Peak Performance SUITE™

REFERENCE MANUAL

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In collaboration with:

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For use with BioGraph INFINITI version 6.1.1 or later

CLASSIFICATION

- Type BF Equipment
- Internally powered equipment
- Continuous operation

- Read Instruction Manual

CAUTION

RxOnly

- US Federal Law restricts this device to sale by or on order of licensed health care practitioners.

WARNING

- Do not operate active sensor within 10 feet (3m) of an operating cellular phone, similar radio transmitting device, other powerful radio interference producing sources such as arc welders, radio thermal treatment equipment, x-ray machines or any other equipment that produces electrical sparks.
- All encoders are totally isolated from line (110 or 220VAC) power due to battery operation and fiber optic connections to computers. However, many hospitals and the FDA require that computers, printers and any other equipment used with medical devices be electrically isolated from line voltage to UL or CSA medical safety standards.
- Do not connect inputs or outputs of the encoder or sensors to line powered devices, except through the fiber optic cable.
- The PC used with the encoder must be placed outside the patient/client environment (more than 3 meters or 10 feet) or the PC must comply with EN60601-1.1 (system safety).
- After use, the disposable electrodes may be a potential biohazard. Handle and, when applicable, dispose of these materials in accordance with accepted medical practice and any applicable local, state and federal laws and regulations.
- To diminish the risk of spreading communicable diseases, always use good hygiene practices with reusable electrodes, particularly if abrasive substances are used. In all cases, refer to your facility's infection control procedure.
- Do not use in the presence of a flammable anesthetic mixture with air or with Oxygen or Nitrous Oxide.
- Not to be immersed in water.
- Take care in arranging patient and sensor cables to avoid risk of patient entanglement or strangulation.
- The operator is responsible for ensuring the safety of any devices controlled or triggered by Infiniti equipment or software, or by any software or hardware receiving data from Infiniti equipment. Infiniti equipment must not be configured or connected in such a way that failure in its data acquisition, processing or control functions can trigger patient feedback stimulus that poses an unacceptable level of risk.
- Use of any equipment in a biofeedback context should be immediately terminated upon any sign of treatment-related distress or discomfort.
- Not to be connected to a patient undergoing MRI, Electro surgery or defibrillation.

ATTENTION

- To prevent static discharge from damaging the sensor and/or encoders, use antistatic mats or sprays in your working area. A humidifier may also be used to help prevent static environments by conditioning hot, dry air.
- Not for diagnostic purposes. Not defibrillator proof. Not for critical patient monitoring.
- To prevent voiding warranty by breaking connector pins, carefully align white guiding dot on sensor plug with slot on sensor input.
- Make sure to remove electrodes from sensor snaps immediately after use.
- Apply conductive gel only to electrodes; never put gel directly on sensor snaps.
- Always use electrodes between the subject and the sensor.
- Sharp bends or winding the fiber optic cable in a loop smaller than 4 inches (10cm) may destroy the cable.
- A fiber optic cable not fully pushed into its receptacle may cause the unit not to operate; make sure that both ends of the cable are fully inserted into their receptive jacks and the nut is tightened firmly.
- Do not plug third party sensors directly into instrument inputs. Plug only Thought Technology active sensor cable connectors into instrument inputs. All electrodes and third party sensors must be connected to active sensors, either directly or through an adapter.
- Remove batteries when the device is not being used for extended period of time. Please dispose of battery following national regulations.

INTENDED PURPOSE

- Biofeedback, relaxation and muscle re-education purposes.

CONTRAINDICATIONS

- None.

NOTE

- No preventative inspections required; maintenance must be performed by qualified personnel.
- The supplier will make available, upon request, circuit diagrams, component parts lists and description or other information required for the repair of product by qualified personnel.
- If a fiber optic or patient cable is damaged or breaks, please replace it.
- Due to the essential performance and intended use of the device, testing for immunity to electromagnetic disturbances was not required and was not performed. The device may be susceptible at levels below IEC60601-1-2 immunity test levels.
- The operator must be familiar with typical characteristics of signals acquired by this equipment, and be able to detect anomalies in the acquired signal that could interfere with treatment effectiveness. Depending on the importance of signal integrity, it may be advisable to continuously monitor the raw signals, in time and/or frequency domain, while the device is being used for biofeedback or other purposes. If anomalies are observed on acquired signals, and if you suspect a problem with electromagnetic interference, contact Thought Technology for a technical note on identification and remediation.

MAINTENANCE AND CALIBRATION

- Wipe encoder with a clean cloth.
- Factory testing and calibration ensure equipment accuracy and frequency response. The user may invoke a self-calibration function that will recalibrate certain device parameters (see section in hardware manual). Contact Thought Technology for factory recalibration if necessary.

STORAGE

- Store in its original case.
- Temperature — -23 to +60C (-9.5 to 140F)
- Humidity (Non-condensing) — 10% to 90%
- Atmospheric Pressure — 70 to 106 kPa

TRANSPORTATION

- Transport in its original case.
- Temperature — -23 to +60C (-9.5 to 140F)
- Humidity (Non-condensing) — 10% to 90%
- Atmospheric Pressure — 70 to 106 kPa

Guidance and manufacturer's declaration - electromagnetic emissions		
The Infiniti system is intended for use in the electromagnetic environment specified below. The customer or the user of the Infiniti system should assure that it is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment - guidance
RF emissions, CISPR 11	Group 1	The Infiniti system uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions, CISPR 11	Class B	The Infiniti system is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions, IEC 61000-3-2	Not applicable	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Not applicable	

Manual No. SA8021 (February 2017)

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Introduction

The Peak Performance Suite is designed to provide you with an integrated set of simple tools to put individuals in a better physiological state to perform. This includes athletes, performing artists, and business people.

With the suite, you can perform quick evaluations that will help you assess a person's reaction to stress and see how well they can return to a state of relaxation. You can also teach the person valuable self-regulation skills to help them become aware of their own physiological responses, learn to rapidly return to a restful state after a physical or mental challenge and voluntarily enter or exit a state of readiness. By teaching these three new skills to high achieving performers, you can help them gain the edge that they need to better manage their physical and mental resources, access a state of readiness at the appropriate time, and stop negative thoughts and emotions from interfering with a performance.

The suite works with the Thought Technology Ltd. ProComp Infiniti, a clinical grade 8 channel physiological data encoder, a number of physiological sensors to monitor respiration, heart rate, peripheral temperature, skin conductance, muscle tension and brainwaves, the BioGraph Infiniti multimedia biofeedback software system and all the assessment, training and reporting tools you need to better understand the dynamics between physiological state and performance.

The Peak Performance Suite was designed in collaboration with Dr. Pierre Beauchamp, Ph.D. who has over thirty five years of experience in sport psychology with the Canadian Olympic Association and various national Sport Organizations.

This reference manual will guide you through the process of learning how to use your equipment, including:

- Connecting the device to the computer (Hardware Setup, page 9).
- Hooking-up sensors to the client (Sensor placement, starting on page 11).
- Using the software to evaluate a performer's physiological responses (Physiological Evaluations, page 18) and do self-regulation training (Self-Regulation Training Sessions, page 28).
- Using the software to review sessions (Reviewing Sessions, page 27) and generate reports (Generating Reports, page 27).

> Psychophysiological assessment and training tools for HRV, physiological biofeedback and neurofeedback are increasingly integrated with sport psychology services for professional and Olympic level athletes (Beauchamp et al., 2012; Blumenstein et al., 1995, 1997; Collins & McPherson1996; Dupee et.al, 2015; Strack, 2003; Lagos et al., 2011; Wilson & Peper, 2011; Zaickhowsky, 1982, 1983).
>
> In the biofeedback domain there are many clinical software packages designed specifically for therapy and diagnosis, however, in the optimal performance domain there are very few software packages that are specifically designed for performance enhancement.
>
> ***Expert Discussion from Dr. Beauchamp***

Overview

Most physiological processes related to stress are unconscious; people are generally not aware of them. When asked, someone can affirm that they are feeling "very relaxed", even though anyone can demonstrate the opposite by simply placing their hands on their shoulders and give the trapezius muscles a gentle squeeze. The effects of repeated or chronic stress on physiology are well documented and can lead to serious health problems. The Peak Performance Suite provides tools to assess these responses, increase the performer's awareness of these responses, and train the performer to regulate them, increasing the likelihood of higher performance.

- The Stress Evaluation allows you to observe the physiological processes engaged when responding to stressful situations - as they are happening.
- The 5 and 10 minute heart rate variability evaluations are perfect ways of visualizing, specifically, the cardiovascular system adapting to stress while assessing its range of variability.
- The Best vs Worst performance evaluation allows you to contrast and highlight a person's physiological reaction to perceived success or failure.
- The HRV Resonance frequency evaluation is used to pinpoint the breathing rate that will exercise the cardiovascular system most effectively.

With the self-regulation programs, you can train and optimize physiological processes.

- Using the respiration training program, you can teach proper abdominal breathing techniques that energize the body and enhance blood oxygenation.
- Go beyond breathing with the heart rate variability exercises to directly entrain the cardiovascular system and maximize its ability to adapt to new challenges.
- With the EMG-based training program, you are able to increase body awareness and help people learn to recognize and control of undue muscle tension.
- Through skin conductance and temperature training, bring the dynamics of stress into view and increase a person's awareness of normally unconscious responses to mental or physical challenges.
- Finally, with the EEG-based training program, you can bring to the surface the mental processes of attention and focus, teaching people to voluntarily concentrate or relax their mind.

Psychophysiology

Psychophysiology is the branch of psychology which concerns itself with the powerful relationship that exists between mind and body. The effects of the mind over the body are well known: Any performer is highly aware of the fact that letting nervousness and overthinking bother them just before an upcoming event will cause sweaty palms, shortness of breath and tension in the neck and shoulders. The effects of the body over the mind are less known but just as remarkable: Sitting down quietly and taking a few slow breaths or going for a brisk walk around the block will help reduce anxiety and refresh the mind. Self-regulation is a potent technique that helps people harness these processes to make them work for, instead of against success.

Autonomic Nervous System

Homeostasis is the body's sophisticated and natural mechanism which ensures as much physiological stability as possible while navigating through life's everyday challenges. The autonomic nervous system (ANS) is the control center of all unconscious bodily functions; it automatically manages heart rate,

breathing rate, blood pressure and the function of the various organs through elaborate physiological mechanisms which are outside of the scope of this manual. The ANS is composed of two main divisions, the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). Those two systems complement each other and regulate physiological processes in response to external or internal stimuli by either accelerating or decelerating physiological reactions. When a stress stimulus occurs, the SNS responds by ramping up heart rate, breathing rate and blood pressure (among other factors). Getting ready to act pushes the body out of its normal point of equilibrium. Once the stressful situation is over, the PNS kicks in to slow things down and the body returns to its equilibrium. Homeostasis is not a flat line. It is a sequence of upward and downward tendencies. One system accelerates the physiology to increase arousal and the other puts the breaks on to decrease arousal and restore the natural equilibrium.

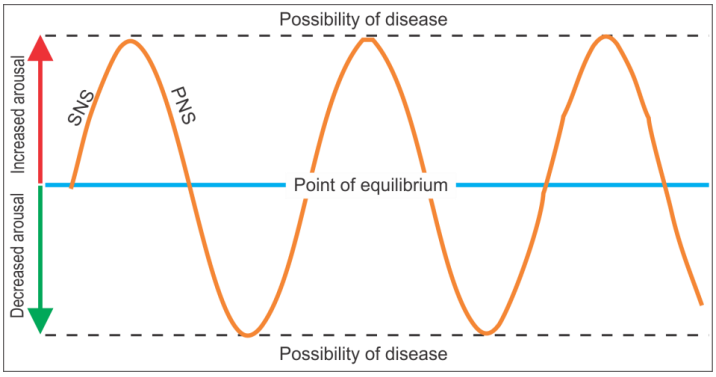


Figure 1: Homeostasis

High level performers frequently experience intense physical and mental challenges which put their physiological responses into high gear. The resulting wear and tear is called allostatic load. In time, the cumulative effects of repeated or chronic stress can cause damage to a person's body. The result is either adaptation or physical change. The person's ability to maintain a healthy autonomic balance is primordial to continued health and ability to perform. Teaching self-regulation skills to high level performers gives them the ability to reset their autonomic balance and restore a healthy point of balance. It also enhances a person's perceptions of control and increases confidence.

Respiration Training

Learning to breathe properly and effectively is the foundation of all peak performance training. Many performers breathe superficially and use the rib cage and shoulders to breathe, instead of the abdomen. Under stress people tend to either stop breathing - getting ready to act - or start breathing very rapidly and shallowly. Although fairly common, these breathing patterns tend to promote anxiety. The main goals of respiration training are to (1) help people become aware of their default breathing habits and (2) help them learn more efficient breathing skills. Respiration training teaches:

- How to become aware of when we are breathing rapidly and shallowly and consciously deciding to lengthen and slow the breath. This overrides anxiety and triggers the relaxation response.
- How to breathe abdominally instead of with the rib cage or shoulders. This increases the intake of air and favors a more efficient blood oxygenation.
- How to power breathe with circular breathing techniques. These techniques are highly energizing just prior to a performance.

Abdominal Breathing

Slow diaphragmatic breathing exercises are commonly taught in many stress management classes because they naturally promote relaxation. For this exercise to be done properly, the person has to breathe from the abdomen, instead the chest or shoulders. Have the person place a hand, flat over their belly button while breathing and encourage them to feel the hand move outward when inhaling and inward when exhaling.

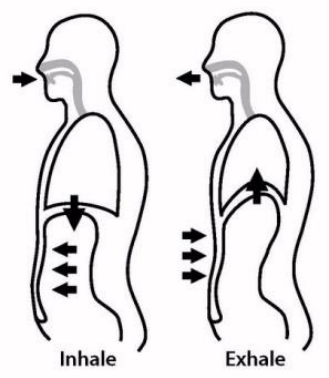


Figure 2: Abdominal breathing. Illustration from: Gorter, R. & Peper, E. (2011). Fighting Cancer-A Non Toxic Approach to Treatment. Berkeley: North Atlantic

If you notice chest expansion or shoulder movement while breathing abdominally, coach the person to become aware of extraneous movements and try to inhibit them. Also, pay particular attention to overly deep and effortful breathing. Breathing too deeply can lead to over breathing and cause dizziness. Have the person reduce the depth of their breathing until it becomes slightly uncomfortable and then increase the depth of their breaths just enough to be comfortable again. Have them practice breathing like this on their own before starting with the exercise.

Paced Breathing

By nature, people tend to breathe fairly irregularly; taking air in only when it is necessary. Paced breathing exercises involve using a respiration pacer to guide the person to regularize breathing patterns. By default, the pacer is set to 6 breaths per minute with a slightly longer time to exhale than to inhale. This is comfortable for most people but you can adjust the pacer settings if the person is not accustomed to this breathing method and finds it uncomfortable. (The pacer is described in more detail further down in this document.)

