

SMARTfit Functional and Brain Fitness Training Games

The Science Behind Its Brain/Body Integrated Approach For
Addressing Mood Disorders and Depression



SMARTfit[™]
Functional and Brain Fitness Training Games

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SMARTfit Multisensory Fitness Training

For Addressing Mood Disorders and Depression

University Researchers Rated SMARTfit #1 in User Enjoyment and Energy Expenditure¹

Introduction

Multisensory Fitness Inc. founder Cathi Lamberti first realized the potential benefits of using technology to motivate people and improve their physical and neurological performance while observing the talents of video game players on Santa Monica Pier in 1993. Watching one player, she first dismissed the activity as a waste of time and money. She soon became aware, however, that there was something special happening, a remarkable convergence of hand-eye coordination and brain speed combined with the fun and challenge of the striving to improve and attain the best score.

A tennis backboard manufacturer and former teacher, she also realized the limits of what she was seeing. If she could find a way to use similar interactive technology in a real and functional, rather than virtual, play environment with full body physical activity requiring multiple senses to achieve success, participants could see improvements in much more than hand-eye coordination and reaction speed.

She knew how our multiple senses affected performance in everything we do, from basic everyday functions to high level sports. Our senses give us information about the physical conditions of our body and the environment around us. Sensations flow into the brain like streams flowing into a lake. Countless bits of sensory information enter our brain at every moment, not only from our eyes and ears, but also from every place in our bodies. We even have a special sense called proprioception that detects the pull of gravity and the movements of our body in relation to the earth and things around us.

At a time in which obesity was much less an issue than it is today, she also knew she'd observed something in the technology that could motivate people to exercise, to do so because they wanted to, not because they had to. Her products appeal to all ages and abilities has proven crucial to success.

The technology she had observed, while limited, clearly affected motivation, sensory integration (the organization of senses by the brain for use in moving, learning and behaving) and physical performance (speed, agility, accuracy). She began to envision applications such as functional fitness (before it was called that), sports performance, physical education and sensory processing (today, reference Autism Spectrum Disorders, ADHD, Dyslexia).

The result of this epiphany was the original Sportwall, which became one of the most unique, most highly rated and best selling products in a developing new industry that came to be known as exergames.

Today, brain research has evolved substantially, and Lamberti's early conclusions about the relationship between physical activity, multisensory stimulation and brain productivity and performance have been confirmed. The concept of neuroplasticity, the brain's ability to change and adapt, even rewire itself, is now accepted science.

Science is also discovering that while all physical activity has a positive effect on the brain ("miracle grow for the brain"), exercise that combines the use of multiple senses with full body movement, including impact and resistance based activities, challenges the brain at higher levels, requiring more complex

cognitive function to make decisions and execute skills. The brain adapts, improving physical, sensory and neurological performance.

Interactive technology further enables this process in ways that traditional fitness can't, simultaneously prompting and providing feedback to participants' physical and cognitive actions, tracking results and setting benchmarks for improvement.

New SMARTfit technology draws on the latest in brain research, exercise science and sports science, then combines this information with cutting edge multisensory interactive technology to create the next generation of brain-body solutions for fitness, schools, sports performance, sensory processing and more. This white paper explores the research and science behind SMARTfit as it relates specifically to Brain Plasticity.

Multisensory Fitness Inc.'s new SMARTfit technology for Multisensory Brain-Body Fitness Training, replaces Sportwall electronics with a simple yet dynamic upgrade to convert them to the SMARTfit Trainer, SMARTfit ProTrainer and SMARTfit PlayPods.

These interactive electronic systems, now featuring the revolutionary new SMARTfit Technology, offer a unique approach to improving the physical and mental health of all ages and abilities by utilizing the attraction and engagement of computer games in a live, multisensory environment.

Instead of simulating play, SMARTfit systems engage players in a real multisensory kinesthetic experience including dynamic, integrated, multi-planar athletic movement with tactile contact and resistance using real sporting, playground, or PE equipment. The result is a powerful combination of cardio fitness, brain fitness, functional fitness, sports specific training and action-based learning in one system.

Success with SMARTfit systems is measured by the ability of participants to keep the game in play as a result of real physical and mental responses rather than emulated movement such as waving a wand as typically called for in many exergaming products that have incorporated some physical movement with video game play. The original concept behind the creation of SMARTfit technology was to create fun, short, full-brain-body games that engage cognitive decision making, motor control, and reaction skills with results measured via electronically generated scores and rewarding sounds.

