**Hit Fit® Training System**  
**Physiological and Neuromuscular Adaptations from Training**  
**Kevin L Sciullo, MS, CSCS, NSCA-CPT**

**Physiology of Exercise – Muscle and Bone Adaptations**

Working through the five major components of fitness, we start with muscular strength/power. The idea of increasing strength is known to be accomplished with the addition of resistance. True strength can only be increased beyond a given point when weight is displaced – it is when weight is displaced quickly over time in an efficient manner we achieve muscular power.

The Hit Fit® Training System has the ability to increase its weight in the core of the bag. Each time the individual strikes the bag and meets resistance, muscles and bones adapt to the increase in resistance.

Muscle contraction occurs when an innervated fiber is flooded with a chemical signal for the fiber to contract – this contraction can cause the muscle to contract (used in weight training) or it can signal the entire motor unit of muscle fibers to stiffen or flex to absorb impact. This process is known as the excitation-contraction coupling phase, and with each impact the muscle achieves work. Strikes can be done as hard power strikes, soft trapping or parrying flow, fluidity of upper and lower extremity techniques, and targeting areas of a moving object greatly increase accuracy on a subconscious level.

Bones also absorb impact and bend/conform under mechanical stress. Over time, muscles adapt with an increase in density and hypertrophy resulting in increased strength. Bones adapt with an increase in boney matrix similar to the adaptations underweight to increase thickness and density.

With this adaptation, training over time with this system can increase muscular strength and can also increase bone density resulting in improved health conditions for everyone who trains with it.

**Physiology of Exercise – Neuromuscular Adaptations**

A nerve and all of the fibers it innervates is called a motor unit. Nerves allow an action potential to reach the nerve terminal and release acetylcholine (a neurotransmitter) which causes calcium to be released from the sarcoplasmic reticulum. This flooding of the messenger fills the terminal gap within the motor unit.

The denser this gap becomes with chemical messengers, the more easily an action can be accomplished. This process improves through repetitive actions (drilling) as well as learning new movements (training new techniques in an unpredictable manner). It is with this principle that The Hit Fit® Training System enhances physical and mental efficiency.

No two movements of The Hit Fit® Training System are alike, and therefore the athlete never falls into a predictable rhythm. This allows the individual to throw hand strikes, elbows, knee strikes, foot techniques, jumping skills, low strikes, sweeps and more all while attempting to impact, block, slip and dodge. No other training device can perform all of these capabilities nor can they perform unpredictably based on their design.

**Muscle Fiber Types**

In general, we can focus on Type I and Type II muscle fibers, known as slow twitch and fast twitch respectively. Type I fibers have a high aerobic capacity based on mitochondrial density, however have a limited potential for rapid force development. On the contrary, type II fibers are prone to fatigue but can generate highly anaerobic rapid force.

Everyone has a different composition of muscle fiber types allowing for a preponderance of an individual to favor strength/power sports vs endurance sports – however training can improve any body type to excel. With this system, one can train BOTH fiber types and develop skill in areas of endurance and power – and in the eyes of most trainers I work with, this is the ultimate goal of athletic prowess.

**Depth Perception and Proprioception**

Kinesthetic sense is also known as proprioception – the knowledge of where the body is in space. The Hit Fit® Training System allows improvements in spatial awareness (proprioception) due to enhancing the function of the cerebellum (a feature within the hindbrain).

This awareness is processed and learned at a subconscious level as proprioceptors act as sensory nerves providing information needed to maintain muscle tone and perform movements of complexity and coordination.

These pathways mentioned are essential to reaction timing, reflex, and subconscious processing. Any athlete will agree that when the moment of action arrives, they feel as though they are not thinking – everything is reaction based on instinct from repetitive practice and preparation. They can trust in their training and simply act.

**Stages of Learning**

Motor skill acquisition is a flow of three stages: the cognitive stage, the associative stage, and the autonomous stage. Every coach or teacher must follow these stages to truly teach an individual. In the cognitive stage of learning, an individual is purely receiving information. They must think through and attempt to process the information given in the cortex of the cerebellum.

