple to understand. The take point home here is that most of the rotation on any axis will be initiated from the trampoline where you can push off of but once in the air you can adjust by changing the body position. Each different body position will change the specific rotation in different amounts.

Athletes can alter the axis in which they rotate in a small amount and "turn out" if they feel they have under rotated a flip to protect the head and neck or alter the axis in a major way by creating a twist. You can even do a flip with a twist in both directions as our video tutorials show. Simply by changing where the center of mass is around the body, you can change the axis you are flipping on.



"Turning Out" to protect the head and neck. Can be performed forwards or backwards.

Some athletes think that "Turning Out" is a sign of fear and they are right. **It is good fear though.** If you are scared to do something it means you are probably not ready for it. Turning Out is a great skill to have and all Flippers should learn it.

#FreestyleFreddyFunFact: Have your athletes play with a stuffed animal on the trampoline trying to make the stuffed animal do basic flips and twists synchronized with the bounces. It will help athletes learn about basic rotations in a fun way that can be made into a game.

@FreestyleFreddy_Official



Rotational Possibilities Frontier (RPF):

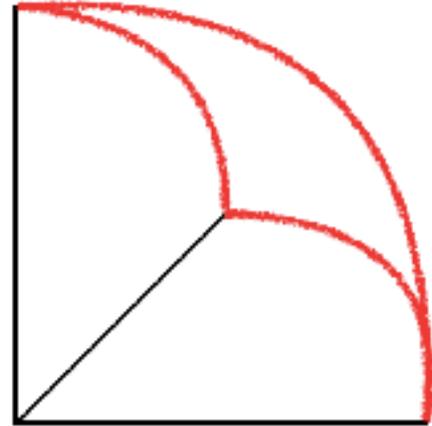
Now that we have discussed the basics about what acrobatics really is from a biomechanics level we can go into the concepts of the RPF and the Spatial Awareness Quotient (SAQ) which will be instrumental in developing our approach to coaching athletes in the Freestyle communities. It should be noted that even though I use these equations primarily for trampoline athletes, it can be applied and modified for all athletes in any sector, even traditional ones.

I have created an equation with the kind help of Mr. Ben Senderling (MS, MBA) that I call the “Rotational Possibilities Frontier” (RPF). This is a mathematical equation that provides an actual number of rotational possibilities across all axes, based on what human beings can do with different body positions, along with the possible rotations around any axis in terms of degrees. Ben has been an amazing advisor on this concept and has made sure that my subpar mathematical abilities did not get in the way of the underlying concept I wish to demonstrate through this equation.

If all rotation is really just degrees of movements around an axis, we can theoretically calculate how many degrees of rotation an athlete does for every skill. This gives us the number of steps it will take for that athlete to learn that skill and gives us a way to build skills like a LEGO™ block kit. The RPF tells us how many different combinations are possible in the universe.

Each degree of each flip can be calculated by this equation and each degree of each body movement can also be calculated in finite terms of

degrees of rotation. By formulating an equation we can actually determine how many 'different' degrees of movement and rotation are possible for an acrobat. **These degrees are important to know because then we know how many different skills can be created and how many building blocks each skill is made of, it makes learning a simple building process that anyone can do.**



RPF Curve showing three axis and Red Line showing the theoretical Maximum Possibilities

Mathematically there are infinite possibilities because you can subdivide each degree along the axis path indefinitely; however, by providing an actual numerical value to the possibilities, in terms of degrees, we can provide coaches and athletes with a baseline of their options when training that is more concrete than the word "Infinite." This is a theoretical equation to demonstrate the vastness of the possibilities, so please don't get too wrapped up in the specific numbers. Just realize that this equation gives backing to a *real* quantification of the possibilities which we can extend to educational models with the SAQ.

The RPF and SAQ will be the first step in providing quantifiable tests across time and even a new acrobatic scoring system that actually quantifies creativity which has never been done successfully for acrobatics.

The RPF mathematical function stands to act as a *Possibility Frontier* much like a "*Production Possibilities Frontier*" used in economics, which is also fundamentally theoretical. By determining what the actual possibilities are, we can derive an actual (SAQ) and categorize an athlete's understanding of how to build skills based on their SAQ score.

Routines are only one aspect of great acrobatics. It does not in any way determine how much control the athlete has when building their skills or their capability to learn new skills, only how well they performed the series

of skills they already knew. The series of skills is repeated over and over again and does not actually determine how 'skilled' that athlete is in the grand scheme of acrobatics. It only shows how well they can repeat previously constructed routines. In the new world where skills can be invented at a moments notice, it is more beneficial to create a test that measures an athlete's ability to learn on their own merits, not the coaches.

Counting medals does not tell you *how* the athlete will be able to build new skills in the future without the coach telling them the answers. Routines are impressive at one level, but they do not encompass the true understanding of the underlying path to success for all the possibilities of skills. The RPF tells coaches how many 'degrees of rotation' there are in the acrobatic landscape. Each 'step' is a degree of rotation around some kind of axis. With the RPF and SAQ, coaches can help athletes build their skills one degree at a time, Step-By-Step along the rotational pathway.

RPF =

Take-off Possibilities (*TOP*) x Flip Possibilities (*FP*) x Landing Possibilities (*LP*)

When described in ordinary language the equation is quite simple: It basically says that by multiplying all of the ways you can take-off, move in the air, and land we can determine how many possibilities an athlete will have to move in some way every time they jump. For a multi skill routine we simply multiply those possibilities by the number of skills that athlete wishes to do to account for each possible combination. The RPF is calculated assuming that each axis an athlete rotates on will be divided into one degree increments.