Respiration Sinus Arrhythmia (RSA)

Self-regulation training with paced breathing commonly amplifies the effect of respiratory sinus arrhythmia (RSA). RSA is a naturally occurring phenomenon during which breathing has a direct effect on changes in heart rate. Breathing in will make the heart rate accelerate (upward trend) and breathing out will make it decelerate (downward trend). While breathing “normally”, RSA is minimal but the effect becomes very significant when breathing slowly and regularly. RSA is best observed on a graph that shows breathing and heart rate together.

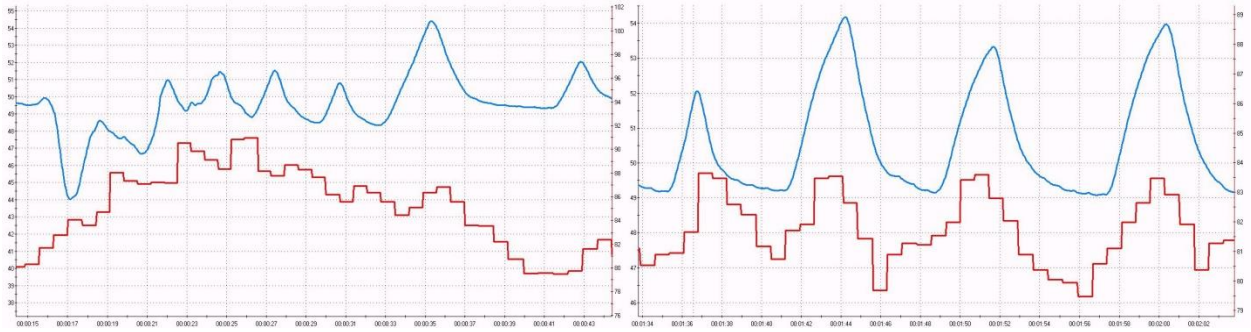


Figure 3: RSA during irregular breathing and slow deep breathing

Circular Breathing

Circular breathing is a slightly modified form of abdominal breathing where the in and out duration are set to be equal with no hold periods. Additionally, the person should be guided to breathe in through the nose and out through pursed lips. This breathing method is energizing and should be used as part of the preparation to any performance.

Just like physical training is used to strengthen body muscles or increase endurance, respiration training is essential to help high level performers maintain optimal respiratory capacity and adaptability. As a coach, monitoring respiration patterns also allows you to detect unconscious signs of stress, such as breath holding or using accessory muscles to breathe.

Heart Rate Variability Training

Heart rate variability training goes beyond respiration training by engaging and exercising the cardiovascular system and providing a direct means of influencing the autonomic balance. Our modern society's preference for high productivity and extreme lifestyles can put us under constant pressure and create a chronic dominance of SNS activity – which can have negative health consequences. Elite performance environments significantly increase the levels of pressure on the performers. Whether it is caused by high-stakes competition, financial rewards, or fame, this pressure can have a tremendous negative impact on the performer's ability to stay in a state of readiness. An autonomic balance tending towards high SNS activity can also negatively influence a performer's decision making abilities and cause a lot of rumination. HRV training helps people counteract SNS over activity by teaching self-regulation skills that (1) automatically engage the PNS slow down and (2) maximize a performer's ability to physiologically adapt to environmental demands.

HRV and Recovery

What's more, when working specifically with athletes, the HRV evaluations are powerful tools for measuring recovery after training routines or competition because they can give you a reliable reading of the cardiovascular system's recuperation level. Sympathetic overdrive should be avoided because it may lead to overtraining, burnout or overreaching. Practicing regular self-regulation exercises also speeds up the athlete's ability to restore a healthy equilibrium between the SNS and PNS (homeostasis).

The suite's HRV tools allow you to evaluate and assign appropriate training loads by:

- Pushing an athlete's performance without risking injury.
- Helping recover more effectively from competition.
- Recognizing warning signs of fatigue.

- Preventing overtraining and burnout.
- Tracking and monitoring rest and recovery throughout the season.
- Increasing metrics for more efficient athlete management.

Understanding HRV

There are many metrics that reflect HRV. In broad terms, they fall in two categories: Time domain and frequency domain statistics. Time domain metrics look at changes in the sequence of beats over time, such as speed, regularity and timing difference between consecutive beats. The frequency domain metrics look at the waviness of the IBI signal.

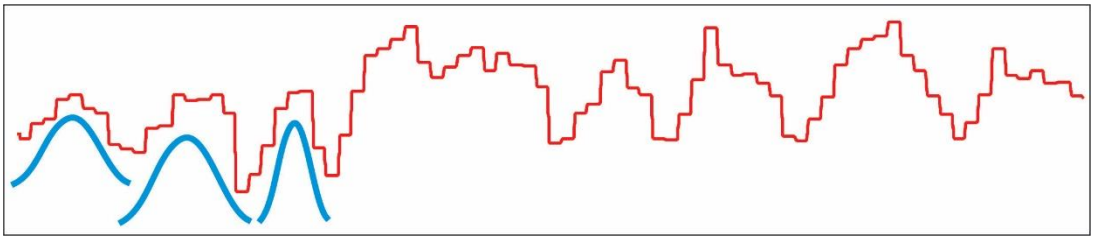


Figure 4: Time domain distribution of IBI values

In general, frequency domain metrics are calculated by analyzing a section of IBI data (64 seconds worth) with a fast Fourier transform (FFT), which identifies the frequency of each wave it finds in the data chunk and generates a frequency distribution graph (power spectrum). The tallest bar in the graph represents the frequency that is the most represented.

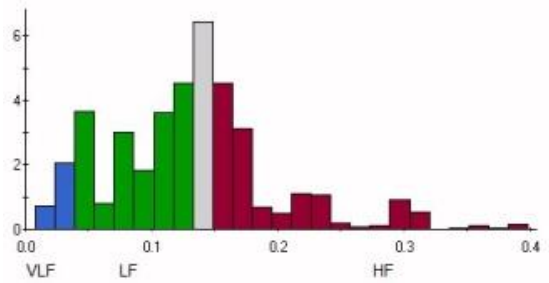


Figure 5: Frequency distribution

When the person is breathing at 6 breaths per minute, each breath cycle takes 10 seconds (60 seconds / 6). Because of RSA, the heart rate's dominant oscillation will be of the same duration (period). Since the unit of frequency (Hertz) is expressed in waves per second, a 10 second long wave is actually a 0.1 Hertz wave. On the HRV spectrum, you should see a peak frequency bar at around 0.1 Hz.

The whole spectrum is divided into the three bands of interest, VLF, LF & HF. The Peak Performance Suite specifically tracks a few of the key HRV metrics:

Time Domain

- RMSSD: The square root of the mean squared difference between adjacent inter-beat intervals (IBI).
- SDRR (or SDNN): Standard Deviation of IBI.
- HR Max-Min: The span between the minimum and maximum heart rate value during a breath cycle.

Frequency Domain

- HRV frequency bands: The frequency domain analysis of HRV looks at the total power and percentage of total power within specific frequency bands of the HRV spectrum that are associated with known physiological processes. The moment to moment shifts in power distribution between three ranges: Very low frequency (VLF), low frequency (LF) and high frequency (HF) give an indication of the changes in the dominating process influencing heart rate. Generally, VLF, LF and HF power changes reflect changes in sympathetic/parasympathetic nervous system activity (SNS & PNS).
- LF/HF ratio: Generally interpreted as a representation of the balance between SNS & PNS activity.

Skin Conductance and Temperature Training

Classical self-regulation training using skin conductance and temperature is generally used to help a person become aware of adverse unconscious physiological responses to stress. Stress is an essential and unavoidable part of any performer's life. In 1979, Nixon P. published the Stress Response Curve, which illustrates how performance is improved by a certain amount of stress, but then rapidly decays if the stress level (arousal) crosses the fatigue threshold.

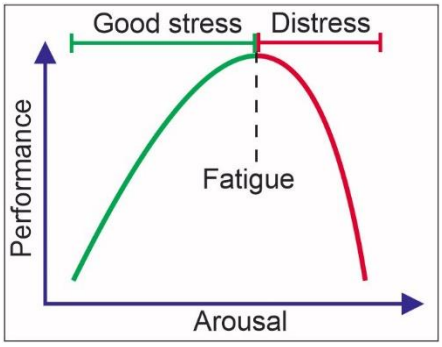


Figure 6: Stress Response Curve

When managed properly, stress appropriately prepares the body to do what needs to be done. Unfortunately, many performers have a negative relationship with stress, allowing fear and anxiety to settle in, which triggers negative thoughts and puts them in a less than optimal state of mind. After a bad performance, people may also have a great difficulty letting go of the negativity, which delays their ability to recuperate and get ready for the next performance. This negative reinforcement cycle can have a catastrophic effect on the ability to perform. Without proper stress management techniques, one bad experience can lead to a series of failures.

When an event occurs, that demands immediate action, the SNS activates and triggers the classic "fight or flight" reaction. When this happens, the eccrine glands on a person's hands and feet start secreting tiny amounts of sweat. The skin conductance sensor detects the changes in electrical conductivity that occur because of the increase in moisture on the skin. The resulting measure reflects arousal, whether positively or negatively experienced.

The SNS activation also causes vasoconstriction in peripheral circulation (hands and feet) in order to shunt blood circulation towards body parts more important to survival. The temperature sensor picks up on the changes in skin temperature that occur because of the resulting decrease in blood flow to the extremities.

Teaching high-level performers practical self-regulation techniques gives them the tools they need to perceive the stress response as it is happening, channel the physiological changes it engages in a more productive manner and avoid any harmful response.

Muscle Tension Training (EMG)

Electromyography (EMG) detects the electrical impulses generated by muscle fibers when they contract. During any movement, many muscles are engaged in synchrony to achieve smooth and efficient action. The voluntary "somatic" nervous system (SNS) controls muscular activity by recruiting more or less muscle fibers in individual muscles. An EMG sensor, placed over a specific muscle, will pick up signals that are proportional to the number of fibers that are recruited at any moment.

At rest, EMG activity should become very low because no muscle fibers are being recruited. Under chronic or repeated stress situations, certain muscles of the body may not be able to return to resting values. "Residual" muscle tension can cause back, shoulder or neck pain and lead to increased fatigue and wear and tear. High resting muscle tension also impedes blood flow and slows down healing.

Muscle tension training helps performers become aware of residual tension and teaches them to voluntarily relax specific muscle groups before or after a performance. It can also be useful to retrain any maladaptive habits, such as muscle guarding, which may reduce flexibility and decrease muscular efficiency.

Brainwave Training (EEG)

The presence of certain brainwave frequencies during specific mental states has been observed for many years. During sleep, for example, slow (delta) waves can be observed across the brain. When a person is deeply relaxed and daydreaming, alpha waves can be recorded over the posterior areas of the brain. With intense mental processing, such as when resolving a mathematical problem, high frequency beta waves become dominant in the frontal areas.

Neurological regulation is a relatively new area of interest in psychology. Until recently, it was broadly believed that brainwaves were outside our conscious control. Teaching someone to voluntarily shift the dominant frequencies of brain activity towards faster or slower brainwaves is a very recent practice which has clinical and optimal performance applications. The Peak Performance Suite includes two types of brainwave training:

1. Alpha training (8-12 Hertz) is useful to help high-level performers disengage their mental activity at will and put their brain in idle mode. Alpha training promotes relaxation and has been associated with enhanced cognitive performance.
2. Sensory motor rhythm training (12-15 Hertz) sharpens body awareness and improves attention and focus.

Often, athletes are assessed against their own personal baselines, self-reported ratings, or in relation to their best and worst performances. At this juncture, there are no published norms for athletes by sport, however, a few studies have reported patterns of EEG responding that differentiate high performers from their low performing teammates and a general EEG pattern in elite athletes is beginning to emerge.

For the purpose of the Peak Performance Suite, only one channel of EEG is necessary and the active electrode should be placed on CZ. (EEG sensor placement instructions are on page 15.)

Getting Started

Hardware Setup

Before you can start recording a session, you have to set up your hardware. The following section describes how to connect a ProComp Infiniti device.

Connecting TT-USB and ProComp Infiniti

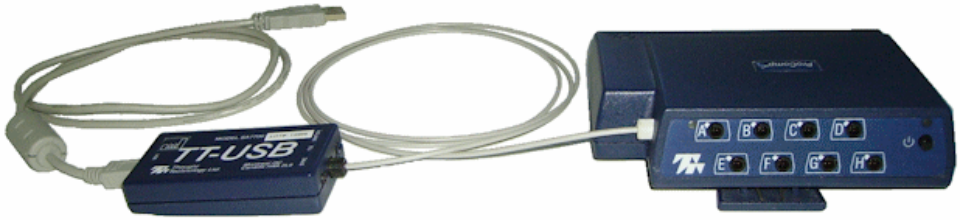
Insert one end of the fiber optic cable carefully into the fiber optic port on the encoder. Tighten the nut gently so that the cable won't slip out.

Do the same with the other end of the fiber optic cable and the fiber optic port of the TT-USB interface unit.

Insert the small connector of the USB cable into the USB port on the TT-USB interface device.

Insert the large connector of the USB cable into the USB port of your PC.

USB ports on a PC are generally located at the back of the base unit. You may also find a USB port at the front of your base unit; you can connect the other end of the USB cable to it. On a laptop, USB ports are usually located at the side or the back of the laptop. It is recommended to always use the same USB port for connecting the TT-USB to your computer.



Battery Placement

Opening the Compartment

Looking at the underside of the ProComp Infiniti device, you will see a long door in the plastic enclosure. Holding the encoder with the connectors facing you and with the door up, push lightly down and back with your thumbs on the door to slide it open.

***Attention**:* The internal workings of the ProComp Infiniti encoder are not intended to be opened for repair except by qualified service personnel. The tamper-evident seal under the batteries in the battery compartment should not be removed or broken. Thought Technology may refuse to honor the unit's warranty if the seal is broken.

Polarity

When the compartment cover has been slid out, place four AA batteries in the slots, observing the correct battery polarity as embossed on the inside surface of the compartment.

Closing the Compartment

Slide the door back into the ProComp Infiniti case, gently pushing it in until you feel the click of the locking mechanism.

Monitoring the Battery Level

Since each sensor draws a small amount of power from the batteries when connected to the ProComp Infiniti, it is better to connect only the sensors that are going to be used for a session before you start recording; this will ensure maximal battery life. Most Thought Technology software applications will display a battery power indicator; we recommend that you replace the batteries as soon as this indicator falls below about 50% of the battery power.

Caring for the Fiber Optic Cable

A fiber optic (FO) cable is used for transmitting the sensor data to the computer. Although this technology provides maximal electrical isolation, signal fidelity and freedom of movement, some care has to be taken when handling the fiber optic cable, as it is much less flexible than a regular electric wire.

Be careful not to bend it sharply or wind it in a loop smaller than 4 inches in diameter.

Sensors

The Peak Performance Suite is designed for use with the ProComp Infiniti encoder and seven physiological sensors. Two types of heart beat sensors can be used, blood volume pulse (BVP) or electrocardiograph (EKG), depending on your preference. When the suite was installed on your system, the choice was made to either install only one or both configurations.