Installed in over 2,600 facilities in 32 countries, this approach continues to incentivize repeated play until mastery takes place.

This concept has evolved into a wide range of applications from sports performance training at all levels to highly engaging, brain integrated, physical exercise classes for school PE and after-school programs, seniors, and children with special needs. This enormous flexibility is one of the most unique aspects to SMARTfit programming. Coaches and Instructors are free to choose from a wide array of drills/curriculum/lesson plans.

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Over the last several decades, a widespread trend toward inactivity has impacted both the how much people exercise *and* their desire to exercise. To engage them SMARTfit focuses on

providing play-based, fun, interactive activities with immediate feedback incorporating the same video game technology they already understand and enjoy. These products have been labeled “computer games that make you sweat” and, “serious fitness for people who love to play” making “practice as exciting as real competition.” Specific training exercises have been developed by qualified instructors and occupational therapists for mainstream instructors who take individuals and small groups through programs.

SMARTfit Multisensory Conditioning for Mind and Body: How it Works

When it comes to localizing and tracking moving objects, it is likely that the human brain evolved to develop, learn, and operate optimally in multisensory environments.² Thus, multisensory training protocols can better approximate natural settings and are more effective for learning.²

SMARTfit programs provide multisensory training for all ages and ability levels. Visual, auditory, and physical tasks are integrated in performing the motor skills required. These protocols, with their profound and SIMULTANEOUS brain/body stimulation, are the key element that differentiates a functional training program from a general conditioning program.

This unique form of exercise stimulates greater input to the proprioceptors of the motor system, and with it, greater subsequent refinement of movement patterns. The resistance and motor patterns encountered by the use of real sports equipment creates very dynamic neuromuscular control in a functional setting of play.

SMARTfit programs are specifically designed to stimulate the body and the brain concurrently. This is accomplished by:

- Encouraging team participation and engaging sustained focus with short attention-grabbing computer games that are played sequentially to pursue mastery of skills and score
- Providing full body exercise by stimulating the hands, feet, eyes, ears, and vestibular system (stimulating the proprioceptive input to the motor and vestibular systems) in playing real games with real, not simulated, sporting goods
- Requiring high levels of attention and focus for success (staying consciously “in-the-now”)
- Engaging in cognitive decision-making under pressure
- Delivering a cardiovascular workout in a game format

“Functional Training” is used by physical therapists as a comprehensive form of rehabilitation to return patients to daily living activities as well as competitive sports by using movement in multiple planes while bearing weight. In contrast, “Strength Training” might use a weight machine, bands, or free weights and usually focuses on uni-planar, one joint motion to build muscular strength.

SMARTfit’s brand of functional training uses a variety of activities that can focus on the core/torso, agility, speed, balance, flexibility, power, and strength while SIMULTANEOUSLY

developing high levels of neuromuscular efficiency. This process of engaging the hands, feet, ears and eyes develops not only eye-hand, but also visual-perceptual motor skills.

Using Exercise in the Prevention and Intervention of Anxiety and Depression

Dr. John Medina states:

Although exercise cannot substitute for psychiatric treatment, the role of exercise on mood is so pronounced that many psychiatrists have begun adding a regimen of physical activity to the normal course of therapy. But in one experiment with depressed individuals, rigorous exercise was actually substituted for antidepressant medication. Even when compared against medicated controls, the treatment outcomes were astonishingly successful. For both depression and anxiety, exercise is beneficial immediately and over the long term.³

SMARTfit's training is frequently presented in play format that appeals to those who traditionally do not want to exercise or play sports. This makes it a critical tool to reach the enormous numbers impacted by technologies which promote sedentary life styles.

According to the Harvard School of Public Health, inadequate physical activity/inactivity is now rated as the FOURTH leading cause of preventable death in America.⁴ It is worth noting that this preventable cause of death was ranked above high blood sugar and high LDL cholesterol.

