SMARTfit Brain Health Gym

The Science Behind Its Cognitive-Motor Integrated Approach For Addressing Mood Disorders, Anxiety and Depression

SMARTfit®
Your Brain Matters

SMARTfit Cognitive-Motor Training

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The Value of SMARTfit Cognitive-Motor Training

Addressing Mood Disorders, Anxiety and Depression

Introduction

SMARTfit interactive brain health training solutions offer a unique approach to improving the physical, cognitive and mental health of individuals who usually don't work out or play sports. The key to engaging these populations is the use of gamification to immerse participants in playing exercise games that are easy to learn yet engaging, with enough challenge to trigger the desire to achieve and improve.

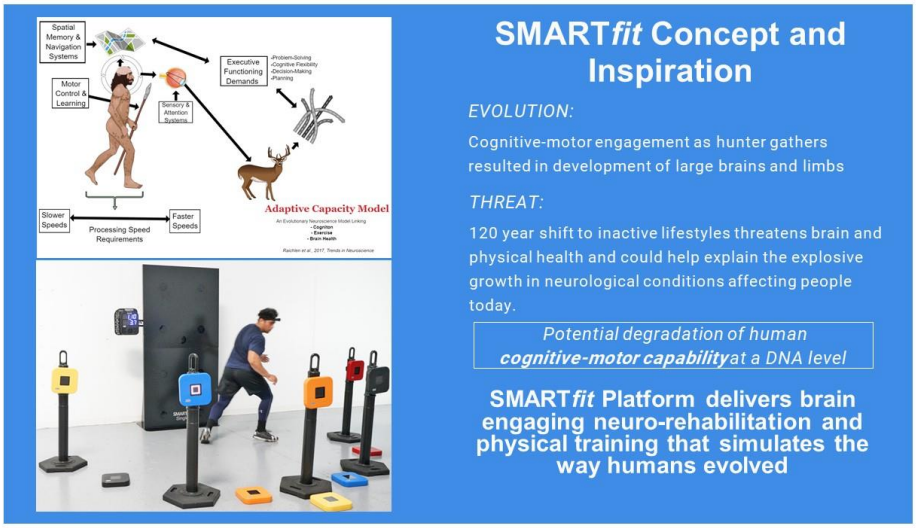
This full immersion in the game that is played with the whole body creates an experience more like play than hard work. The games are easy to learn yet challenging to master, resulting in repeated play to earn more points. This effective workout produces a boost to the endocrine system, creating mood enhancing hormones.

Like computer games, each successful step toward mastering the game skills is thought to release dopamine, which encourages repeated play and enjoyment. However, unlike other computer games, SMARTfit also enhances cardiovascular fitness, strength, motor skills and cognitive health. Training participants to derive dopamine from exercise can support the maintenance of a happy and healthy lifestyle based on exercise.

SMARTfit Uses the Adaptive Model – How Is It Different?

SMARTfit technology draws on the latest in brain research, exercise science and sports science to build functional games designed to activate various domains of the brain while executing motor tasks. Activities average one minute and can last up to three minutes and can be adjusted to any participant's cognitive or physical ability level to keep them challenged and engaged without being overwhelmed. The resultant motivation to improve scores results in repeated play and skill development.

SMARTfit systems engage players in a real multisensory kinesthetic experience including dynamic, multi-planar athletic movement combined with tactile contact and resistance using actual exercise equipment. The result is a powerful exercise program that simulates how we function in our everyday lives.



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Success with SMARTfit is measured by the ability of participants to keep the game in play as a result of real physical and mental responses rather than the emulated movements of virtual reality games. The concept behind SMARTfit technology is to create training that engages cognitive decision making, motor control, and reaction skills with results measured via electronically generated scores and rewarding audio cues.

Over the past several decades, a widespread trend toward inactivity has impacted both how much people exercise *and* their desire to exercise. This has correlated with deterioration of mental health which has been further exacerbated by pandemic lockdowns, pushing the already reluctant into further inactivity.

SMARTfit focuses on providing gamified cognitive-motor training programs that incorporate the technology that people already understand and enjoy and have been described as "computer games that make you sweat" making "practice as exciting as real competition."