The sensor input configuration is as follows:

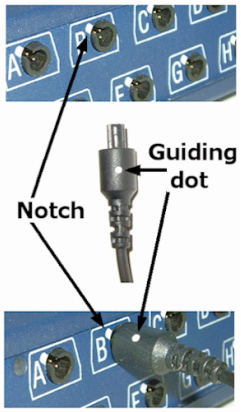
- Input A: Finger Pulse (Blood Volume Pulse, or BVP) or Heart Beat (Electrocardiography, or EKG) to record heartbeats.
- Input B: Not used.
- Input C: Muscle Tension (Electromyography, or EMG) to record muscle tension.
- Input D: Muscle Tension (EMG) to record muscle tension.
- Input E: Arousal (Skin conductance, or SC) to record arousal.
- Input F: Temperature (Temp) to record finger temperature.
- Input G: Respiration (Resp) to record breathing patterns.
- Input H: Brainwaves (Electroencephalography, or EEG) to record brainwaves.

When recording sessions, you can connect all the sensors or just the one(s) you will need to train. During a session, the signal from any sensor that is not connected is replaced by a constant value of 1.

This section of the manual describes the various sensors, how to connect them to your encoder, and how to hook them up to your client.

Connecting the Sensors

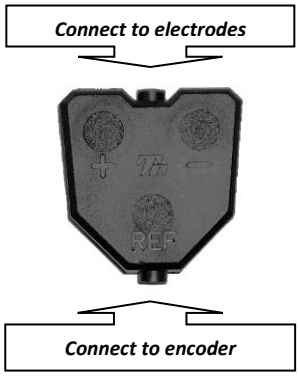
When connecting a sensor to the ProComp Infiniti, make sure to properly line up the guiding dot on the top of the plug with the notch in the protected pin socket. Forcing the plug into the socket in any other position may damage the equipment.



Correct Orientation of Sensors

For some sensors, such as the temperature and skin conductance sensors, either the connection cable or the electrode cable forms a permanent part of the item. Other sensors, for example the push button switch, have removable cables but only a single input entrance. This makes it impossible to connect these sensors in the wrong orientation to the encoder.

Certain sensors, however, have removable cables and two input entrances. It is important to orient these sensors to the encoder correctly so that the physiological signal is properly received. These sensors include the EKG, EEG, and EMG sensors, all of which are shaped like the illustration at the right.



Such a sensor is correctly oriented to the encoder when the cable joining them is connected to the bottom entrance of the sensor. If an extender cable with electrodes needs to be attached to such a sensor, it should be connected to the top entrance of the sensor.

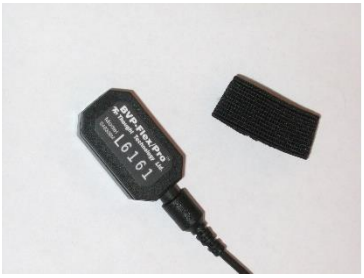
Sensor Placement

HR/BVP Sensor (P/N: SA9308M)

The HR/BVP sensor is a blood volume pulse (BVP) detection sensor (also known as a photoplethysmography – PPG – sensor) housed in a small finger worn package, to measure heart rate (HR) and provide BVP amplitude, BVP waveform, HR and heart rate variability (HRV) feedback.

An elastic strap is provided with the sensor.

The BVP sensor does not require skin preparation as it is placed directly in contact with the skin. Place the sensor against the fleshy part of the first joint of any finger and hold it in position using the elastic strap.



EKG Sensor (P/N: SA9306M)

The EKG sensor is a pre-amplified electrocardiograph sensor, for directly measuring the heart's electrical activity. It connects via extender cables for a single channel hook up.

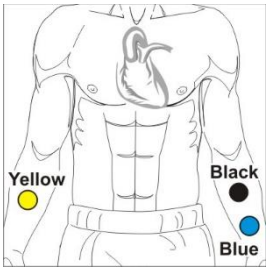
A 3 snap extender cable is provided with your sensor.

Cleaning the skin with an alcohol pad prior to applying the electrodes helps improve the signal. For optimal contact between the electrode and the skin, it is recommended to use conductive gel.

Make sure the electrodes are placed firmly on the skin and that there is good contact between the skin and the electrode.

Arm Placement

One electrode placement uses the forearms, as indicated in the illustration. The yellow electrode is on the right arm and the other two are on the left arm.



Ideally, an area with little or no hair is preferred. The arm placement is more susceptible to artifacts, particularly interference caused by arm and chest muscle activity.

Wrist Placement

The forearm electrode placement requires the use of an extender cable with longer leads like the one that is sold with the EKG Wrist straps (SA9325). The wrist straps provide the easiest placement method for EKG signal detection.

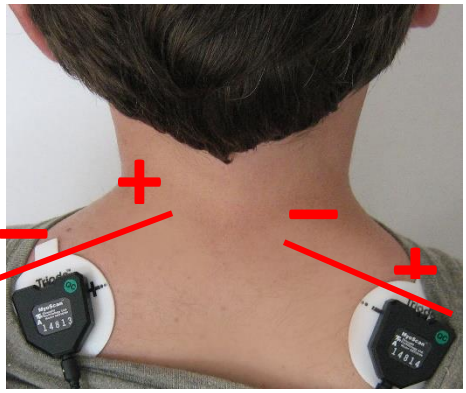
MyoScan-Pro EMG (P/N: SA9401M-60 or SA9401M-50)

The MyoScan-Pro is a pre-amplified surface electromyography sensor for use on low sampling rate encoder inputs and designed to measure root mean square (RMS) SEMG.

Affix a triode on each MyoScan-Pro sensor.

Clean the skin with an alcohol pad and remove the cover from the Triode electrode. Line up the positive and negative electrodes with the muscle fibers and apply the sensor to the skin, making sure it is well over the muscle belly.

The illustration shows sensors placed on the trapezius muscles.

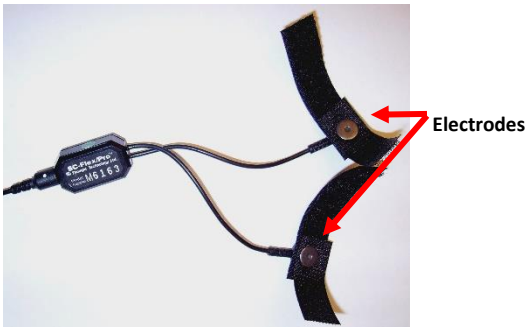


Skin Conductance Sensor (P/N: SA9309M)

The Skin Conductance sensor measures the electrodermal response of the skin, and is normally connected to the fingers or toes. Supplied with two finger bands.

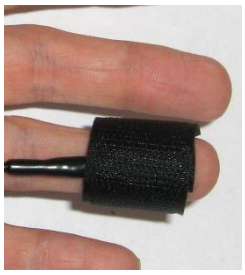
There are two finger straps attached to the skin conductance sensor.

The conductive electrode in each finger strap should be placed against the inside part of the finger.



Close the hook and loop fasteners around the fingers so that contact is snug yet comfortable.

Skin Temperature Sensor (P/N: SA9310M)



The Temperature sensor measures skin surface temperature between 10°C – 45°C (50°F - 115°F). It is supplied with a self-adhering band for easy finger placement.

This device converts changes in temperature to changes in an electrical signal. The body's peripheral temperature, as measured on its extremities, will vary according to the amount of blood perfusing the skin. This, in turn, is dependent on the client's state of sympathetic arousal. As a person gets stressed, their fingers tend to get colder. Relaxation training involves learning to voluntarily increase the finger temperature.

The temperature sensor can be strapped to the dorsal or palmar side of any finger or toe using the short strip of “hook and loop” fastener provided with the sensor. Remember to clean the thermistor bead with an alcohol wipe between clients.

Respiration Sensor (P/N: SA9311M)

The respiration sensor is a sensitive girth sensor worn using an easy fitting high durability woven elastic band fixed with a length adjustable webbing belt. It detects chest or abdominal expansion/contraction and outputs the respiration waveform.

The sensor is latex-free, magnet-free, and Velcro-free, and can be worn over clothing.

The three straps (respiration sensor strap, elastic strap, and belt strap) are buckled together, and then placed around the client's torso.

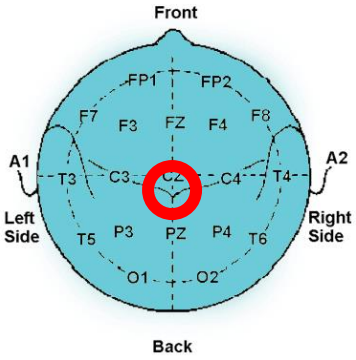
Open the plastic cam lock and then slide it to adjust the strap tension. Ask the client to breathe out as fully as possible and close the cam lock to attach the sensor so there is minimal tension. The fit should be snug enough that the strap stays fixed when the client has fully exhaled.

EEG-Z Sensor (P/N: SA9305M)

The EEG-Z is a pre-amplified electroencephalograph sensor with built in impedance sensing capabilities. This sensor can be toggled to record regular EEG or monitor skin impedance (both the reactive and resistive elements) to help optimize electrode hook-up.

Some skin preparation is required before placing the EEG sensor. Directions for skin preparation follow.

The EEG sensor goes at the top of the head, at the site labeled CZ, shown below.



Skin Preparation

The scalp must be prepared before an electrode can be fixed. This involves slightly abrading the skin to remove dead skin, sweat and other contaminants to the EEG signal.

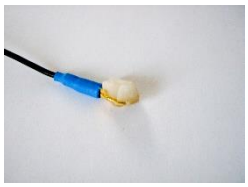
1. Scoop up a small quantity of skin prepping gel on a cotton swab or tissue.

2. Separate the hair around the CZ electrode site and rub the gel gently along the scalp.

3. Wipe away any excess prepping gel with a dry cloth, and smear a small amount of conductive paste on the newly prepared site.
4. Do the same for the ear lobes where the reference and ground electrodes will be placed.

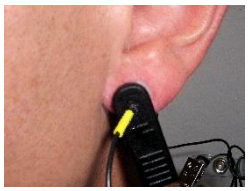
Electrode Placement

1. Lightly fill the cup of the blue electrode with conductive paste.



2. Place the cup face down on the CZ electrode site, and gently push the electrode down to fix it to the scalp.

3. Lightly wipe the disks of the black and yellow earclip electrodes with conductive paste, and then clip them to the ear lobes.



Entering Software Key Codes

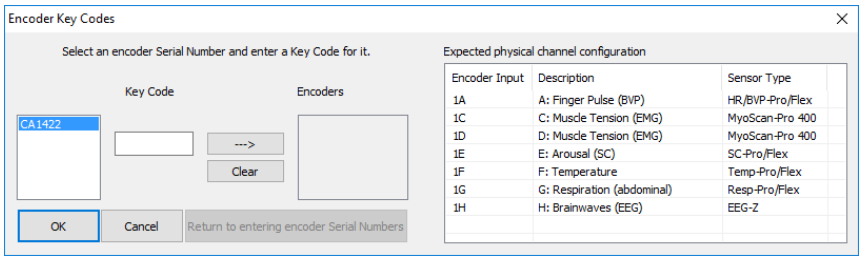
The first time you use an encoder to record a session, the BioGraph Infiniti software will check for its key codes and ask you to enter them. This registers the encoder with the software, and you won't need to enter the key codes again.

Note: *If you have more than one encoder, you will need to enter key codes for each unit the first time you use it to record a session.*

---

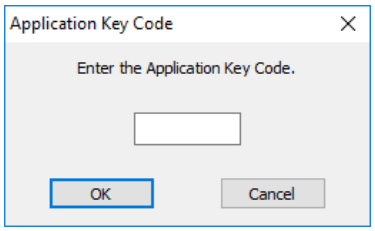
1. Click **Quick Start**, select a name from the **Clients** list and a protocol from the **Favorites** list, and then click **OK**.

   The **Encoder Key Codes** dialog box opens.
2. Click to highlight your unit's serial number in the left table (in this example, CA1422; this is the same number as on the back of the encoder).



3. Enter the **Encoder Key Code** (found inside the encoder battery compartment) in the **Key Code** text box.
4. Click ---> to move the serial number from the left table to the right table.
5. When the serial number appears in **Encoders**, click **OK**.
6. When the **Application Key Code** dialog box opens, enter the Application Key Code.

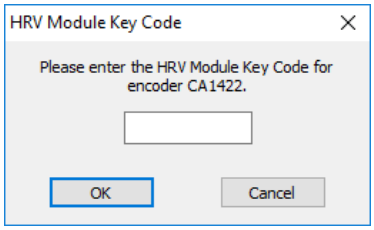
   This number is found in the battery compartment with the encoder key code.
7. When done, click **OK**.



If the key codes have been entered properly and there is no problem with your encoder setup or your sensor connections, the recording screen will open.

Note: *Detailed instructions for using the software are provided in document SA7913,* ***Getting Started with BioGraph Infiniti****, which is provided with BioGraph Infiniti. When the software is running, you can also access context-sensitive on-line help by pressing the F1 button.*

The CardioPro Infiniti HRV Analysis Module also requires you to enter a Key Code the first time you use it to review a session recorded with a specific encoder.



Using the Peak Performance Suite

Psychophysiological assessment and training tools, including biofeedback and neurofeedback, are increasingly integrated with peak performance coaching services for professional performers, including athletes, performing artists, and business people. The Peak Performance Suite is designed to include all you need to evaluate and train key physiological processes essential to peak performance. With the suite, you can:

- Run periodic assessments of a person's status using any one of five physiological evaluation protocols.
- Generate easy-to-understand reports to help track progress.
- Use physiological and neurological self-regulation training to improve physiological resilience.

Physiological Evaluations

The Peak Performance Suite includes a number of assessment tools which allow you to monitor change and track progress over time. The evaluations are scripts which run automatically and guide you and the person you are evaluating through the process, step by step. In order to keep each session to a minimum, the scripts are designed to be as short as possible while still recording enough data to generate reliable analysis.

- 10 minute HRV evaluation
- 5 minute HRV evaluation
- HRV Resonance frequency evaluation
- Stress evaluation
- Best vs worst performance evaluation

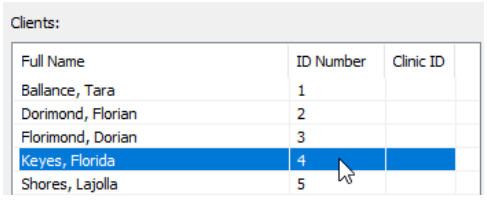
Prior to running any of these evaluations, but especially the three that focus on HRV, it is important to allow the person about five minutes of quieting down, sitting in a chair. This acclimatization period is necessary for the cardiovascular system to regularize itself and settle at a stable baseline level. Running the assessment when the person is not at baseline can skew the evaluation's results.