Each of the sections of the RPF equation are a bit more technical and calculate actual degrees on each axis. For these axes " α " represents rotation around the mediolateral axis (*flips*), " β " represents rotation around the anteroposterior axis (*cartwheel*) and " γ " represents rotation around the vertical axis (*spinning*).

Like any equation there are certain assumptions we have to make to identify what situation the equation will describe. We will also make the assumption that for an acrobatic athlete, you can only do a maximum of five twists on the anteroposterior axis (*cartwheel*) and five rotations on the mediolateral axis (*flips*). We will also assume that athletes will only maintain one position once within each complete flip and that they can choose to flip or twist in either direction, but not both at the same time even though it is possible. While it may be possible to rotate on all three axes, this is a very advanced subset of skills.

You will see that with these assumptions, based on the current capabilities of an acrobat, we can make an estimation about the total number of different possibilities an athlete has in the air. The SAQ will then tell us how much control they have in building their skills with the RPF as a baseline concept. On the next few pages we will look at each section of this equation in more detail.

Take-Off Possibilities (TOP):

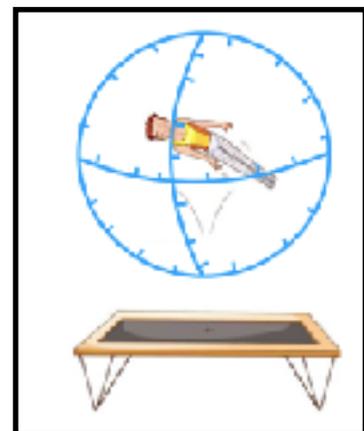
$$TOP=(TOP_{\alpha})(TOP_{\beta})(TOP_{\gamma})(ROM_{TOP})$$

Simplified: $TOP = (360 * 360 * 360) (1.09633 \times 10^{39})$

$$TOP= 5.11503 \times 10^{46}$$

Think of the body in a bubble with 360° surrounding it on all three axes. We are simply accounting for all the degrees of possibilities along these three axes of rotation and multiplying it by the possible body positions (*each degree being a different position*). The result is the total number of possible take-off positions.

Taking off from your head may be dangerous in certain circumstances; however, some performers in circus acts have shown it is possible to flip from



their head and neck. Freestyle athletes also have come up with a way to support the head and neck with their forearms to enable them to land on their head which is called an “Arm Cast.”

[See A Video Of An Arm Cast:](#)

Arm Cast Video

It can be done by those who have properly learned how to do it. This equation is meant to provide a numerical value to *all* the possibilities and in no way determines what each athlete *should* or *can* do. The SAQ equation that follows this RPF function will go into more detail about practical applications.

The above section of the equation describes all of the positions an athlete can take-off from on a trampoline. This includes standard take-off positions from the feet, stomach or back, to obscure take-off positions such as bouncing off one pointed toe like a ballerina with the other leg over the head, with one arm at 68° elbow flexion and 64° shoulder flexion and the other arm at 3° elbow flexion and 31° shoulder abduction. You can also have 54° shoulder flexion with the head tilted to the right at 29°. Everything you can do with your body is located within the RPF.

The ROM_{TOP} was simply calculated by taking all the joints of the major body such as elbows, knees, neck, arms etc. and multiplying their range of motions together to find the total number of possible positions. The calculation is based on current anthropometric data from different sources and is sufficient to provide an estimate of the total number of body positions for the purposes of this theoretical equation. Every study has slightly different values for each range of motion but an average was taken and gives us this number:

$$ROM_{TOP} = 1.09633 \times 10^{39}$$

As you can see already, when really adding up the potential possibilities of body movement, the options are so vast it is hard to keep track. This is

why a ‘Code of Points’ was created. It is important to have a RPF as a baseline to remind ourselves of all the options we tend to forget about on a regular basis in the face of constant routines.

Flip Possibilities (*FP*):

$$FP = (RP_{GBA} * RP_{\gamma}) * ROM_1^{FP^N}$$

$$FP = (5 * 360 * 360) * (ROM_1^{FP} * ROM_2^{FP} * ROM_3^{FP} * ROM_4^{FP} * ROM_5^{FP})$$

RP_{GBA} is the degree of flips about the body’s “Gravity Based Axis.” This may seem to go against what is typically taught in biomechanics where the body can rotate on three axis, but I believe this view is a much more applicable formulation to help us achieve the desired possible flips numerical value. If you are doing a flip by being asymmetrical during the take-off, then you will either do a flip forwards, backwards, sideways (*left or right*) or *somewhere in between*. This means that gravity will pull you towards the Earth on one side of the body or another creating a rotational trajectory that will not stop until you hit the ground. We are not concerned with whether it is a forward or backwards flip on the mediolateral axis or the anteriorposterior axis creating a side flip. No matter what, you are doing a “flip” so we have condensed the traditional three-axis label and simplified it into two axes for the practical application of this formula.

When in the air rotating with the GBA you will also be able to twist along the vertical axis after gravity has decided what “flip” you will do, be it sideways, forwards or backwards.