Since physical engagement in exercise and outdoor activities to promote mental health has been well documented, the losses incurred this past year have made a widely recognized problem even worse. At SMARTfit, after years of success in creating exercise solutions effective with at-risk populations, we deepened our focus to target the highly vulnerable, such as the bed-bound and those unable to leave their rooms. We can now bring SMARTfit to them, provide tasks with low physical and mental demands, and scale up over time as appropriate.

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. Thus, dual tasking, or, cognitive-motor training protocols can better approximate natural settings and are more effective for learning.[2]

SMARTfit programs provide multisensory challenges for every demographic group. Visual, auditory, and physical tasks are integrated with performance of motor skills.

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 produced by the use of actual exercise equipment calls for 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:

Being fun and engaging. Participants look forward to their workouts

- Encouraging sustained focus with short attention-grabbing computer games played repeatedly to achieve mastery
- Providing full-body functional exercise that delivers stimulation to the endocrine system, helping to jump-start production of desired mood improving endocrine health
- Using gamification to trigger the development motor skills that improve activities of daily living (ADLs).
- Requiring high levels of attention and focus (staying consciously present)
- Engaging in cognitive decision-making while moving

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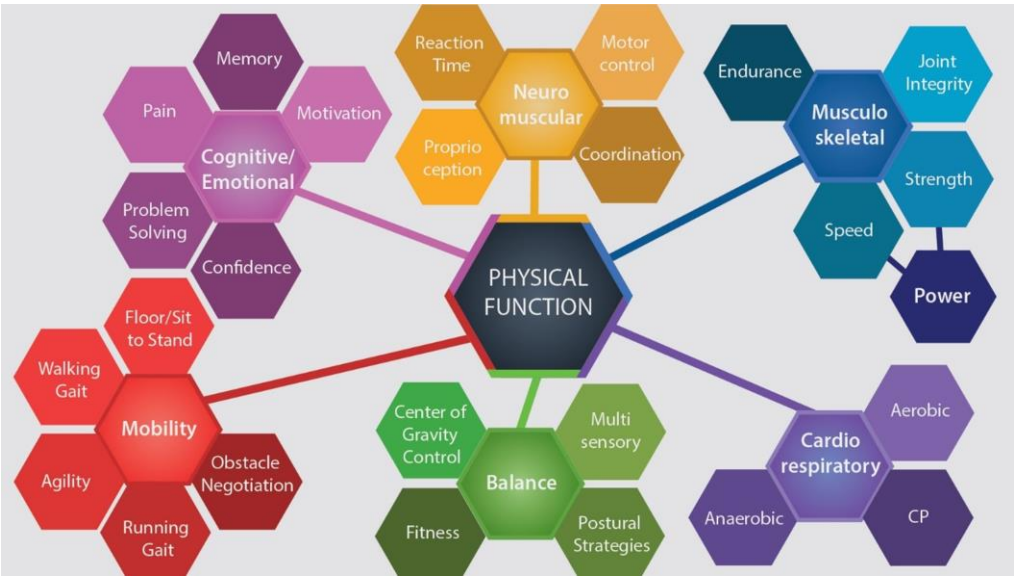
How the Right Kind of Exercise Can Positively Affect The Whole Person



- Exercise can improve mood, acutely and chronically, in myriad clinical and non-clinical populations
- SMARTfit falls into the category of Exergaming, which can consist of dual-tasking, has demonstrated the potential to improve mood states in a variety of populations
- Cognitively-enhanced tasks may target certain functions & pathways that may not be as robust due to alterations in mood
- Tasks that focus on challenge, enjoyment, goal-orientation, engagement, and healthy competition may further modify the effects of cognitively-enhanced exercise on mood
- Impact of Playing Exergames on Mood States: A Randomized Controlled Trial Playing exergames enhanced vigor and happiness for participants in the intervention group. In two weeks, this group exhibited more positive change in vigor and happiness than the control group.[10]

SMARTfit's Emphasis on Leveling, Essential to Improving Mental Health in the Vulnerable

What happens when leveling is not a component of the programming?

Cognitive engagement means taking part in activities that are mentally challenging. Monitoring blood pressure allows the researchers to track how hard study participants are working to accomplish cognitive tasks. Specifically, blood pressure rises as more blood is pumped to the brain when participants work harder at these tasks.

Broadly speaking, the researchers found that if a participant's cognitive ability, physical health or mental health declined over the course of the six month study period, that participant became less cognitively engaged as the tasks became harder.