In the associative stage, the individual must realize that if they want to improve and become efficient, they must release the old incorrect habits, retain the correct new habits, and be open to countless drilling and practice.

The subconscious processes information 30,000 times faster than the conscious – therefore, if movement and action remain in the cognitive or associative stages, there can be no reaction response or use of acquired skill.

It is in the autonomous stage of learning that the individual can rely within the subconscious that all reactions to actions will surface. No plan is required, no guessing what the action or attack will be, and no visualization of possible scenarios; simply confidence in one’s skill and preparation as the time for action arrives.

It is in this stage that the trained individual becomes enlightened; that as he can gain immense skill and ability, he also understands the need for continued training, learning, and drilling.

The enlightened athlete and martial artist will never cease use of The Hit Fit® Training System due to the clear benefits of its use; there is no end goal when one trains in martial arts, fitness, boxing, and all sports other than to continuously learn and grow.

**Muscle Spindle Fibers and Golgi Tendon Organs**

Muscle spindles, when sensing a stretch in the muscle, react by contracting and flexing as a protective reflex. This is used as an advantage of training to achieve high levels of power and explosiveness. Prime example: plyometric training. With this system, each time an athlete jumps, springs, kicks, or rotates requiring a rapid stretch-shortening cycle, the muscle and the entire body system experiences work.

Golgi Tendon Organs are proprioceptors found in tendons which, when activated, provide an inhibitory response of the central nervous system. This happens when an athlete wants to avoid muscle contraction to achieve a deep stretch while improving flexibility.

**Energy Systems of the Body**

Keeping the complex simple, the body has three main energy systems which can produce usable energy in the form of Adenosine Triphosphate (ATP) from macronutrients, mainly Carbohydrates and Fat.

The three main energy systems include the phosphagen system, glycolytic system, and the oxidative system. In general, each system produces ATP from specific sources with the intension of various durations/intensities of movement.

With The Hit Fit® Training System, an athlete can work on one or all of these energy systems based on the desired training outcome. Let’s start with the phosphagen system.

In short, phosphocreatine in muscle is dissimilated by creatine kinase to produce ATP enough for short, explosive activities typically 30 sec or less. This is necessary in sprinting, fast short striking movements, hard and solid impacts meant to quickly shock and stop an attacker or opponent. This is done without the presence of oxygen and therefore is considered anaerobic in function.

Glycolysis involves the production of ATP from carbohydrates as glucose or glycogen. We have glucose in the blood especially after a carbohydrate-heavy meal, and we also store glucose as glycogen in liver and muscle. This is useful in longer activities and utilized oxygen as the final electron acceptor so is considered aerobic.

Oxidative systems use fat rather than carbohydrate to yield many more ATP – this is common in long endurance activities like distance running, biking, and activities longer than 30 minutes.

Through cross training, an athlete can choose workouts that work short fast and strong bursts of energy, mid-duration events like rounds of boxing or kickboxing, or recreate 30 minutes or longer workouts involving work/time ratios of exercise using a multitude of stations. This type of circuit training with varied stations and exercises is still possible all with one system: The Hit Fit® Training System.

**VO2 Max and Blood Lactate**

Blood lactate is typically measured and is used as a determinant of fitness. Typically, lactate threshold is reached around 50-60% of VO2 max (maximal oxygen update) in untrained people.

Research can show this threshold is increased to 70-80% of VO2 max in trained athletes. So, the onset of blood lactate (OBLA) can be trained to occur at a later time in activity allowing for increased intensity and duration of activity – an invaluable asset to all athletes.

**Endocrine System and Training**

Training with The Hit Fit® Training System allows an athlete to improve cardiovascular endurance as well as increase muscle protein synthesis.

Anabolic hormones (for growth) include insulin, insulin like growth factors, testosterone, and growth hormone released from the pituitary gland.