For Elaine Alexander of the Kansas City School District, the SMARTfit Trainer says, "Our students absolutely love the SMARTfit Trainer." She continues, "They ask to play on it and the whole class's demeanor changes to one of total cooperation when they know we are going to work with the SMARTfit Trainer. If we need to change from another activity to the SMARTfit Trainer, we never hear any complaints. We find the SMARTfit Trainer can be adapted to almost any skill we are teaching. We believe the it is the most motivating piece of equipment we have in our program!"⁵

Principal Craig Rupert, of Kansas City's Woodland Elementary School says, "PE4Life has had a tremendous influence on the lives of our students. It's not just the increased levels of fitness we are seeing in our kids which has everyone excited. Students are also more motivated throughout the day, their enthusiasm is way up, and discipline issues are way down."⁵

Dr. John Medina comments on mood:

A body of work now believes that exercise can affect the course of diseases such as anxiety and depression. This is believed to be due to the release of the three neurotransmitters associated with mental health. Although exercise cannot substitute for psychiatric treatment, the role of exercise on mood is so pronounced that many psychiatrists have started adding a regimen of exercise to the normal course of treatment. Exercise proved to have both an immediate and long-term effect.³

Due to the neurochemical response, many researchers have concluded that we can control mood through exercise and thereby dramatically impact human psychological health. In addition to its massive appeal to at-risk populations, the following section explores how SMARTfit's "short-burst/short-rest" style of interval training programs can:

- release endorphins which lift mood,
- stimulate the elimination of adrenalin and cortisol, thus improving the sense of well-being, and
- increase naturally the production of neurotransmitters (building blocks of hormones) such as serotonin, norepinephrine, and dopamine (known as "the happy hormones").

Endorphins

Endorphins function as neurotransmitters that act as the body's "natural painkillers" as they resemble opiates in their abilities to produce analgesia and feelings of well-being. Endorphins are responsible for our ability to diminish, or even ignore, physical pain. They are also partly responsible for the "runner's high" often reported by devout runners. Importantly, endorphin production increases with the frequency of exercise.

It is a fact that endorphin production increases with the frequency of exercise. All people, regardless of history, will experience a rise in endorphin levels with even modest regular exercise. Those who establish a regular exercise routine often report a sense of beneficial "addiction" for their body.

Dopamine

Dopamine stores can become depleted with chronic stress, or anxiety, intense trauma, starvation, or low carbohydrate diets. Performing long duration exercise at moderate intensity can elevate dopamine levels.

Norepinephrine

Norepinephrine is the chemical in the brain that controls physical wants and needs, is increased along with serotonin during strenuous exercise, and continues long after exercise is completed.

Serotonin

Serotonin helps to govern the healthy function of the other neurotransmitters as well as providing critical support to the entire neurological system. Many stress related conditions are being tied to shortages of serotonin production. These include chronic fatigue syndrome, fibromyalgia, migraine headaches, anxiety, and depression.

Serotonin is produced in the intestines and 75% is used to control intestinal activity. The remaining 25% is synthesized in the brain. The rate of serotonin production in the neurons determines mood. High serotonin levels are linked with elevated or happier moods, whereas low levels are linked with feelings of anxiety and depression.

Although all neurotransmitters affect mood, serotonin is considered the most crucial, and exercise is one of the most efficient stimulators of serotonin production. While exercise is often linked to weight loss, it can in fact also help a person feel better. Several studies have found that once a person engages in physical activity the brain's serotonin function increases, which in turn reduces depression, anxiety, and stress.

SMARTfit Promotes the Production of the “Happy Hormones”

Inactivity is a major contributor to depression. A study of 276 middle-aged women found that those with a positive sense of well-being had also engaged in about 85 more minutes of physical activity per week than women who were clinically depressed.⁶

About 10% of the US population (27 million) was taking prescription anti-depressants in 2005.⁷ Of those, about 700,000 are ages 5-17. Astonishingly, this group's usage doubled from 1995 to 2005, according to the Archives of General Psychiatry.

While serotonin, norepinephrine and dopamine are critical ingredients found in manufactured anti-depressants, they are also produced naturally in a healthy person whose diet, exercise, and stress levels are well managed.

Neurotransmitter levels affect the way a person feels, and have been referred to as the “feel-good hormones” or “happy hormones”. Aside from enhancing mood, they also help control sleeping habits and digestion.

There are several conditions that may arise if neurotransmitter levels, especially serotonin, are low. Depression, migraines, constipation and feelings of increased stress are possible indicators of low serotonin levels. While serotonin, dopamine, and norepinephrine levels may be boosted using various types of drugs or medication, many experts support the idea that exercise may be just as efficient.