"Normally, you'd expect more engagement as the tasks became harder, but we found that some people essentially stopped trying," says Claire Growney, co-author of the study and a postdoctoral researcher at Washington University in St. Louis.

SMARTfit allows trainers to avoid both stress and boredom with is ability to keep the programming at slightly higher than the clients comfort zone but always in the zone.

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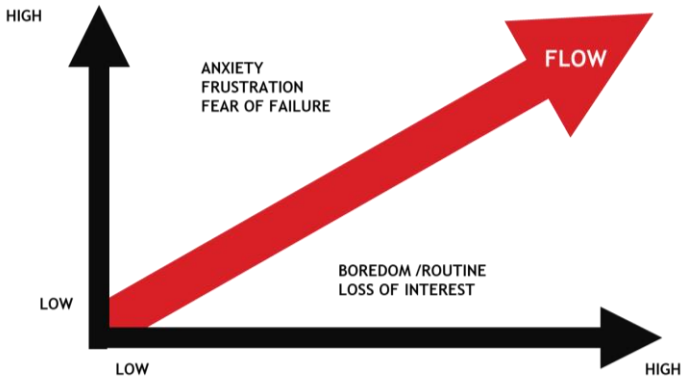
According to SMARTfit clinical advisor, Dr. Rob Winningham, the main take away of decades of research on cognition and mental health, is that almost every common mental health condition (e.g., depression, bipolar, anxiety, schizophrenia, drug abuse, ADD/ADHD) has a significant executive functioning correlate. Leveling is critical for interventions to be maximally effective, across settings and participants. SMARTfit has been specifically designed to facilitate this.

Exercise – Needs to be Easily Customizable to Match and Challenge Individual's Needs

Exercises that bring joy, pride, confidence, and a balance of challenge, but not frustration or amotivation is key to exercise adherence as well as to delivering the best dosage that can produce sustained improvements to lifestyle and physical and mental health.



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.
>
> 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. [3]

SMARTfit's training is presented in play format which appeals to those who traditionally do not exercise or play sports, making it a critical tool to reach the enormous numbers impacted by inactivity and consequent mental health issues.

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.

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:

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- 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 (a.k.a. “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” reported by devout runners.

Importantly, 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 be depleted by chronic stress, anxiety, intense trauma, starvation, or low carbohydrate diets. Performing long duration exercise at moderate intensity can elevate dopamine levels.

Norepinephrine

Norepinephrine, 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 tied to shortages of serotonin production. These include chronic fatigue syndrome, fibromyalgia, migraine headaches, anxiety, and depression.

Serotonin is produced in the intestines with 75% used to control intestinal activity and the remaining 25% is synthesized in the brain. 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 emotionally. 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.

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SMARTfit Promotes the Production of Mood Enhancing 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 were ages 5-17. Astonishingly, the latter 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 have been referred to as the "feel-good hormones" or "happy hormones". In addition to 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 believe 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, that it is a safe and natural way to raise neurotransmitter levels and relieve depression.[8]

The 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. For this reason, SMARTfit cognitive-motor training emphasizes gamification and provides **leveling which is the ability to gradually increase challenges and complexity without ever overwhelming clients**.

- Specifically, stress hurts declarative memory (memory that can be stored and retrieved) and executive function (problem-solving). Those, of course, are the skills needed to excel in school and business.

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- Stress hormones have an attraction 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 does one 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 a higher increase in BDNF than the non-sprinters. Futhermore, the sprinters learned vocabulary words 20 percent faster than the non-sprinters. This suggests that even a small amount of high-intensity exertion can have a very 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. With adequate 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, they will eventually overwhelm the brain's natural defenses. [3]
- Stressed brains do not learn as well as non-stressed brains; children living in high anxiety households do not perform as well academically as those living in more nurturing households.[3]

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SMARTfit's Balanced Programming - Key to Performance & Adherence

While even mild exercise will have a positive effect on our neurochemicals, the 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) 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 which have adopted the SMARTfit programs are noting a significant reduction in aggression and out-of-school suspensions.[9]

Interval training is now well documented to hold the key to maximizing performance. In order to replenish its biochemical sources of energy, the body must compensate (rest) after a period of activity. Too much stress without recovery increases risk of injury and burnout. While 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, resulting in 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 brought by play.

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

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