Running an Evaluation

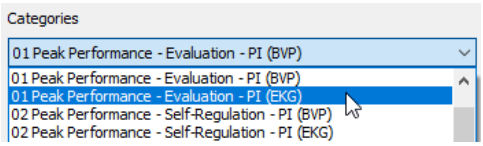
Note: *The first time you use an encoder to record a session, the BioGraph Infiniti software will prompt you to enter key codes. Follow the instructions on page 16 to do so. You will only have to do this once.*

1. Launch BioGraph Infiniti and click on **Quick Start**.

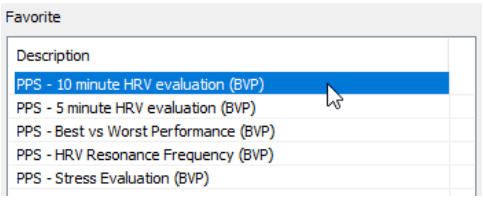
2. In the **Clients** list on the left, select an existing client name or use **Add New Client** to create a record for this client.



3. To display only favorites associated with a specific category, select it from the **Categories** drop-down list.



4. In the list of **Favorites**, select an evaluation script and click **OK**.



5. Ensure that:
   - The sensors are properly placed on the client.
   - The encoder is properly connected to the PC.
   - Your encoder is turned ON.
6. Click the **Start** button  to start the session, and follow the instructions in the screen sequence which follows.
7. When the script ends, click **Yes** to save the session.

Note: *Detailed instructions for using the software are provided in document SA7913,* ***Getting Started with BioGraph Infiniti****, which is provided with BioGraph Infiniti. When the software is running, you can also access context-sensitive on-line help by pressing the F1 button.*

---

10 Minute HRV Evaluation

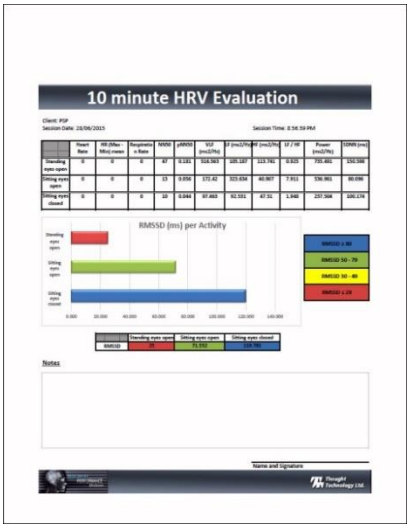
This evaluation is specifically looking at the changes in heart rate variability (HRV) that happen when a person goes through postural and mental attentiveness changes.

Script sequence:

1. Stand for 3 minutes
2. Sit for 3 minutes with eyes opened
3. Sit for 3 minutes with eyes closed

The evaluation looks very specifically at the performer's ability to breathe efficiently in each condition. While people are generally able to breathe from the abdomen in a sitting position, they tend to tense up and breathe more through the chest when standing. As well, sitting with eyes open and then closed will show if the person's breathing becomes more relaxed when their attention is brought inward.

The report specifically focusses on the RMSSD, which is a vagal related heart rate variability index that is preferred when monitoring adaptation to physical training. Measuring RMSSD during resting or post-exercise conditions gives an indication of how well the person is adapting to their training regimen and can show if they are overreaching. A table of other HRV metrics is included.



Rationale

This evaluation was designed as a manipulation check for athletes, to give feedback on the quality of their breathing and to examine levels of fatigue in athlete (Schmitt et al., 2013, 2015). The assessment asks athletes to breathe under three conditions: a) Standing eyes open, b) Sitting eyes open and c) Sitting eyes closed. This manipulation check is designed to highlight the standing condition as to whether athletes have sufficient diaphragmatic breathing amplitude when compared to the sitting condition. Because athletes utilize their breathing during the recovery phases (e.g., General, Dynamic and Specific Preparation) their preparation phase before competition, they would benefit from increased amplitude and higher HRV. Moreover, we can also see whether the eyes closed condition is more effective than the eyes open condition.

Interpretation

The rules for interpreting RMSSD are the same as in the 5 minute evaluation (see the HRV Zone table on page 22).

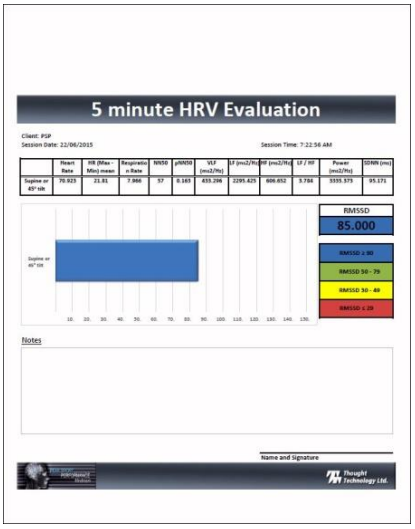
The report above demonstrates excellent breathing while in the seated condition but highlights a weakness in this athlete in his ability to do quality breathing in a standing position. Differences in Total Power and Power Spectrum Frequencies (VLF, LF, HF), when compared to baseline measures may indicate varying types of fatigue in elite athletes (Schmitt et al., 2015). These HRV patterns of fatigue types (Functional Overreaching (FOR), Non-functional Overreaching (NFOR), and Overtraining (OT) executed in both supine and standing conditions may provide sport scientists a quantitative measures from which to assess endurance athletes.

Expert Discussion from Dr. Beauchamp

5 Minute HRV Evaluation

This quick evaluation is useful to take a snapshot of the cardiovascular system's resilience at any moment of the peak performance training. The script is quick to run and simply records 5 minutes of breathing and heart rate data and generates a number of HRV metrics.

As for the 10 minute evaluation, the report shows RMSSD and other key HRV metrics. You can run the 5 minute HRV evaluation every week to give you a longer term view of the person's ability to improve the quality of their breathing and overall heart rate variability.



Rationale

Heart rate variability (HRV) is a physiological cardio biomarker used to assess autonomic nervous function which can be recorded over short or long periods of time. Long-term recordings (e.g. 24-hr. Holter monitor) are a good method for assessing mortality and patient prognosis (SDNN, Standard Deviation of the Normal-to-Normal R to R intervals). They are usually done while patients are in cardiac recovery. Short-term measurements are widely used, due to practical advantages and reproducibility, to assess athletes on a weekly basis.

In sports, HRV is usually measured utilizing RMSSD (root mean square of successive R-R intervals). This time-domain measure is utilized because it is a vagal related heart rate variability index that is preferred when monitoring athlete adaptation to training and measured during resting or post-exercise conditions.

The report also shows frequency-domain measures from the Power Spectrum, including VLF (Very Low Frequency – 0.016-0.04 Hertz), LF (Low Frequency – 0.04-0.15 Hertz) and HF (High Frequency – 0.15-0.4 Hertz). Along with the RMSSD, the power spectrum measurements are the most accurate metrics to utilize when doing short-term HRV measurements. Finally, in terms of methodology for the evaluation, supine with a 45-degree tilt or sitting at 45-degree incline are acceptable methods for conducting the 5min HRV evaluation. For research purposes, please see Schmitt's (2015) methodological stabilization approach with Supine testing procedures.

Interpretation

RMSSD is the root mean square of successive differences between normal heartbeats. This value is obtained by first calculating each successive time difference between heartbeats in milliseconds. Then, each of the values are squared and the result is averaged before the square root of the total is obtained. The RMSSD reflects the beat-to-beat variance in heart rate and is the primary time domain measure used to estimate the vagally-mediated changes reflected in HRV (Shaffer, McCraty, & Zerr, 2014). While the RMSSD is correlated with HF power (Kleiger et al., 2005), the influence of respiration rate on this index is uncertain (Schipke et al., 1999; Pentillä et al., 2001). RMSSD is more influenced by the PNS than SDNN (Gevirtz, 2012). This metric is utilized in sport and military populations to assess fatigue and risk of injury during training.

HRV Zone	Mental Efficacy Range	Accuracy & Decision-Making Speed	Reaction Time	Blood Alcohol Equivalence	Risk of Accident / Serious Error on Job
Blue Zone	Normal	Normal	Normal	Normal	Very Low
Green Zone	Reduced	Reduced	Reduced	Reduced	Somewhat Elevated
Yellow Zone	High Risk	Elevated Risk	High Risk	High Risk	Elevated Risk
Red Zone	**High Risk**	**High Risk**	**High Risk**	**High Risk**	**Very High Risk**

Expert Discussion from Dr. Beauchamp

Resonance Frequency Evaluation

Heart rate variability (HRV) gives a reliable reflection of the cardiovascular system's ability to respond to changing situational requirements. It has been demonstrated that a regular practice of self-regulation exercises aimed at increasing HRV can improve a person's flexibility of adaptation to physical and mental challenges, therefore HRV self-regulation training is an essential component of any effective peak performance training regimen.

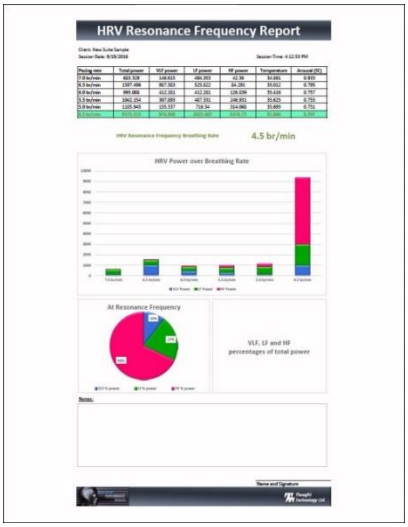
When practicing HRV training, a person is usually asked to breathe slowly and regularly at a given breathing rate. This is most often done with a breathing pacer which gives a visual indication of when the person should breathe in and breathe out to maintain, for example, a constant rate of 6 breaths per minute. Slow regular breathing engages respiratory sinus arrhythmia (RSA), where HRV becomes synchronized with breathing. During the in breath, heart rate increases and during the out breath, it decreases. When breathing at 6 breaths/min, the resulting wavy pattern causes increases in the power of the low frequency (LF) band. The maximum LF power is shown on the screen during each pacing stage.

Research demonstrates that each person has a specific breathing rate which will generate significantly more variability than any other breathing rate. When breathing at that rate, a synergy between two or more physiological factors influencing HRV occurs and the resulting "resonance" augments the power in the LF band even more. The resonance frequency evaluation script allows you to identify the breathing rate that generates the most powerful HRV for a given person.

Script sequence:

1. Breathing for 1 minute at 7.0 breaths/min
2. Breathing for 1 minute at 6.5 breaths/min
3. Breathing for 1 minute at 6.0 breaths/min
4. Breathing for 1 minute at 5.5 breaths/min
5. Breathing for 1 minute at 5.0 breaths/min
6. Breathing for 1 minute at 4.5 breaths/min

The report shows the total power within the whole HRV spectrum and each of the bands. The breathing rate that produced the most total power and the largest proportion of power in the LF band is the breathing rate you want to use for paced breathing exercises.



Rationale

The purpose of resonance frequency assessment is to find the breathing rate that maximizes heart rate variability (HRV), before initiating HRV biofeedback. This breathing rate ranges, among adults, between 4.5 and 7.5 times/minute (Leher & Vaschillo, 2000; Lehrer et al., 2013; Lehrer & Gevirtz, 2014). Specifically, every athlete has an individualized resonance frequency. Respiratory sinus arrhythmia (RSA) is a naturally occurring variation in heart rate that occurs during the breathing cycle. Consequently, RSA is also a measure of parasympathetic nervous system activity - which denotes "rest and digest" behaviors. Once the athlete knows his resonance frequency breathing rate, then all the subsequent breathing exercises are done at his individualized resonance frequency by adjusting the pacer settings. On the resonance frequency report below we can easily see the highest amplitude that occurred in the Low Frequency range in green, was at 7.0 respirations per minute.

Interpretation

Prior to interpreting the report, always visually inspect your data for artifacts and use the artifact rejection function to clean it up. Once you have completed this step, you can then go to the summary report with confidence. The resonance frequency is the breathing rate that satisfies the majority of these parameters (Lehrer et al., 2000):

- Synchrony of the respiration and heart rate signals.
- Largest peak-to-trough HR differences (HR max-min).
- Largest absolute and percentage LF power, and highest LF peak frequency near 0.1 Hz.
- Smoothest and most regular heart rate waveforms.

Expert Discussion from Dr. Beauchamp

Stress Evaluation

The stress evaluation script is designed to take the person through a series of mildly stressful mental challenges interspersed with periods of recovery. The script records a few minutes in each state and allows you to compare the physiological changes that happen when going from state to state. The

objective of the assessment is to get an understanding of how the person's physiology responds to being stressed and how well it is able to return to rest levels when the stressful event stops.

Script sequence:

1. Eyes closed baseline
2. Eyes open baseline
3. Stroop test (color words)
4. Recovery
5. Math task
6. Recovery
7. Psychomotor challenge (ReactTrak games)
8. Recovery
9. Positive imagery
10. Recovery
11. Negative imagery
12. Recovery

The evaluation starts with two periods of resting during which the system can measure baseline values. These represent how the person is at rest and provide a comparison point for the rest of the evaluation. Since the script records brainwaves (EEG), recording the baseline with eyes closed and eyes opened also set a good reference point for changes in mental states during the evaluation.

After the baseline recording, the script runs a series of mild mental challenges designed to elicit the stress response in the person. During each challenge period:

- Heart rate and breathing should increase
- Heart rate variability and hand temperature would decrease
- Arousal (skin conductance) and muscle tension would increase
- The dominant brainwave frequency would increase

Immediately following a stressor period, the recovery period allows you to monitor how the person is able to return to baseline values. During the recovery periods, the relaxation response would reverse the direction of the physiological changes:

- Heart rate and breathing should decrease
- Heart rate variability and hand temperature would increase
- Arousal (skin conductance) and muscle tension would decrease
- The dominant brainwave frequency would decrease

As the person relaxes, observe:

- How fast the physiology returns to baseline during each recovery period.
- Whether the physiology is able to return to baseline values or if it plateaus above baseline values or settles higher and higher each time.
- Whether atypical physiological responses can be observed (ex. hand temperature decreasing even more while resting).
- If the physiological responses to the stressors become stronger or weaker from stressor to stressor.

Note: *At the end of this manual, you will find four tables of numbers that you can use when running the math task step of the evaluation. Give the person a starting number from the table and verify his answer by referring to the table. If an answer is wrong, give the right answer and ask the person to continue from that number. If you repeat the evaluation with a given performer, make sure to use a different table each time so they cannot use their memory to complete the task.*

The report shows trend graphs for each physiological value across all steps of the evaluation. Running the Stress Evaluation before and after you have worked with a person will help you highlight progress and demonstrate efficacy.

Rationale

The Peak Performance Suite Stress Evaluation is a psychophysiological stress profile adapted from Wilson (2006). The report highlights the athlete's response to a variety of stressors and his ability to return to baseline levels during the recovery periods between stressors. The report allows you to see the athlete's starting point, before beginning a self-regulation program. Typically you will do pre- and post-training stress evaluations to highlight the progress of the athlete in the self-regulation program.

Specifically the report tracks changes in heart rate, respiration rate, HRV, skin conductance, skin temperature and muscle tension throughout the assessment. A table of descriptive statistics is also given at the end of the report.