Dr. David C. Nieman of “The Exercise-Health Connection” has written that the benefits of exercise far exceed that of any medication or supplement. He suggests since the results of exercise can last for days, it is a safe and natural way to raise neurotransmitter levels and relieve depression.⁸

The important Roles of Exercise and Play in Stress and Stress Management on Cognitive Performance

One study showed that adults with high stress levels performed 50 percent worse on certain cognitive tests than adults with low stress.

- Specifically, stress hurts declarative memory (things you can declare) and executive function (the type of thinking that involves problem-solving). Those, of course, are the skills needed to excel in school and business.
- Stress hormones have a particular liking for cells in the hippocampus which is deeply involved in many aspects of human learning.

- "Stress hormones can stop the hippocampus from giving birth to brand-new baby neurons."³

Brain Derived Neurotrophic Factor (BDNF): "Miracle Gro for the Brain"

"At the molecular level, early studies indicate that exercise also stimulates one of the brain's most powerful growth factors, BDNF, which aids in the development of healthy tissue. BDNF exerts a fertilizer-like growth effect on certain neurons in the brain. The protein keeps existing neurons young and healthy, rendering them much more willing to connect with one another. It also encourages neurogenesis, the formation of new cells in the brain. The cells most sensitive to this are in the hippocampus, inside the very regions deeply involved in human cognition. Exercise increases the level of usable BDNF inside those cells. The more you exercise, the more fertilizer you create."³

Harvard psychiatrist John Ratey refers to BDNF as "Miracle-Gro for the brain."⁷ He calls BDNF "a crucial biological link between thought, emotions, and movement." So how do you get more BDNF?

Daily aerobic exercise is good but including intervals of sprints is even better. In a recent German study, volunteers who, during the course of a forty-minute treadmill session, did two 3-minute sprints separated by 2 minutes of lower intensity demonstrated higher increases in BDNF than non-sprinters. Not only that, the sprinters learned vocabulary words 20 percent faster than non-sprinting exercisers. It seems even a small amount of high-intensity exertion can have a profound effect on the brain.⁸ This is precisely the format adapted in SMARTfit programming.

Stress and BDNF

- BDNF in the hippocampus acts like a standing military armed with bags of Miracle Gro, keeping neurons alive and growing in the presence of hostile action. As long as there is enough BDNF, stress hormones cannot do their damage.³
- If too many stress hormones linger in the brain too long, a situation found in chronic stress, the stress hormones will eventually overwhelm the brain's natural defenses.³
- Stressed brains do not learn the as well as non-stressed brains and children living in high anxiety households will not perform as well academically as kids living in more nurturing households.³

SMARTfit's Balanced Programming: Key to Performance & Adherence

While even mild exercise will have a positive effect on our neurochemicals, exact effects vary with the severity of exertion. Exercise at very high intensity and long duration can cause adrenalin levels to become elevated while serotonin levels drop. However, these undesirable results can be avoided. As long as the body is not over-stressed, the more demanding the

exercise, the better the chances of increasing serotonin production. A balance is required for the most advantageous results.

SMARTfit's interval training (short-burst/short-rest regimen), when delivered to groups, is an excellent way to achieve the balance needed to optimize results without over-producing adrenaline or under-producing serotonin. Intensity is balanced with recovery during a thirty to sixty-minute workout. This balance may explain why schools that have adopted the SMARTfit programs are noticing a significant reduction in aggression and out-of-school suspensions.⁹

Interval training is now well documented to hold the key to maximizing performance. The body must rest (called compensation) following a period of activity in order to replenish its biochemical sources of energy. Too much stress without recovery increases risk of injury and burnout. Too much rest without stress will lead to atrophy and weakness. Balancing stress and recovery is essential to increasing performance and adherence.

All SMARTfit training programs utilize this method of training, which is a key to its superior adherence and performance results, especially among at-risk populations. Inactive people often report that pain is the greatest barrier to adopting an exercise regimen. SMARTfit's format of short, intense games, followed by short rest in preparation for the next turn, is believed to be a key factor in successfully encouraging individuals to conquer this "pain barrier."

The thrill of play and competition balanced with intermittent rest holds the player's focus on the game rather than on the length of time spent exercising. Add the neurochemical release of "happy hormones" and the drudgery of regular exercise is replaced with the pleasure that play brings.

References

Evidence in this document has been gathered from scientific research, interviews with medical and science professionals, as well as experienced observations by seasoned trainers who have worked with the SMARTfit products and programs in their facilities during the past seven years.

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