Since twisting rotations are also determined primarily by your take-off position we assume for the purposes of this equation that once you take-off you will continue the path that was created by the take-off position based on where the mass of the body is distributed. The GBA which is determined by the take-off position follows a constant trajectory meaning you do not really have another option. You also do not really have another

option in terms of twisting. Few athletes have the ability to twist in both directions once already in the air so that would be considered negligible and those few options are not included in the RPF.

Remember how humans have inherent rotation and velocity woven into their existence? This equation only focuses on two of the three axes: The gravity axis (*GBA*) is both the front flip/backflip axis and the side flip axis as well as everything in between. The second axis in consideration with this equation is the spin axis (*twisting*). Rotating on all three axis at one time is not as simple as some think. You can tend to rotate on two axes at a time and rearrange the combination of the two axes (*out of three*) but maintaining a rotation on all three axes stably over time is not easy to do. If you would like to get involved with the research we are doing with Ben please let us know. Further research needs to be done on this topic for acrobatics.

To see a video demonstrating this stability issue please check out this video: Astronaut Richard Garriot demonstrates a great visual in space of how unstable rotating on three axes can be with a pack of cards:

[Richard Garriott Space Video Blog: Rotational Inertia:](#)

Mid Axis Theorem

Due to the above issue we will simply assume only two axes can be rotated on stably at one time until more research is done; the rotational axis based on gravity and the twisting axis. Another important assumption is that athletes can flip to a precision of one degree. If a skill is assumed to have five flips we can start to enter some numbers based on degrees.

ROM_1^{FP} , ROM_2^{FP} , ROM_3^{FP} , ROM_4^{FP} and ROM_5^{FP} represent the range of motion for each flip (1.09633×10^{39}). We assume that the athlete can maintain a new position during each flip for the purposes of this equation. If the athlete chooses to change position in the air then it is assumed each flip could be a new position in the air and means that each rotation is multiplied by the ROM^{FP} constant seen earlier. ROM^{FP} is always a whole number and is the total number of possible body positions. Any shape

take-off so the function is actually the same. The reason for keeping them separate terms is because in practice there could be different possibilities for the take-off and landing positions. And for these cases the two terms should be separate. This would only be a factor when taking a specific skill and reverse engineering it to determine how many degrees of rotation there are and therefore how many steps an athlete can take to build that skill.

$$LP=(LP_{\alpha})(LP_{\beta})(LP_{\gamma})(ROM_{LP})$$

$$\text{Simplified: } LP = (360 * 360 * 360) (1.09633 \times 10^{39})$$

$$LP= 5.11503 \times 10^{46}$$

In total you could look at the complete RPF for 5 flips as follows in a simplified manner:

$$\text{RPF for 5 flips} = (5.11503 \times 10^{46}) * (1.026317 \times 10^{201}) * (5.11503 \times 10^{46})$$

$$\text{RPF For 5 Flips} = 2.685208 \times 10^{294}$$



What the above theoretical equation demonstrates is that all the possible rotations that athletes can do along the rotational landscape is astronomically high. This is the total amount of 'degrees' on the path of acrobatics including all axes and all body positions. As well, if you did all of those pathways up to five flips in every possible human body position you would get the number above. We now know how many degrees there are on the 'path' so to speak and simply need to now narrow in on the specific skill that the athletes needs to do to be able to build up a particular skill. They will not want to go through all of the possibilities but now that we have outlined how many possibilities there are, we can now decide which options we want to take and can literally count how many steps there are for an athlete.

Ben had a great analogy: Understanding the distance of the 'total' rotational pathway is similar to taking two different pathways when on a family vacation. You can go from Omaha straight to California and get there after a day of driving or you can take the scenic route for your entire life enjoying every step of the way. **Your path is yours to choose and the speed at which you go along this path is up to the athlete, not the coach.**

Spatial Awareness Quotient (SAQ):

I developed this test as a way to practically measure athletic development. It is meant to be a fun drill and a test that gives practical results for the athlete, coach and gym owner. As it is currently substantiated, trampoline *(and the greater acrobatic community)* does not have a test that can be performed on athletes that will obtain any kind of objective measure of their ability to learn new skills with previous prerequisites.

This lack of quantifying athletic ability in acrobatics seems to be a long standing issue. Currently, success in the industry is based on accumulation of points, awards and skills over time but has failed to quantify the athletes capability to actually learn the skill on his or her own.

I suggest for any athlete, that they perform this test and game with a coach at first to help guide them. A Freestyle coach will want to start off by simply giving the athlete a few easy demonstrations of the SAQ and gradually let the athlete learn about the 3D 'map' as they learn to build their own skills. As discussed in "Building The Freestyle Community," the SAQ will be a great tool in coaching athletes.

With the SAQ, coaches can simply let the concept of the game do the coaching and can even manipulate the game in creative ways to educate the Freestyle Flipper (*or traditional athlete*). The SAQ will teach the athlete to build their skills Degree-By-Degree along a rotational pathway using different equipment such as foam blocks and mats.