In addition, you have the option to include EEG readings for each activity. Because placing EEG electrodes on a person's head is time consuming, EEG is usually done when working on a one-one basis. When you have an entire team of 20 athletes or more to evaluate in two days, limiting your methodology to the physiology only, allows you to complete the evaluation in 10-15 minutes per athlete.

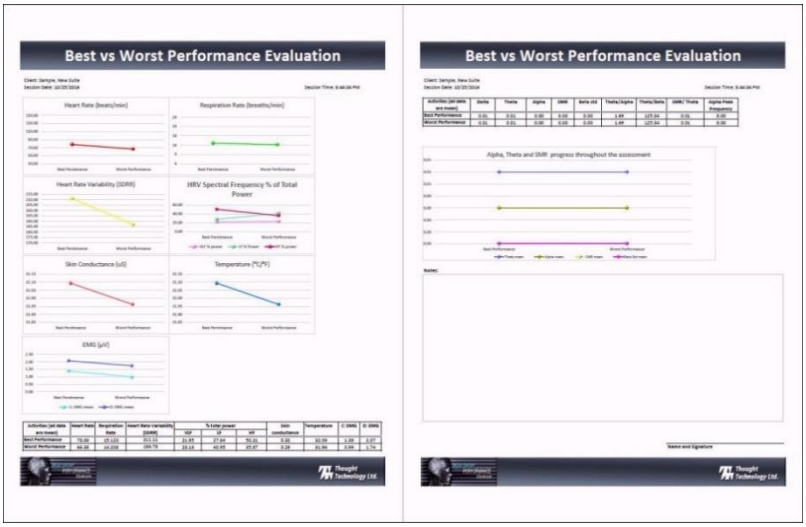
Interpretation

Generally, at first glance, you would look for any 'Irregular' responses in the profile. For example, in the profile above, we can see very high heart rate (HR), respiration rate (RR) and skin conductance as well as very low heart rate variability for a professional athlete. Consequently, in your feedback to the athlete you could ask the question of whether he gets tired easily in games. Based on the report you could then suggest rest and recovery strategies that would both enhance is recovery from training and also his competitions.

Expert Discussion from Dr. Beauchamp

Best vs worst performance evaluation

This evaluation script essentially looks at how positive and negative mental visualization can influence a performer's physiological responses. The person is asked to remember and visualize as intensely as possible a "good" and a "bad" performance for 5 minutes each. The report compares physiological averages between both states.



Rationale

This assessment serves to enhance an athlete's awareness of and highlight the physiological differences between the athlete's best and worst competition (Orlick, 2000). (If you have access to video, the evaluation may be done with a second monitor playing the athlete's competition video as they utilize voice recall describing their competition and performance results.) The physiology screen will reveal differences in their physiology from their best vs. worst competitions.

Often athletes are not aware of their skin conductance and breathing change during the stressful moments in competition (e.g., skater holding their breathing before start of routine). Stress desensitization and inoculation interventions can then be trained and built into their pre-performance routines.

Interpretation

Follow the same rules as interpreting the Stress Evaluation report (provided on page 25).

Expert Discussion from Dr. Beauchamp

Interpreting the Color Zones of Recovery

The 5 and 10 minute evaluation report shows an important HRV metric which helps gauge a performer's (more specifically an athlete's) recovery level. The RMSSD gives a useful index which can help you evaluate your performer's current state of fatigue and decide whether more training is warranted or if they should spend more time recuperating.

	Equal to or greater than 80	In the blue zone, normal training can be performed. The performer is sufficiently rested and healthy.
	Between 50 and 79	In the green zone, normal training can be performed but you should monitor the performer's health and lifestyle behaviors.
	Between 30 and 49	In the yellow zone, light training is recommended. Coach the performer in developing efficient rest and recovery strategies.
	Less than 29	In the red zone, a full rest day is recommended.

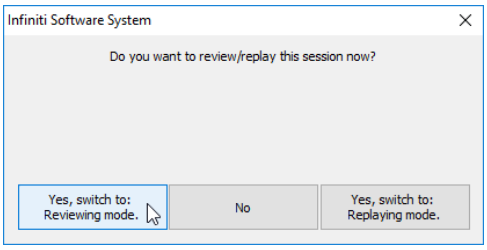
Session Review Options

After recording a session you analyze the data by entering review mode. Review mode allows you to scroll through graphs, look at statistics, and generate a report displaying the data in graphical and/or statistical form.

There are two ways to access review mode.

Entering Review Mode after Recording a Session

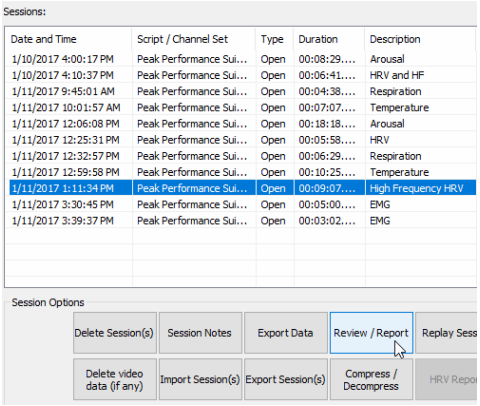
After you have finished recording a session, saved its data, and (optionally) entered session notes, the software offers you the option to open the session in review mode. This lets you provide immediate feedback if you want to go over session results with the performer.



Entering Review Mode from the Database

You can also open saved sessions in review mode by accessing them through the session database.

1. Select **Database** from the main screen, and in the Main Database window highlight the client whose session you want to review.
2. Select the session from the **Sessions** table, and click on **Review/Report** to open the Review/Replay Session Confirmation window.
3. Click **OK** in the Review/Replay Session Confirmation window to enter review mode.



Generating Excel Reports

Microsoft Excel must be installed on your computer system in order to take advantage of this feature.

BioGraph Infiniti

The Peak Performance Suite includes predefined Excel Report configurations for BioGraph Infiniti. After recording a Stress evaluation or a Best vs Worst Performance evaluation, you can generate a report from the review mode.

In the Tool Bar at the top of the screen, click the **Session Report** button and select **Generate Excel Report**. Microsoft Excel opens and displays your report as a workbook. You can print or save the report using Excel's **Print** and **Save** functions.

CardioPro Infiniti

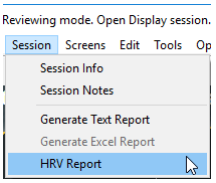
The 10 minute, 5 minute and HRV resonance frequency evaluation reports require the use of CardioPro Infiniti, Thought Technology's specialized HRV analysis software. The Peak Performance Suite includes predefined Excel Report configurations for CardioPro. In order to generate Excel reports, CardioPro Infiniti must be installed on your computer system, and the session must include valid BVP or EKG data.

The first time you use CardioPro Infiniti to analyze a session, the HRV Module Key Code box opens, and you must enter the registration key code to continue. (For more about key codes, see page 16.)

There are two ways to access CardioPro Infiniti from within BioGraph Infiniti.

- If the session is already open in review mode, select **HRV Report** from the **Session** menu.

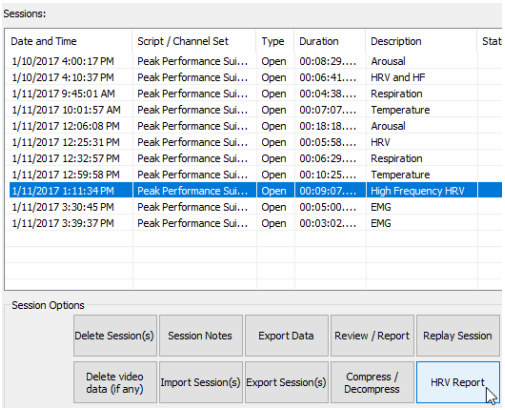
  This will open CardioPro Infiniti with the session automatically loaded.



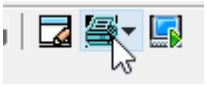
- If the session is not already open in review mode, do the following:

  1. Select **Database** from the main screen, and in the Main Database window highlight the client whose session you want to analyze in CardioPro.
  2. Select the HRV session from the **Sessions** table, and click on **HRV Report**.

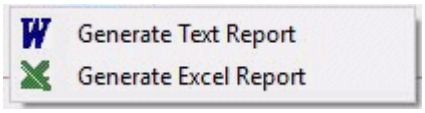
  This will open CardioPro Infiniti with the session automatically loaded.



In the Tool Bar at the top of the CardioPro Infiniti screen, click the **Report** button.



Select **Generate Excel Report**.



Microsoft Excel opens and displays your report as a workbook. You can print or save the report using Excel's **Print** and **Save** functions.

Note: *Detailed instructions for using the CardioPro software are provided in document SA7597,* ***CardioPro Infiniti Reference Manual****, which is provided with CardioPro Infiniti. When the software is running, you can also access context-sensitive on-line help by pressing the F1 button.*

Self-Regulation Training Sessions

Whereas the evaluation scripts allow you to assess a person's physiological status and see how well the person can adapt to changes in environmental and mental demands, the self-regulation training sessions are designed to help the person learn and practice the skills of self-regulation. Just like regular

physical exercise helps strengthen muscles and sharpen psychomotor skills, biofeedback training sessions help the person (1) become aware of usually subconscious physiological processes related to stress and anxiety, (2) learn how to control these physiological responses and (3) generalize the learned skill to real-life situations. The transfer of skills from self-regulation training to competition is a normal part of learning theory.

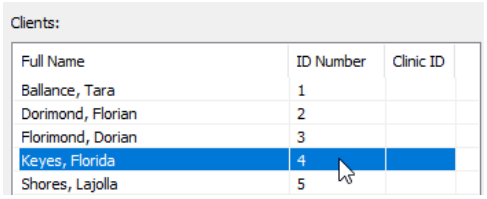
The Peak Performance Suite includes 7 specialized psychophysiological training groups, covering the main physiological modalities:

- Respiration
- HRV (heart rate variability)
- High frequency HRV training
- Arousal (skin conductance)
- Temperature
- EMG (muscle tension)
- EEG (brainwaves)

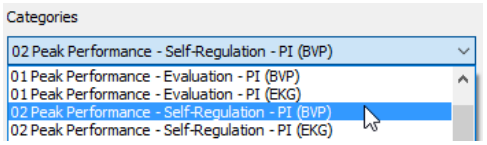
Running a Self-Regulation Session

1. Launch BioGraph Infiniti and click on **Quick Start**.

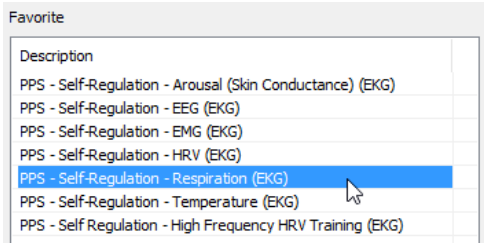
2. In the **Clients** list on the left, select an existing client name or use **Add New Client** to create a record for this client.



3. To display only favorites associated with a specific category, select it from the **Categories** drop-down list.



4. In the list of **Favorites**, select a training session and click **OK**.



5. Click the **Start** button  to start the training session.

   There is no set duration for the session; it continues until the stop button is clicked.

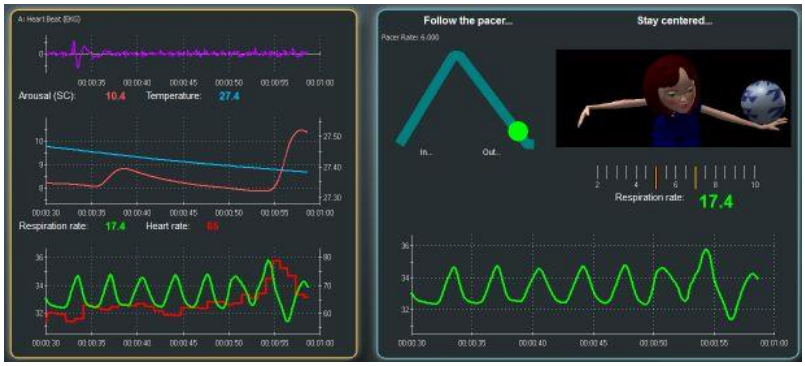
6. To stop the training session, click the **Stop** button:  .

Note: *Detailed instructions for using the software are provided in document SA7913,* ***Getting Started with BioGraph Infiniti****, which is provided with BioGraph Infiniti. When the software is running, you can also access context-sensitive on-line help by pressing the F1 button.*

Overview

Equipped with more proficient self-awareness and self-regulation skills, a performer will be able to recognize when stress starts impacting results and rapidly counteract its effects with increased resilience. Using the practiced behavior, they will be able to quickly return to a state of calm and ready awareness after a negative experience and voluntarily shift into a mental and physiological state that favors rapid reactions and appropriate decision-making.

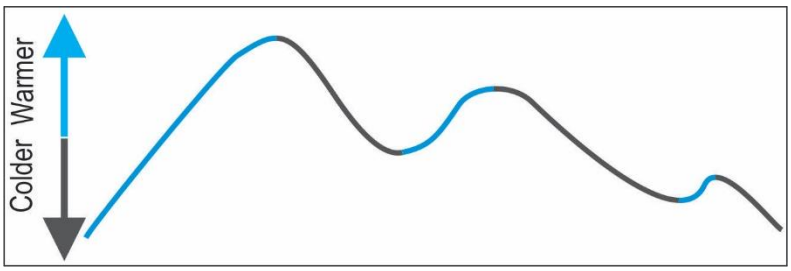
In general, the Peak Performance Suite training screens are designed with two distinct areas. The yellow bordered area on the left is used to display trainer/coach relevant information while the blue bordered area on the right displays trainee/performer relevant information. The trainer area shows key relevant physiological signals that you can monitor while the person is practicing the self-regulation exercise. The trainee area gives feedback to the person being trained to help them become aware of their own physiological processes and guide them towards making appropriate adjustments in real-time.



Each session configuration includes a group of feedback screens which implement increasing levels of challenge for the person being trained. During a session, you can click number buttons to switch to a different level without stopping and restarting the session.

Biofeedback

For a biofeedback session to work, a tight loop has to be created between a person's awareness of an internal physiological process and a recognizable event on the computer screen. When doing hand warming biofeedback, for example, you have to explain to the person being trained that the line that is moving across the screen is their current moment by moment temperature. When the line is going down, their hand is getting colder and when it is going up, their hand is getting warmer. In order to help the person understand this, the line's color can change as soon as there is a direction change.



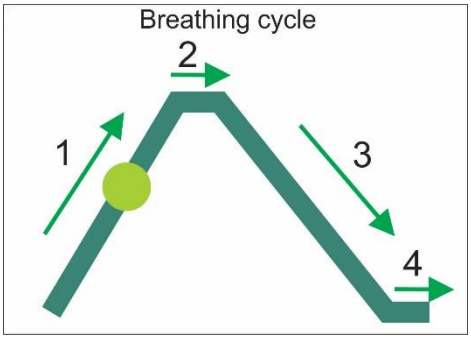
The feedback is the color going from grey (cold) to blue (warm). If you coach the person to practice a specific mental strategy (visualization, relaxation, mindfulness, etc.) that aims at stimulating an increase in blood flow to the hand, the positive color change gives them instantaneous feedback that the strategy is working. If the color changes again, they know that something happened to get them out of that zone.