Catabolic hormones (degrading proteins) include cortisol and progesterone.

Using this system to cross train various exercise and martial arts techniques as a circuit, stations, round simulation, or simple sets and reps, allows for the highest benefit of training which is a greater anabolic response and lower catabolic response. Otherwise the athlete will experience greater degradation known as overreaching or overtraining.

**Cardiovascular Endurance**

When an untrained individual begins activity, the system quickly climbs to a near-maximal level of heart rate and respiration, typically higher than is needed for the activity. This is due to an excessive stimulation of the sympathetic nervous system which prepares the body for fight or flight response.

The more an athlete trains, the more control they have on their sympathetic response and can even use breathing and visualization to enhance their parasympathetic response which allows for rest and digestion to slow the system down.

Training with The Hit Fit® Training System can therefore enhance sympathetic control and increase parasympathetic tone – this allows an individual to react/respond to any threat or stimulus within the appropriate level of state anxiety without reaching over-excitement and losing the ability to react and function.

**Visual Acuity and Reaction Time**

An incredible feature of The Hit Fit® Training System is its unpredictability of movement. Due to the design, it does not swing as a pendulum, rather it moves in completely different patterns with each hit. This prevents the mind-body connection to avoid falling into a predictable rhythm.

In any sport or physical activity, training with a partner or coach is ideal because a human can move unpredictably which is representative of real life.

Reaction time is inversely related to heart rate and blood pressure as well as sympathetic tone as mentioned earlier. Therefore, physical training that improves conditioning can decrease reaction time.

Looking into reaction speed related to visual acuity, we see that familiar scenarios resulting from training can decrease the processing time needed to perceive a stimulus and react.

It is with this practice that the sensory pathways go beyond the visual – the lemniscal, auditory, and vestibular neural pathways all process stimuli faster than the visual pathway.

Therefore, as the athlete and martial artist train with The Hit Fit® Training System they react based not only on visual stimuli, but also the sensation of touch, balance, and rhythmic changes to process this information quickly – resulting in elite reaction time and accuracy.

**Conclusion**

The Hit Fit Training System develops your mind, as well as your body due to the vast number of techniques that can be done with the system. Something no other training device can do. One is only limited by their own imagination. 

Training with The Hit Fit® Training System develops all skills and attributes related to fitness and martial arts prowess. This device is completely unpredictable in movement causing adaptations physically and mentally which enhance these skills.

The ability to train from both standing and the ground, and changing between the two, enhances both the muscular and cardio benefits. We have coined the phrase "circuit training in a bag".

This device combines the benefits of seven pieces of martial arts training equipment into one ideal system. Additional unique qualities are its unpredictable movement, structure, and variability in weight and resistance. It allows the athlete to develop their own unique sense of rhythm, reaction, and skill based on practical drilling rather than predictable repetition.

Practitioners can develop all of the essential attributes of a martial artist, boxer, or fitness enthusiast. These include hard versus soft striking, dodging and awareness skills, instincts necessary for live encounters, and much more. All of this is accomplished through utilizing practical boxing techniques, maintaining optimal levels of fitness, and mastering the most advanced and effective martial art techniques from any system or style.   
  
Benefits and uses exist with The Hit Fit® Training System beyond martial arts, boxing, and fitness. Studies suggest high intensity aerobic exercise incorporating the learned skills of boxing techniques can be beneficial for many chronic diseases across the board such as but not limited to Parkinson’s disease.

In this day and age, I believe any coach, teacher, instructor, athlete, and martial artist can benefit immensely from training with The Hit Fit® Training System; this training tool is affordable, space-efficient, allows for individual training while remaining socially distant from others, and has incredible market potential. This is one of the most advanced, realistic, and effective training devices on the market today.

*References of physiological and neuromuscular statements and information:*Haff, G., & Triplett, N.T. (2016). *Essentials of Strength Training and Conditioning.* Fourth Edition. Champaign, IL: Human Kinetics.