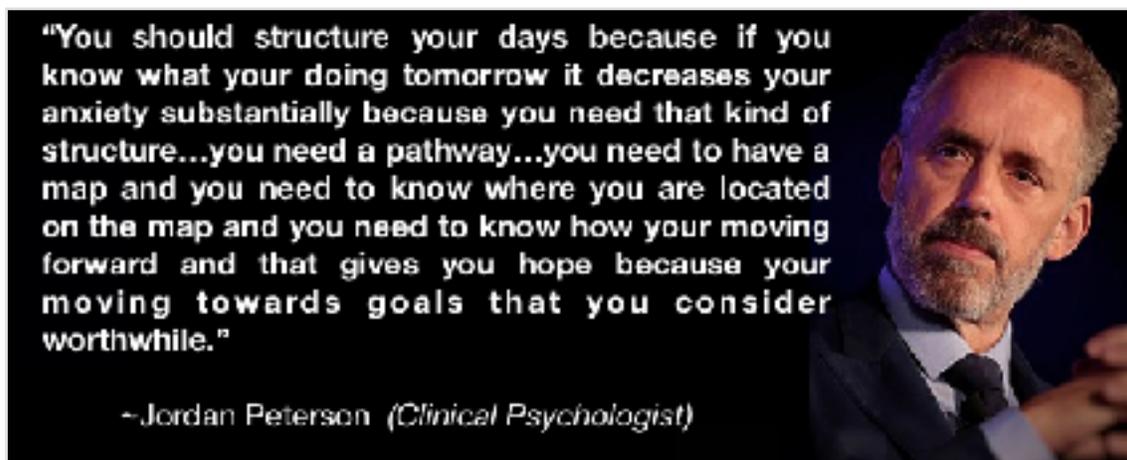
With the development of the Freestyle based disciplines, athletes are taking skills into their own hands and therefore we must take action and determine key indicators of developmental success outside of the traditional structured gym club. Simply put, we need to know if athletes have a proper grasp of how to build skills safely without needing to await the instructions of their coach. I am hoping the RPF and SAQ concepts outlined in this story will actually help athletes both traditional and Freestyle communities.

Since acrobats base their success on competition standards there is currently no data that determines how well equipped an athlete is on their own to learn certain skills along the path of the 2.685208×10^{294} degrees that can be combined in many different ways to create skills. How does any athlete know if they are ready for a skill?

If they have chosen not to utilize the expertise of a coach, then what markers do they have to determine their success without an educational structure? Even competitive traditional athletes seem to have little ability to actually understand the underlying education process that is used to build the skills appropriately without a coach present, providing most if not

all of the answers. I have gone to gyms, both traditional and Freestyle, witnessing a general lack of understanding. See Your FTA training package for videos demonstrating this reality.

The current literature on gymnastics covers a wide spectrum of education in the form of certain bio-mechanical techniques. However, it makes very little, if any headway in measuring how prepared an athlete is to perform a new skill that is not currently in their repertoire or their coaches handbook. Traditional acrobats look to their coach for help in this department. If you do not have a coach you will need to measure your ability to move up the hierarchy of skills with the help of the SAQ. The SAQ will simply outline how to test an athlete's ability to build their skills on trampoline by combining different degrees of rotation on top of one another systematically creating a path to success based on previous steps taken.



Don't get me wrong, I believe a coach is still a benefit to an athlete without doubt. However, in this day and age with athletes choosing to go it alone, I believe this test will give coaches and independent athletes a measurement that determines really how much they understand the building process. This will directly correlate to how successful that athlete will be in creating new skills, in the future and in a safe manner.

**The SAQ does not measure what an athlete CAN do.
It measures how safely an athlete will train for what they CAN'T do.**

How to Administer the SAQ Test

Step 1:

Write down all of the following words and fractions onto a piece of paper and cut them out individually. Make sure each heading is a different colour of paper or marked in some way to separate them.

Take-Off Positions:

SEAT DROP	STOMACH DROP	BACK DROP
ONE LEG BENT	STRADDLE	FROG LEGS
(Invent Your Own)		

How Many Quarter Rotations:

1/4	1/2	3/4	4/4
------------	------------	------------	------------

How Many Quarter Flips:

1/4	1/2	3/4	4/4
------------	------------	------------	------------

Direction Of Twist:

LEFT	RIGHT
-------------	--------------

Direction Of Flip:

FORWARD	BACKWARD
----------------	-----------------

Landing Positions:

SEAT DROP	PIKE	TUCK	STRAIGHT
LAZY BOYS	STRADDLE	FROG LEG	
(Make Your Own)			

Step 2:

Separate them into the categories as shown below and mark each one a different colour (*depending on the level*).

1. **TAKE-OFF POSITION**
2. **DEGREES OF ROTATION**
3. **Direction Of Twist**
4. **Direction Of Flip** (*For Advanced Levels*)
5. **POSITION IN THE AIR BEFORE LANDING**

Step 3:

Put each of the squares from each separate category into separate piles, shuffle each pile and put them up face down (*or put in a bowl/jar*).

Step 4:

Pick out one piece of paper out of each category at random. This will give a series of cards each relating to different aspects of the NEW skill they will have to create.