The suite includes many audio and visual feedback tools including increasing and decreasing audio tones, music, video and representative animations. These will be described in the training session section of this manual.

Repeated practice of this exercise will eventually make the person aware of how it feels, internally, to get in the state that makes the line go up and recognize when the feeling is lost. When this happens, the skill is essentially transferred to everyday life and the person doesn't need the biofeedback system anymore.

Breathing Pacer

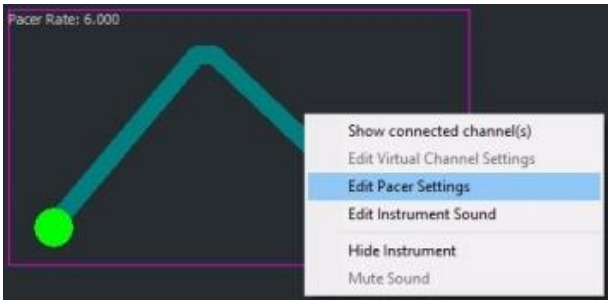
Some of the training screens show a breathing pacer instrument. The pacer is useful when doing abdominal breathing or heart rate variability training. The main purpose of the pacer is to help the person being trained learn how to breathe slowly and regularly. A dot moves slowly along the guideline. There are 4 stages to the breathing cycle:



1. Breathe in: The dot moves upward.
2. Hold in: The dot moves across at the top.
3. Breathe out: The dot moves down.
4. Hold out: The dot moves across at the bottom.

By default, the pacer is set to pace at 6 breaths/minute with 4 seconds to breathe in and 5 seconds to breathe out with very short (1/2 second) hold periods. Once you have run the Resonance Frequency evaluation script, you will want to adjust the pacer to the breathing rate that will maximize heart rate variability. To access the pacer's settings:

1. Pause the session (click the **Pause** button in the toolbar).
2. Right-click over the pacer itself to open the instrument's menu.
3. Select **Edit Pacer Settings**.



4. By clicking the up or down arrows, adjust the target rate value to the specific breathing rate. The other parameters will adjust themselves automatically to keep the same in/out proportions so you don't have to adjust them.

5. Click OK to close the pacer settings.

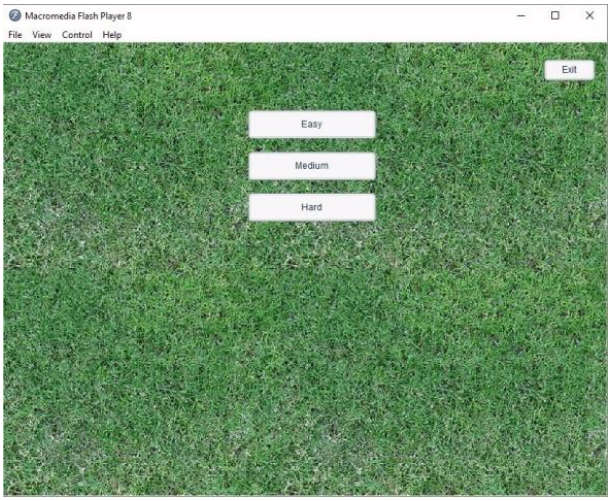
6. Verify that the proper pacing rate is shown on the pacer.

ReactTrak Game

Some of the training screens are designed to work along with the ReactTrak game. This is a simple game that requires mental focus as well as precision of movement and rapidity of reaction. To launch the game:

1. Right-click over the yellow icon to open the menu.

2. Select **Run Target Application**.
3. The game should appear.



4. When you are ready, click on **Easy**, **Medium** or **Hard** to start the game at the desired level of difficulty.

5. The soccer ball will have a tendency to slowly move left or right, accelerating as it moves away from the center line. The person has to keep the ball between the two black lines by gently moving the mouse cursor left or right in the opposite direction from the ball. Doing this makes the ball change direction. Wide movements will make the ball accelerate even more, so quick short movements are better. When the ball hits a black line, the game ends and a score table appears, reflecting how long the person was able to keep the ball from touching the black lines.
6. Restart the game by clicking **Play Again**.
7. Click **Exit** to close the game.

Score

Some training screens have a small yellow Score area in the lower right corner of the screen. When using a screen that shows a score, a small yellow star will appear, during the feedback session, each time the Success Condition for the trained physiological modality is met and points will accumulate for each 10 second period that the condition is sustained.

It is important to understand that the Success Condition is different from a training screen's feedback condition. For each self-regulation session configuration, different screens may train different aspects of the same physiological process but on all screens, the success condition is the same. Scores are calculated for:

- *Respiration*: Each time the breathing rate is between 5 and 7 breaths per minute for 10 seconds.
- *HRV*: Each time the power of LF is increasing while the power of VLF and HF is decreasing for 10 seconds.
- *Arousal*: Each time skin conductance is decreasing for 10 seconds.
- *Temperature*: Each time temperature is increasing for 10 seconds.
- *High frequency HRV*: Each time the power of HF is increasing while the power of VLF and LF is decreasing for 10 seconds.

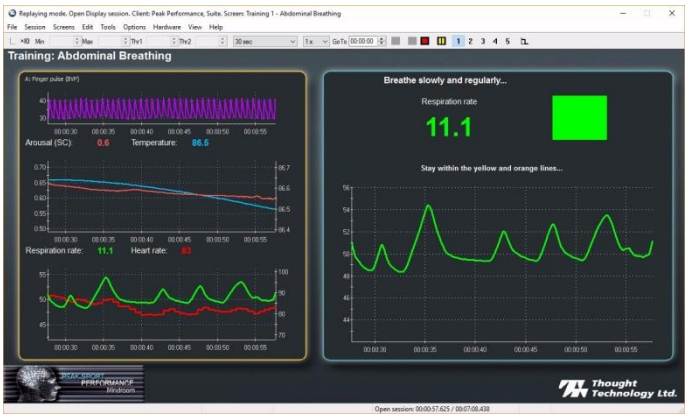
Score points are defined as a statistic for the session. When you review a recorded session and generate the session statistics, the score will be listed with session means. There is no score for brainwave (EEG) or muscle tension (EMG) training.

Respiration

When you are running a Respiration self-regulation session, 4 training screens are available. Using these screens, you can train a person to learn powerful breathing techniques including abdominal breathing, paced breathing and circular breathing.

1. Abdominal breathing
2. Paced breathing
3. Paced breathing – Balance
4. Circular breathing - ReactTrak

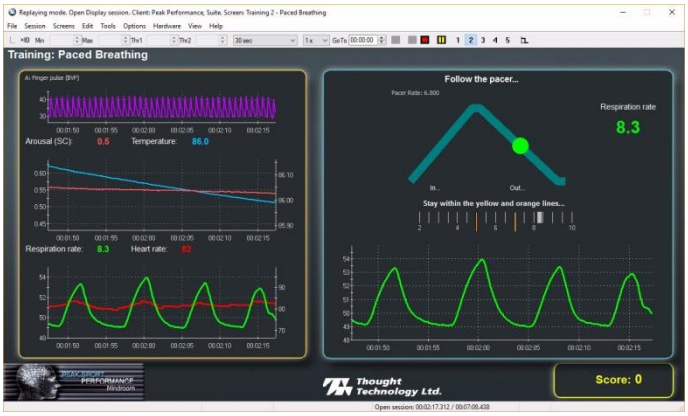
Training 1: Abdominal breathing



The abdominal breathing training screen shows the respiration signal on a large line graph with two thresholds/guidelines that you can adjust up or down along the vertical scale. The person being trained has to maintain regular breathing depth so as to stay within the guidelines. If the thresholds are not visible, the auto-scaling function should bring them into view if you ask the person to take a deep slow breath.

Music plays normally when the signal stays within the guidelines and becomes quiet when it is outside of the lines. A green square grows and shrinks with the person's breathing to provide a visual representation of the expansion/contraction of the abdomen.

Training 2: Paced breathing



The paced breathing training screen is similar to the previous screen with the addition of a breathing pacer. Instruct the trainee to breathe in when the dot moves up and breathe out when it moves down. By default, the pacer is set to entrain 6 breaths per minute. The horizontal graph below the pacer shows the current breathing rate, from breath to breath. The training goal is to keep the breathing rate within the two threshold lines.

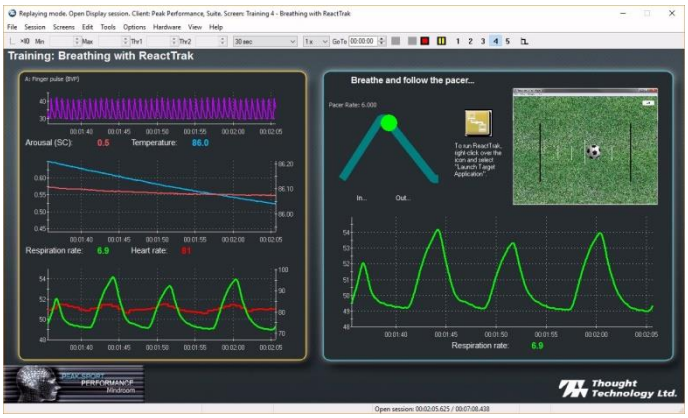
You can adjust the position of the threshold lines by clicking and dragging the mouse over each one. The indicator turns green and the music plays louder when the breath rate falls within the two thresholds. This screen shows the current Score for the respiration success condition.

Training 3: Paced breathing - Balance

This screen is similar to the previous screen with the addition of an animation visually representing the changes in breathing rate. When the ball is positioned right over the animated character's head, the person is breathing at the target breathing rate. This screen shows the current Score for the respiration success condition.

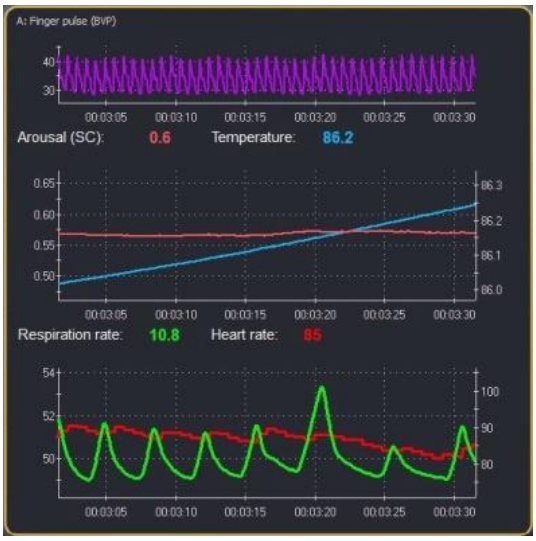
Training 4: Breathing with ReactTrak

Circular breathing involves breathing in and out for the same amount of time as well as breathing in through the nose and out through pursed lips. To add a level of challenge for the performer, you can have them play the ReactTrak game while doing the specific breathing exercise.



Coach/Trainer side information

On all screens, the Coach/Trainer side shows:



- Finger pulse (or heartbeats): The raw BVP (or EKG) signal is shown on the top graph. Monitor this regularly to verify that the signal shows clearly distinct beats, ensuring that the heart rate information is based on valid signal.
- Arousal and Temperature: The middle graph shows skin conductance (arousal) and finger temperature. During abdominal breathing exercises, the person should be relaxing and not straining. SC should be going down and temperature up.
- Respiration and heart rate: The bottom graph shows breathing and heart rate on a single graph so you can easily observe RSA.

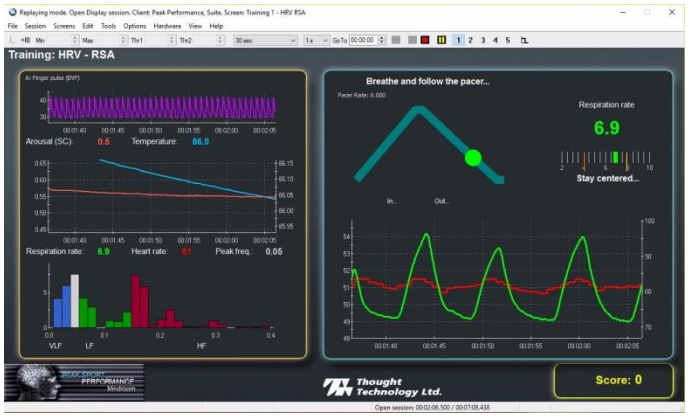
HRV

The heart rate variability training screens build upon the breathing techniques that were learned with the respiration training but add the dimension of HRV to the training. It is recommended that novice performers start practicing with breathing techniques before moving on to HRV training.

Since the feedback exercises generally involve paced breathing or breathing at around 6 breaths per minute, the desired success condition happens when the low frequency band (LF) is increasing in power while the very low frequency (VLF) and high frequency (HF) bands are decreasing in power. At a breathing rate around 6 breaths/minute, the effect of RSA generates power in the LF band.

1. HRV RSA
2. HRV power
3. HRV RSA – Physiology
4. HRV RSA – ReactTrak

Training 1: HRV RSA



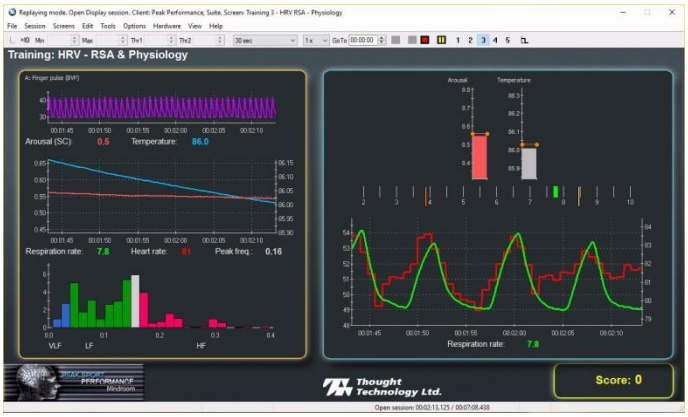
This screen is specifically designed to train the ability to maintain a constant breathing rate. The pacer is set, by default to train at 6 breaths/minute but you can adjust it to the person's resonance frequency breathing rate. Music plays quietly as long as the breathing rate is outside of the two thresholds on the horizontal graph to the right of the pacer. The music becomes louder when it falls inside the thresholds.
This screen shows the current Score for the HRV success condition.

Training 2: HRV Power

This screen is used to train HRV with VLF, LF and HF power. As in the previous screen, the pacer is set, by default to train at 6 breaths/minute but you can adjust it to the person's resonance frequency breathing rate. The software takes 64 seconds to start displaying the HRV spectrum and computing the band power. Music is played quietly as long as the feedback condition is not met.
The music becomes louder when the power of VLF and HF is decreasing while the power of LF is increasing. This screen shows the current Score for the HRV success condition.