Step 5:

Let the athletes create the skill (*without help*) that they randomly picked. Please supervise athletes during this stage if you are doing this with your athletes,

The athlete will have 4-6 pieces of paper *(depending on level)* **that when put together will create a skill:**

Take-off Position + Direction of Twists + Degrees of Twists + Degrees of Rotations + Direction of Rotation + Position in the Air = Skill To Solve

For Example: *The athlete has chosen to try to learn a skill that begins with a Seat Drop, 1/2 turn to the Left with a Tuck Position, performed at any time during the skill before they land on their feet.*

BEGINNER LEVEL:

This version of the test is for new or younger athletes and only picks **one axis** to rotate on. As a coach it is easier to have new jumpers focus on twisting, so the degrees of rotation will be on the twisting axis, not the flipping axis (*yet*). The athlete will simply combine the picked slots of paper at random and create a “*skill*” that they have to accomplish as part of the test/game. Coaches and athletes will need to cut out each of the below ‘elements’ and scramble them in a bowl or jar to be picked randomly. Coaches or athletes can simply write down each element below and write the element on the paper. They need to combine the Take-off Possibility (*TOP*) with the Degree of Twists (*DOT₁*) with the Direction of Twist (*DOT₂*) with a Position (*P*).

$$TOP + DOT_1 + DOT_2 + P = Skill\ To\ Solve$$

TAKE-OFF POSITION (<i>TOP</i>)	DEGREES OF TWISTS (<i>DOT₁</i>)	DIRECTION OF TWIST (<i>DOT₂</i>)	POSITION (<i>P</i>)
SEAT DROP	1/4	LEFT	TUCK
BACKDROP	2/4 (<i>HALF TURN</i>)	RIGHT	PIKE
STOMACH DROP	3/4		STRADDLE
HANDS & KNEES DROP	4/4 (<i>FULL TWIST</i>)		STRAIGHT
STRADDLE SEAT DROP (SPLITS)			

As you can see, you will be able to test how well the athlete can be given a “*skill to solve*” and based on how well they understand the mechanics they will be able to build these skills Degree-By-Degree. I suggest the coaches

do this with their athletes at first to ensure that they are safe. It is more of a drill at the start with the younger ones who won't really understand how to build skills yet. This test will help them do that in a quantifiable way. For Freestyle athletes who are using this as a training program more than a test, start slow!

Notice how certain combinations will require unique landing positions such as a sideways landing? This is where the coach can start teaching the mechanics of falling safely to the athletes in a controlled environment. When doing a skill that requires the athlete to land on their side, make sure the arms are pulled into their chest and they are staying *'tight,'* squeezing every muscle. Coaches can take beginners and simply start with only feet take-offs, having them try these different moves into a foam pit as a starting point until they understand the building process a bit more. As they start really understanding how to build the skills then you can take it to the trampoline and start introducing new take-off positions; Degree-By-Degree.

For the position, the athlete will have to simply create the picked position in the air at any time during the skill. It can be at the beginning of the skill, the middle or the end. This will teach them that certain skills require positions to be held at different times.

For example if you pick: **Seat Drop + Full Turn + Right + Pike** the athlete will learn very quickly (*probably with the help of the coach*) that they need to twist first and then do the position.

You can always modify the test slightly by adding in unique take-off positions or positions in the air like animal shapes to keep the game fun and entertaining for the athletes. It also allows them to explore the building process with their own ideas. Exploring is crucial for human development so start them off on the right path with this drill.

I suggest making it a team building exercise. I know that I call it a Spatial Awareness Quotient but functionally, you build spatial awareness like a map in your head of the different degrees on different axes so it is fundamentally testing how well your athlete can build the spatial awareness necessary for all possible skills.

If you want to quantify this drill with the young children to get an actual SAQ score here is how:

SAQ Test Formula

- Step 1:** Figure Out The Perfect Score = $5 \times 4 \times 2 \times 4 = 160$ Total Skills
- Step 2:** Give Your Athlete 10 Random Picks of each Element (*10 skills*)
- Step 3:** Give Each Athlete 20 Minutes to Solve the Skill
- Step 4:** Record How Many They Completed Successfully Out of 10
- Step 5:** Multiply That Score by 16 so it Relates to the Perfect Score
- Step 6:** Write Down the Score and Test Again Next Month with Different Take-off and Aerial Positions

10 attempts with a maximum of 20 minutes will be a long test so you may want to do this test over a few days and can make it a fun for the group. Freestyle athletes using this for training can forgo this part since they are testing themselves.

SAQ Test Scores Formula - Beginner Level 1 (Traditional)

5 Take-off positions and 4 aerial positions:

$$\underline{5} \times 4 \times 2 \times \underline{4} = 160 \text{ Total Skills} / 10 = 16$$

Each successful skill is awarded **16 points**

July 1, 2019 Sally does 4 out of 10 tries = $64/160 (4 \times 16) = 40\%$

Aug. 1, 2019 Sally does 6 out of 10 tries = $96/160 (6 \times 16) = 60\%$

Sept. 1, 2019 Sally does 10 out of 10 tries = $160/160 (10 \times 16) = 100\%$

Each level is separated into a Traditional and Freestyle component. By adding in new take-off positions and aerial positions coaches can change up the test to keep it fresh. Try bending one leg or another at different degrees and come up with 10 Freestyle positions in the air and on the trampoline to move athletes to Beginner Level 2.

SAQ Test Formula - Beginner Level 2 (Freestyle)

10 take-off positions and 10 aerial positions:

$$\underline{10} \times 4 \times 2 \times \underline{10} = 800 \text{ Total Skills} / 10 = 80$$

Each successful skill is awarded **80 points**

Oct. 1st 2019 Sally does 4 out of 10 tries = $320/800 (4 \times 80) = 40\%$

Nov. 1st 2019 Sally does 6 out of 10 tries = $480/800 (6 \times 80) = 60\%$

Dec. 1st 2019 Sally does 10 out of 10 tries = $800/800 (10 \times 80) = 100\%$

I would like to gather more data from the acrobatic industry that objectively shows *how* athletes are progressing. Currently, coaches are utilizing skin-fold measurements, running speed or medal counts. These values are indicative of only certain specific aspects of the sport that do not really indicate how effective the athlete is at learning.

I have never seen a real ***Spatial Awareness Quotient*** that actually shows how effective the athlete is at safely navigating new skills and using the *Degree-By-Degree* approach. With the SAQ, a coach or athlete can't just claim to know *Degree-By-Degree*, we can quantify actual results with this method.

Like anything, not every test is perfect and you will see that some athletes may accidentally pick 'easier' combinations at random. Do not worry, general patterns will start to be apparent as you do this test over the long term. This way you can track the improvements of your athletes in a statistically relevant way. **It should be apparent how this test demonstrates to the coach and athlete their knowledge of how to build skills.**

At the beginning it will be more of a partnership, a 'walkthrough' with the coach; but as time goes on the athlete will really get a handle on how to build-up their skills, then they can begin to be more independent. It will become more of a game they can start to play with their friends. They can also play it on their own like a personal game of "ADD-ON."

If you have athletes who want to do bigger skills but you don't think they are ready, this is a great test that can show them, in an objective way, how they are not as ready for the skill as they may have thought. Emotions fly high especially with younger athletes who are in 'hierarchy climbing' mode. The brain tells younger athletes they can do skills that maybe they shouldn't due to trying to establish higher status and this test will help slow down those athletes and show them there is a process to everything and they need to put in the time before moving up the ladder. **Freestyle coaches can use this to help their athletes learn about self control but without looking like they are telling the athlete "No."**

INTERMEDIATE LEVEL:

When the athlete gets 100% they can move onto the next level of the SAQ test/game. This version will be based on the exact same principals as the beginner levels but you will do **Flips** instead of **Twists**. Again build your athlete's spatial awareness Degree-By-Degree on a different axis with the same principal. You may have a potential issue if athletes pick combinations that require them to land in handstand or on their head. I have seen quite a few athletes who are strong enough to do these variations when jumping low but if you don't think the athletes are ready for it, simply 'round up' or 'round down' the nearest quarter degree of flip.

For example, if they pick: **Back Drop + 3/4 + Forward + Pike** they will have to land in handstand to do the skill. Coaches can instead 'round up' to a 4/4 (*complete flip*) to get the athlete to land on their back instead. For athletes who have not learned that skill yet, they can round down to just a quarter which is easier, but still requires the athlete to adhere to the 'building' process. This is where the coach will want to supervise this drill but should be having fun and can even try it themselves while they supervise.

TOP + DOF₁ + DOF₂ + P = Skill to Solve

TAKE-OFF POSITION (TOP)	DEGREES OF FLIP (DOF ₁)	DIRECTION OF FLIP (DOF ₂)	POSITION (P)
SEAT DROP	1/4	FORWARD	TUCK
BACKDROP	2/4 (HALF)	BACKWARDS	PIKE
STOMACH DROP	3/4		STRADDLE
HANDS & KNEES DROP	4/4 (FULL FLIP)		STRAIGHT* THIS ONE WILL BE TOUGH BUT PLAY WITH IT
STRADDLE SEAT DROP OR SPLITS			

As you can see, some of these skills are more advanced (*such as the straight position*) and will require a more methodical build-up of the skill. This is where the coach will want to supervise and help out to ensure the athlete

takes all of the necessary small steps to accomplish these skills. The coach will also want to gently encourage the athlete to think about solutions on their own in times of confusion within the building process. The coach can ask 'pointed' questions to engage the athlete within a mental capacity.

This is also where "turn outs" can be developed and learned as the athlete builds. They can learn to fall with their 'arms in' and generally systematically strengthen themselves physically and efficiently as they build.

In the case of a straight position, simply start in a tuck position and 'slowly' extend the body a few degrees every attempt. If you are not conducting a formal SAQ test, make a note in their training folder on which steps they struggled with, then address it during training over the next few weeks and come back to it. This is how you can obtain a quantifiable result in athlete comprehension, making it not just a fun drill but a measurable statistic that can be shown to other coaches, athletes, gym owners and parents. Yes gym owners, do not tell the coaches this, but you can use this as one scientific way to quantify your coach's results...

When calculating Level 2 scores, you don't even have to change the formula, as you can see it's mathematically the same, just change the twisting axis to the flipping axis. You can write down scores over time for all of your athletes. This will show their "*evolution*" within the sport.

SAQ Test Formula - Intermediate Level 1 (Traditional)

5 take-off positions and 4 aerial positions:

$$\underline{5} \times 4 \times 2 \times \underline{4} = 160 \text{ Total Skills} / 10 = 16$$

*Each successful skill is awarded **16 points***

July 1, 2019 Sally does 4 out of 10 tries = $64/160 (4 \times 16) = 40\%$

Aug. 1, 2019 Sally does 6 out of 10 tries = $96/160 (6 \times 16) = 60\%$

Sept. 1, 2019 Sally does 10 out of 10 tries = $160/160 (10 \times 16) = 100\%$

SAQ Test Formula - Intermediate Level 2 (Freestyle)

10 Take-off positions and 10 aerial positions:

$$\underline{10} \times 4 \times 2 \times \underline{10} = 800 \text{ Total Skills} / 10 = 80$$

*Each successful skill is awarded **80 points***

Oct. 1st 2019 Sally does 4 out of 10 tries = $320/800 (4 \times 80) = 40\%$

Nov. 1st 2019 Sally does 6 out of 10 tries = $480/800 (6 \times 80) = 60\%$

Dec. 1st 2019 Sally does 10 out of 10 tries = $800/800 (10 \times 80) = 100\%$

Notice how we are keeping the math very simple and all we changed is the way we calculated the SAQ score in Level 1 for the 'twisting' axis and in the Intermediate level we calculated the exact same equation for the 'flipping' axis.