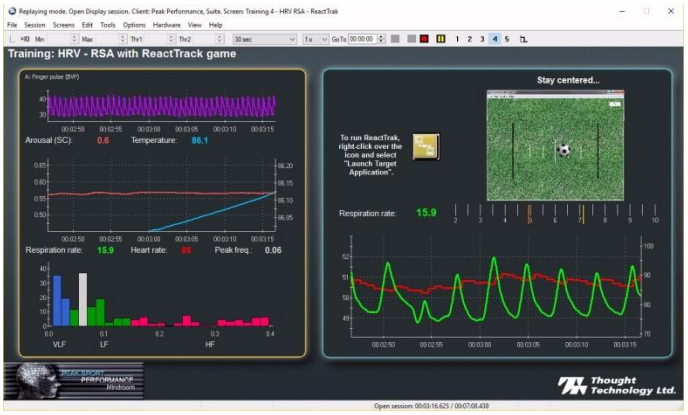
Training 3: HRV RSA - Physiology

This screen is used to train RSA with arousal (skin conductance) and temperature. Music is played quietly as long as the feedback condition is not met. The music becomes louder when the breathing rate falls between the two thresholds on the horizontal graph, arousal is decreasing and temperature is increasing. This screen shows the current Score for the HRV success condition



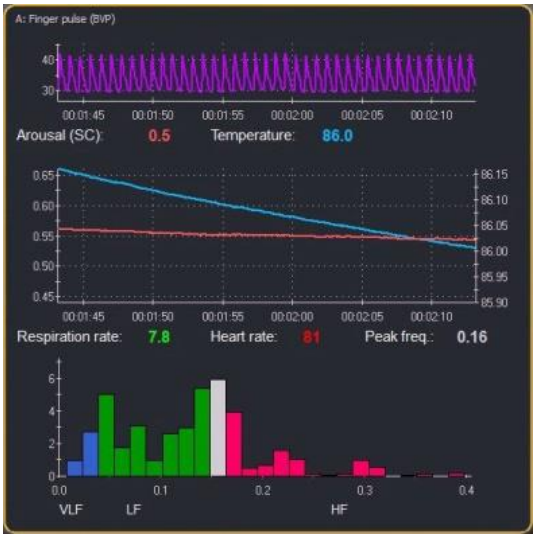
Training 4: HRV RSA - ReactTrak

Using this screen, you can have a person practice RSA breathing and add a level of challenge with the ReactTrak game.



Coach/Trainer side information

On all screens, the Coach/Trainer side shows:



- Finger pulse (or heartbeats): The raw BVP (or EKG) signal is shown on the top graph. Monitor this regularly to verify that the signal shows clearly distinct beats, ensuring that the heart rate information is based on valid signal.

- Arousal and Temperature: The middle graph shows skin conductance (arousal) and finger temperature. During abdominal breathing exercises, the person should be relaxing and not straining. SC is expected to be going down and temperature up. If you observe the opposite, the person may be trying too hard and feeling stressed.
- HRV Power spectrum: On this graph, you can see how the distribution of power shifts across the three bands when the person's breathing rate is modified. At 6 breaths/minute, a tall bar should appear at 0.1 Hz in the LF band.

High Frequency HRV Training

A modified HRV training screen was included in the suite to allow you to train for high frequency (HF) HRV power. The neurovisceral integration theory introduced by J. F. Thayer proposes a Vagus nerve mediated communication pathway between autonomic regulation and the neural structures affecting the control of executive functions. The model suggests that HRV training, particularly in the high frequency band, could have a beneficial impact on improved attention control.

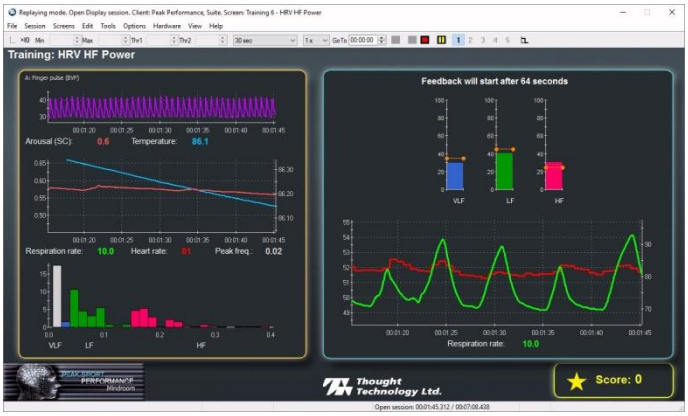
The purpose of this training screen is to assess decision-making in closed-skill sports such as Olympic pistol shooting, golf putt, archery or a trade, for investment professionals, etc. A modified HRV training screen was included in the suite to allow you to train for high frequency (HF) HRV power. The neurovisceral integration theory introduced by J. F. Thayer (Jennings et. al., 2015; Park & Thayer, 2014) proposes the Vagus nerve mediated communication pathway between autonomic regulation and the neural structures affecting the control of executive functions.

Based on the early work of Landers (1985), Boutcher & Zinsser (1990) demonstrated that Heart Rate Deceleration (HRD) was found to accompany and index the presence of attentional capacity, whereas HR acceleration (HRA) is more prevalent in conditions of processing overload (Crews, 1993). More recently, researchers are utilizing ECG frequency domain measures of attention (e.g., High Frequency power) making it one of the more promising physiological indicators of attentional workload, effort, and particularly under high pressure (Laborde, Furley & Schempp, 2015).

The model suggests that HRV training, particularly in the high frequency band, could have a beneficial impact on improved attention control. Therefore, you can use this screen to demonstrate how complex decisions, under pressure, directly relate to HRD and HF power in the frequency spectrum pre-post the sport event (or trade decision for Investment professionals).

Expert Discussion from Dr. Beauchamp

Training 6: HRV HF Power



This screen is similar to the screen for VLF, LF and HF power but the feedback is defined to reward increases in activity in the HF band with a decrease in the other two bands. As with the other HRV training screens, the software takes 64 seconds to start displaying the HRV spectrum and computing the band power. Music is played quietly as long as the feedback condition is not met.

The music becomes louder when the power of VLF and LF is decreasing while the power of HF is increasing. This screen shows the current Score for the High Frequency HRV success condition.

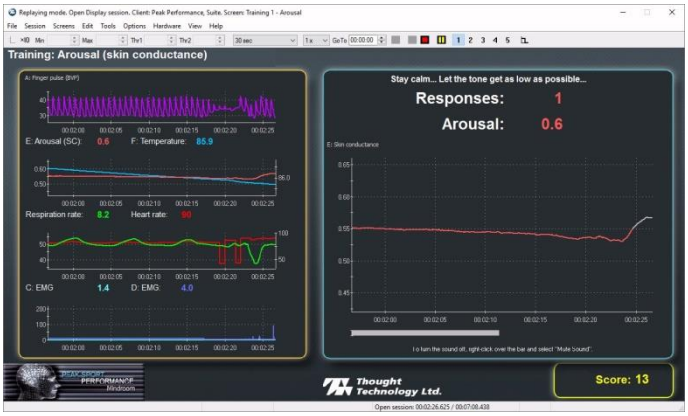
Arousal

Arousal is measured with skin conductance. Under stress, the SNS activates and triggers the fight or flight response, which increases perspiration in areas of skin where eccrine sweat glands are situated, mainly hands, feet and forehead. The skin conductance sensor is fastened around two fingers and measures the skin's conductivity. As arousal increases, so does the skin's sweatiness. Because of its saltiness, sweat increases conductance.

Two aspects of SC are monitored in the Peak Performance Suite: The SC level (SCL) is measured in micro-Siemens and shown as a line and number on the feedback screens. The number of SC responses (SCR) is also tracked. A skin conductance response occurs each time the person reacts to a sudden event or environmental change (stimulus). Events can be internal (a memory) or external (a loud noise); both types of events will cause a SC response.

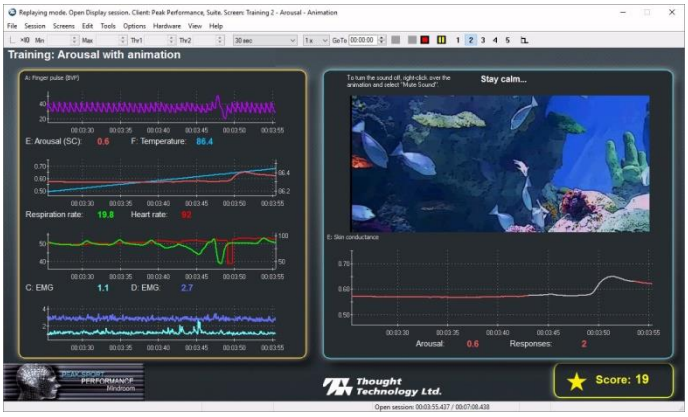
1. Arousal
2. Arousal – Animation
3. Arousal – Dual thresholds
4. Arousal – ReactTrak

Training 1: Arousal



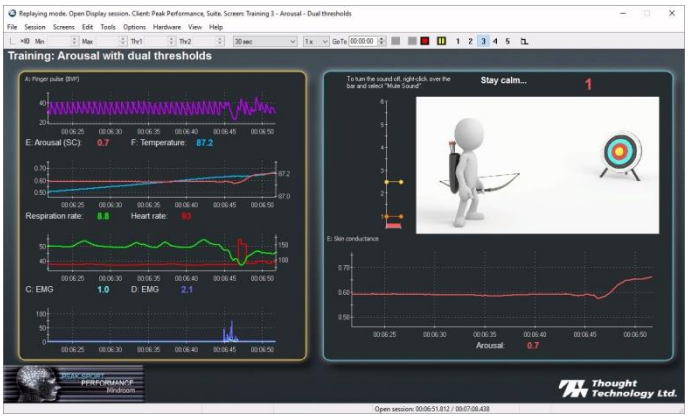
This screen is used to teach basic skin conductance awareness. The large line graph shows the SC signal change over time. The line's color becomes grey when SC increases (out of condition) and dark pink when it decreases. A grey bar shrinks and audio feedback becomes lower in tone as SC decreases. The bar grows and the tone becomes higher when it increases.
A counter keeps track of the total number of arousal responses. This screen shows the current Score for the arousal success condition.

Training 2: Arousal - Animation



This screen is similar to the previous one with the addition of an animation. The animation plays and the sound is louder when SC decreases. It stops and the sound is quieter when it increases. A counter keeps track of the total number of arousal responses. This screen also shows the current Score for the arousal success condition.

Training 3: Arousal – Dual thresholds



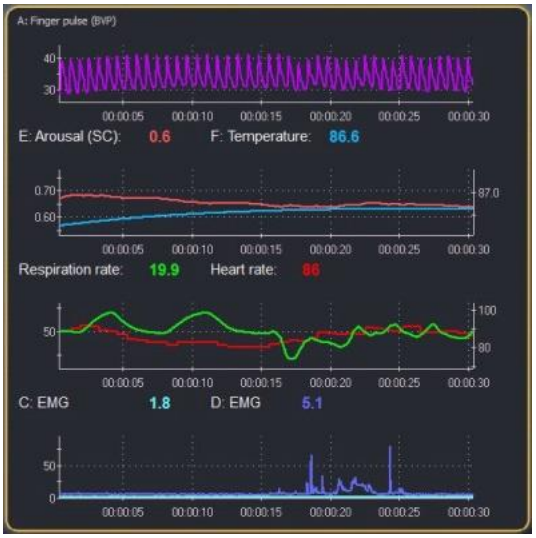
This screen is used to train control of arousal. The bar graph on the left of the animation has two thresholds that you can adjust by clicking and dragging. The person has to be sufficiently aroused to be higher than the lower threshold but not so much that their SC level goes over the higher threshold. When SC is within the defined zone, the archer aims and shoots an arrow towards the target.
A counter keeps track of how many shots were successfully completed. Music plays normally when the SC is inside the thresholds and goes quiet when it is outside.

Training 4: Arousal - ReactTrak

This screen is similar to the basic arousal training screen with the addition of allowing you to launch the ReactTrak game. A grey bar shrinks and audio feedback becomes lower in tone as SC decreases. The bar grows and the tone becomes higher when it increases. This screen also shows the current Score for the arousal success condition.

Coach/Trainer side information

On all screens, the Coach/Trainer side shows:



- Finger pulse (or heartbeats): The raw BVP (or EKG) signal is shown on the top graph. Monitor this regularly to verify that the signal shows clearly distinct beats, ensuring that the heart rate information is based on valid signal.
- Arousal and Temperature: The middle graph shows skin conductance (arousal) and finger temperature. During abdominal breathing exercises, the person should be relaxing and not straining. SC should be going down and temperature up. If you observe the opposite, the person may be trying too hard and feeling stressed.
- Respiration and heart rate: The bottom graph shows breathing and heart rate on a single graph so you can easily observe RSA.
- EMG: The bottom graph shows the signals from the two EMG sensors (C & D). Use EMG to monitor neck, shoulder or upper/lower back tension.

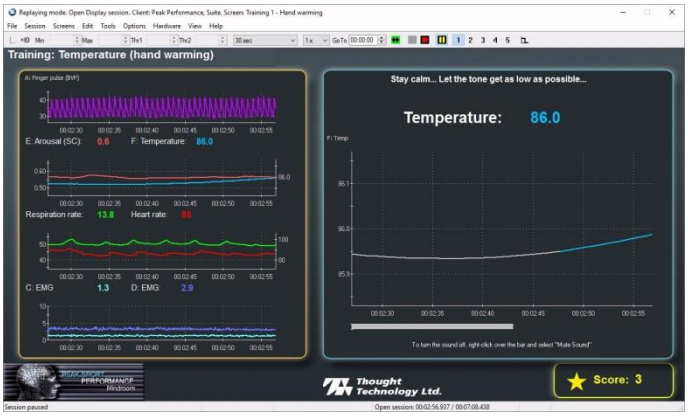
Temperature (hand warming)

Skin temperature is generally measured from a finger of either hand. The stress response, which is triggered each time the SNS is activated, causes constriction in the peripheral circulation (hands and toes get cold) and the expansion of the larger blood vessels to the bigger body muscles -- in order to provide more oxygen in preparation for intense physical activity. While the fight or flight response is desirable, before a performance or a game, because it prepares the person for immediate action, the effects of long term vasoconstriction – sustained by an inability to return to baseline values - can be damaging.

By coaching the person to relax and internally "feel" the circulation in their hands increase and their fingers become warmer, you can teach them to counteract the effects of SNS activation.