ADVANCED LEVEL:

This is a much more advanced version of the game because you can see now we are adding in both **twists and flips** for two axes where before in the beginner and intermediate levels we just picked one or the other. Notice the position will be a tough aspect but again, the athlete will be forced to learn when to put in the position at the right time as well as to gradually develop the position over time. Remember when doing the unique side landings keep your arms in and stay tight. Also, if any weird combinations, just round up and land on feet if not obvious otherwise.

$$\text{TOP} + \text{DOF}_1 + \text{DOF}_2 + \text{DOT}_1 + \text{DOT}_2 + \text{P} = \text{Skill to Solve}$$

TAKE-OFF POSITION (<i>TOP</i>)	DEGREES OF FLIP (<i>DOF</i> ₁)	DIRECTION OF FLIP (<i>DOF</i> ₂)	DEGREES OF TWIST (<i>DOT</i> ₁)	DIRECTION OF TWIST (<i>DOT</i> ₂)	POSITION (P)
SEAT DROP	1/4	FORWARD	1/4	LEFT	TUCK
BACKDROP	2/4 (HALF FLIP)	BACKWARD	2/4 (HALF TWIST)	RIGHT	PIKE
STOMACH DROP	3/4		3/4		STRADDLE
HANDS & KNEES DROP	4/4 (FULL FLIP)		4/4 (FULL TWIST)		STRAIGHT* THIS ONE WILL BE TOUGH BUT PLAY WITH IT
STRADDLE SEAT DROP (SPLITS)					

Notice how we don't mention any double and triple flips? You can do the exact same SAQ with those bigger tricks once you pass all three levels. Generally speaking most people will have a hard enough time with these skills as they are, so I have limited the test to just these three basic levels. You can see how it would be possible to build-up this platform and modify

the SAQ test with bigger skills or do the test in different disciplines (*such as tumbling, double mini or floor*). You will find out long before you get the doubles and triples if the athlete understands the building process.

If you are going to have the athletes do doubles and triples then you need to have a deep fluffed foam pit to begin with, maybe with a soft mat on top, to quantify the landing. I like having even a soft landing as it make the point of throwing yourself in the air very clear without the hard landing.

Do not try to do new complex variations on the trampoline or you will risk serious injury. This is where a coach should know when to have the athlete commit to the skill on the trampoline to toughen them up. When athletes are clearly struggling, the coach will need to know when to allow this variation to keep the athletes engaged and safe. A balance between both pit and trampoline options is probably best.

I know some of you crazy Freestyle athletes may not listen to this warning and attempt crazy stuff anyway, but you do so at your own risk. I do not recommend it unless you have a great understanding of building these skills and you can do every single combination on this SAQ test. Remember, this test measures an athlete's ability to do a new skill safely so if you are failing the SAQ it probably tells you to not try new skills yet until you have a more strategic plan...

SAQ Test Formula - Advanced Level 1 (Traditional)

5 Take-off positions and 4 aerial positions

$$\underline{5} \times 4 \times 2 \times 4 \times 2 \times \underline{4} = 1,280 \text{ Total Skills} / 10 = 128$$

*Each successful skill is awarded **128 points***

July 1, 2019 Sally does 4 out of 10 tries = $512/1,280$ (4×128) = 40%

Aug. 1, 2019 Sally does 6 out of 10 tries = $768/1,280$ (6×128) = 60%

Sept. 1, 2019 Sally does 10 out of 10 tries = $1,280/1,280$ (10×128) = 100%

SAQ Test Formula - Advanced Level 2 (Freestyle)

10 Take-off positions and 10 aerial positions

$$\underline{10} \times 4 \times 2 \times 4 \times 2 \times \underline{10} = 6,400 \text{ Total Skills} / 10 = 640$$

*Each successful skill is awarded **640 points***

Oct. 1, 2019 Sally does 4 out of 10 tries = $2,560/6,400$ (4×640) = 40%

Nov. 1, 2019 Sally does 6 out of 10 tries = $3,840/6,400$ (6×640) = 60%

Dec. 1, 2019 Sally does 10 out of 10 tries = $6,400/6,400$ (10×640) = 100%

What Are The SAQ Research Results?:

The results were surprising in some ways and completely obvious in other ways. It highlights the fact that both traditional and Freestyle athletes should be working together instead of in opposition. They both have much to learn.

Methods:

We started each test by administering level 1 or level 2 to small groups of athletes 4/5 per group. We did not give any help, advice or instructions and were told to solve a skill. This shows us what was taught to them before the clinic and gives us a baseline starting point to measure the results.

They wrote down what skill they had picked and had to get their skills accomplished within 15 minutes. This way we could observe the strategy each athlete was using to 'solve' the skill. Sometimes athletes would work together and try to help each other but these instances have not been included in the results because the end result was still the same.

We have administered it to over 20 Traditional Gyms, including Team Gym athletes, as well as 20 trampoline parks having events with Freestyle athletes. We had a total of 800 athletes complete the test in a somewhat informal setting. Athletes could talk to each other and work together even though they were not encouraged to do so but coaches were not allowed to help in anyway.

After the initial round we would then bring them together and discuss that we would like them to start building skills using the 'building' process analogy. Each time we did the test I would pick 2 skills based on athlete level (*Level 1, Level 2 or Level 3*) and go through the building process with the athletes.

Then the athletes would be told to pick another skill and we observed the change in training behaviour. Athletes were brought together and congratulated for a job well done and the test was over.

Results:

Preliminary results show that both traditional and Freestyle athletes have a natural tendency to “huck and chuck” new skills when a coach is not present telling them specifically what to do. Even when in small voluntary groups, athletes still never get past that barrier of breaking down the skill into smaller parts. Faced with a new challenge both sides of the sport failed every single initial stage with roughly 75% of athletes able to utilize the building process after only one 30 minute SAQ specific coaching seminar.

Discussion:

Every single one automatically just started throwing the body at different angles hoping to figure it out and land the skill (“Hot or Cold” Trial and Error method). This disproves the claims made by some critics that *only* Freestyle athletes are reckless enough to “huck and chuck.” The facts are that this mentality is hardwired into the traditional and Freestyle communities and maybe even into our biology.

The question remains as to whether it is a lack of proper coaching education throughout the industry or if it is a deeper biological circuit. I believe part of the answer is that humans naturally want the dopamine release of “huck and chuck.” By not knowing the outcome, we can get a dopamine release when it turns out well. By knowing everything we take out the satisfaction of learning because we already know it. The satisfaction of learning has necessary risk tied into it from a psychological level. It is similar to how people will say that you can’t feel good without feeling bad.

When I train, I tend to have fun throwing myself in the air so I can understand the draw. Like many traditional athletes, when looking to acrobatics to give myself a step up in the hierarchy, I would like to know the steps I am taking are efficient and guaranteed though if I am depending on getting to the Olympics. Coaches also can benefit from having these quantifiable results. Athletes and coaches are climbing the hierarchy within the sport and most investors love a financial report.

This raises the question as to how humans can navigate the seemingly necessary need to 'not know' the results with knowing they will be safe. If the only way to feel like you have accomplished something is to actively risk something in the first place then it would truly put a 'wrench' in the quest for absolute safety that seems to permeate the entire acrobatic culture.

If you are an athlete who enjoys throwing yourself into the unknown then please at least stick to the basic safety concepts. Make sure there are mats. Make sure you are playing within your limit. Keep your arms in and don't be dumb. If you are using acrobatics to climb the hierarchy and you want results use the SAQ to help you systematically build success.

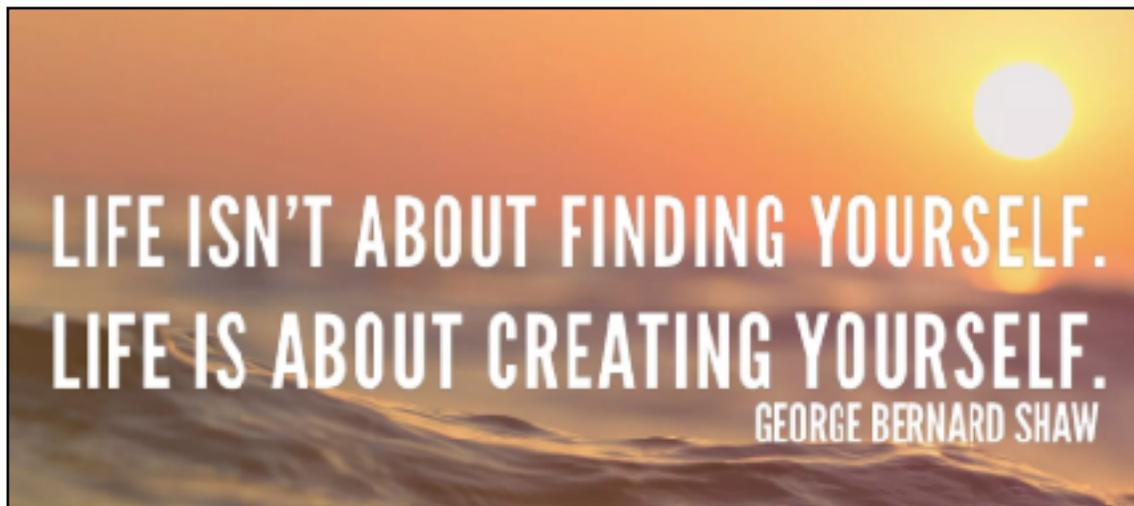
I believe that with the SAQ, any athlete can take training into their own hands systematically. I believe that it will give athletes a scope in which to invent skills systematically and safely. Instead of history dictating the development of future athletes, I think we should let future athletes dictate their own future.

[See Administering The SAQ Video:](#)

[SAQ Test](#)

Further Research:

The preliminary results of this informal study show that both psychological and educational research needs to be reviewed within the entire acrobatic community. In future studies different categories can be made to compare different athletes within the large acrobatic industry. Different coaches and different coaching styles can be directly measured and then improved on in a systematic way.



Freestyle Trampoline

A s s o c i a t i o n