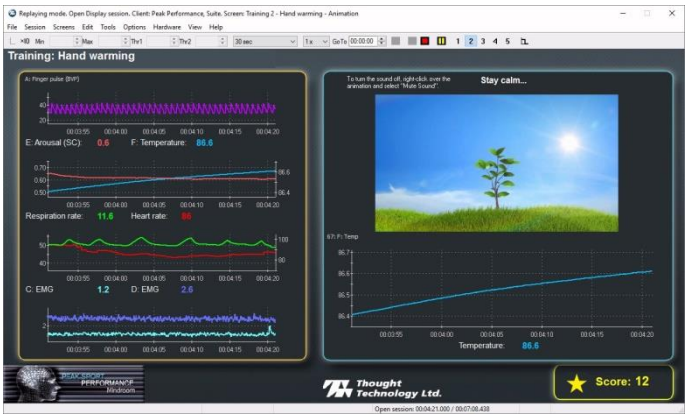
1. Hand warming
2. Hand warming – Animation
3. Hand warming – Light bulbs
4. Hand warming – ReactTrak

Training 1: Hand warming



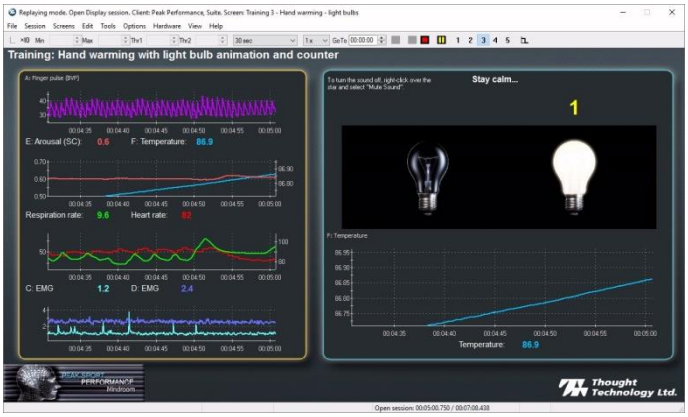
This screen is used to teach basic temperature awareness. The large line graph shows the hand temperature signal change over time. The line's color becomes grey when Temp decreases (out of condition) and blue when it increases. A grey bar grows and audio feedback becomes lower in tone as Temp increases. The bar shrinks and the tone becomes higher when it decreases.
This screen shows the current Score for the temperature success condition.

Training 2: Hand warming - Animation



This screen is similar to the previous one with the addition of an animation. The animation plays and the sound becomes louder when Temperature increases. The animation stops and the sound gets quieter when it decreases. This screen also shows the current Score for the temperature success condition.

Training 3: Hand warming – Light bulbs



This screen is similar to the previous one but adds the challenge of having to maintain hand warming for a sufficiently long period of time. The light bulb on the left starts glowing when temperature rises. It turns dark when it lowers. If the temperature rises long enough to make the bulb on the left as bright as the one on the right, the bulb on the right explodes and a point is counted.

A counter keeps track of how many bulbs were successfully exploded. Music plays normally when the temperature is rising and goes quiet when it lowers.

Training 4: Hand warming - ReactTrak

This screen is similar to the basic temperature training screen with the addition of allowing you to launch the ReactTrak game. A grey bar grows and audio feedback becomes lower in tone as temperature increases. The bar shrinks and the tone becomes higher when it decreases. This screen also shows the current Score for the temperature success condition.

Coach/Trainer side information

On all screens, the Coach/Trainer side shows the same information as on the Arousal training screens.

EMG

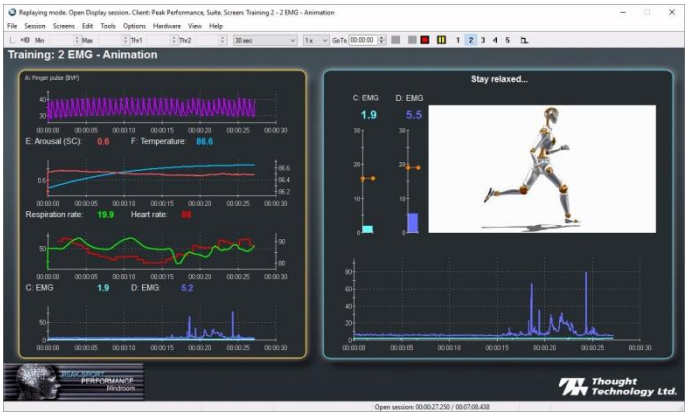
The electromyography self-regulation screens allow you to monitor muscle tension from two muscle sites at the same time and train the person to become conscious of the residual tension that can build up in low back, shoulders or neck muscles after long periods of stress or intense exercise. Practicing how to voluntarily lower resting levels of EMG also favors relaxation and speeds up recuperation.

Training 1: 2 EMG

This screen is used to teach basic muscle tension awareness. The two bar graphs and the line graph show the moment by moment changes in EMG for two muscle sites. You can adjust a bar's threshold up or down by clicking and dragging on the orange line. Music plays normally when both signals are below thresholds and becomes quiet when either bar goes over its threshold.

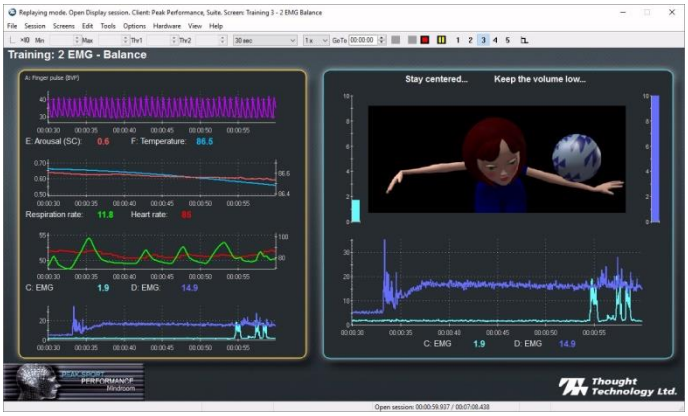
Training 2: 2 EMG - Animation

This screen is similar to the previous one with the addition of an animation. The animation plays and the sound becomes louder when both EMG signals are below threshold. The animation stops and the music quiets down when either bar goes over its threshold.



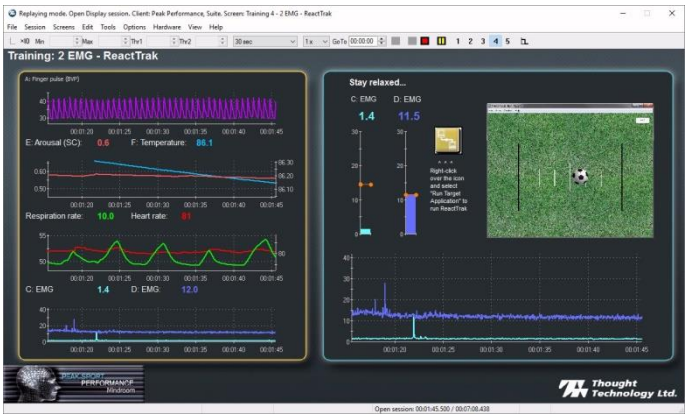
Training 3: 2EMG Balance

This screen is used to teach muscle balance. The ball moves left or right on the animated character's shoulders and arms when the tension on that side is higher than on the other. The goal is to keep the ball in the center position. The music's volume on each side is also driven by the signal's amplitude+.



Training 4: 2 EMG - ReactTrak

This screen is similar to the first one with the addition of allowing you to launch the ReactTrak game.



Coach/Trainer side information

On all screens, the Coach/Trainer side shows the same information as on the Arousal training screens.

EEG

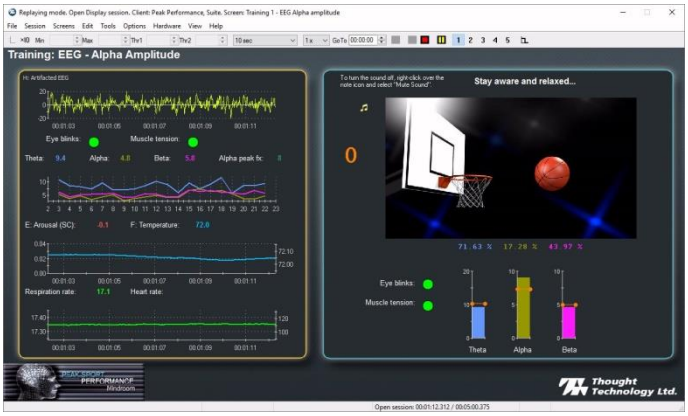
Standard neurofeedback practice generally involves placing multiple electrodes on the person's head, running elaborate assessments and configuring custom training protocols for each person. The Peak Performance Suite includes brainwave self-regulation screens that are mainly concerned by three skills:

1. Ability to enter a state of relaxed awareness by shifting the dominant frequency towards alpha.
2. Ability to focus on the present, become more aware of one's body and be ready to perform by shifting it towards SMR.
3. Ability to voluntarily transit from one state to the other.

For the purpose of running the EEG brainwave self-regulation exercises, only one channel of EEG is necessary and the active electrode should be placed on CZ (see sensor placement instructions).

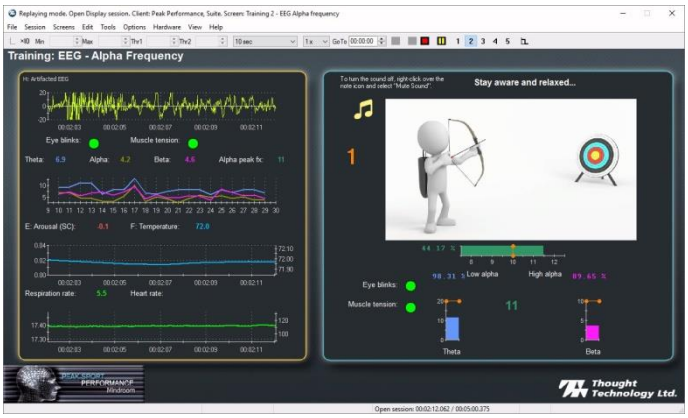
Training 1: EEG – Alpha amplitude

This screen is designed to help train brainwave activity within the alpha frequency band. The three bar graphs on the client side show the moment to moment changes in amplitude (microvolts) for theta, alpha and beta. Feedback occurs when alpha is above threshold and theta and beta are below threshold. When this happens, the animation plays and the music plays louder.



The screen counts how many times the ball goes through the hoop during the session. The screen monitors for low and high frequency artifacts and stops feedback when the person tenses up their facial muscles or blinks their eyes.

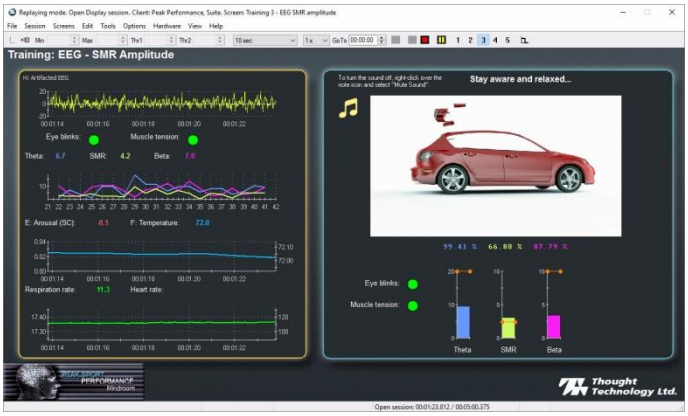
Training 2: EEG – Alpha frequency



This screen is similar to the previous one but helps train brainwave activity within the higher end of the alpha band. The horizontal bar under the animation shows frequency. When the dominant alpha frequency is greater than the threshold (by default, 10 Hertz) while theta and beta are below threshold, the animation plays and music plays louder. The screen counts how many times the target was reached during the session.

The screen monitors for low and high frequency artifacts and stops feedback when the person tenses up their facial muscles or blinks their eyes.

Training 3: EEG – SMR amplitude



This screen is designed to help train brainwave activity within the sensory motor rhythm (SMR) frequency band. The three bar graphs on the client side show the moment to moment changes in amplitude (microvolts) for theta, SMR and beta. Feedback occurs when SMR is above threshold while theta and beta are below threshold. When this happens, the animation advances and the music plays louder.

The animation plays backward when the condition is lost. The goal is to stay in SMR long enough to build the whole car. The screen monitors for low and high frequency artifacts and stops feedback when the person tenses up their facial muscles or blinks their eyes.

Training 5: EEG – Alpha & SMR with HRV

This screen is similar to the previous one but the feedback shows two lightbulbs that represent amplitude in alpha and SMR. As the dominant band shifts left or right, the corresponding bulb becomes brighter. The audio feedback also shifts left or right. HRV and levels of theta and beta are monitored. VLF and HF are in condition below threshold and LF is in condition when LF is above threshold.

These conditions do not affect the feedback but a red X appears when either condition is not met. Green checkmarks appear when they are.

Psychophysiological Training Programs

The Peak Performance Suite provides many tools to evaluate a performer's psychophysiological responses, pre- and post-performance, and to help retrain these processes in order to help the performer function at his best, more often. The methods and rationales for selecting and sequencing specific training exercises greatly depend on the coach's experience and judgement.

Over his years of experience, Dr. Beauchamp has developed a number of powerful programs aimed at optimizing coaching interventions and removing the guesswork when defining the proper psychophysiological training.

Overall 5 Step Process

1. **Assessments**: Evaluate a performer's status with the 5 or 10 min. HRV evaluation, resonance frequency evaluation, stress evaluation, best vs. worst, etc.
2. **Education**: Discuss benefits of basic self-regulation skills (ex. abdominal breathing, circular breathing, etc.).
3. **Training**: Give breathing exercises. 4 min, 8 min, 12 min, plus mental rehearsal and/or imagery.
4. **Simulation**: Visualize performance in micro-situations, build success blocks.
5. **Evaluation**: Re-evaluate status in varying situations, set log-book goals for deliberate practice.

Mindroom PSP Program Training Protocols

- Olympic Mindroom Bronze Medal Psychophysiological Training Program
- Olympic Mindroom Silver Medal Psychophysiological Training Program
- Olympic Mindroom Gold Medal Psychophysiological Training Program

Please consult with Pierre Beauchamp (drpierrebeauchamp@gmail.com) for specific training regarding these protocols and programs.

Acknowledgements

Pierre Beauchamp

The Peak Performance Suite was developed in collaboration with Pierre Beauchamp, Ph.D., a graduate in Sport Psychology (University of Montreal) with over thirty five years of experience as a sport psychologist with the Canadian Olympic Association and various national Sport Organizations. Pierre is a professional member of the Canadian Sport Psychology Association (CSPA), the Association of Applied Sport Psychology (AASP) and the Association for Psychophysiology and Biofeedback (AAPB) with a Biofeedback Certification International Alliance (BCIA) certification in HRV Biofeedback.

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Support

Contacting Thought Technology

Returning Equipment

Be sure to call for an authorization number (RA) before returning any equipment!

Send the unit(s) postage prepaid and insured, with proof of purchase to one of the addresses below.

If you are shipping from outside Canada or the USA to Canada, mark the package "**Goods to be repaired – Made in Canada**" to avoid unnecessary customs charges.

All customs and duties charges will be billed to you if incurred by sending the unit to the wrong address.

Provide a detailed description of the problem you are experiencing, and your telephone/fax number and email (see form on the next page of this manual).

- **In the USA**, ship insured to:

  Thought Technology Ltd.
  Cimetra LLC
  8396 State Route 9
  West Chazy, New York
  12992, USA

- **In Canada and all other countries**, contact your dealer or ship insured to:

  Thought Technology Ltd.
  8205 Montreal/ Toronto Blvd. Suite 223
  Montreal West, Quebec
  Canada H4X 1N1

  "**Broker: Livingston International – 133461**"

Technical Support

For technical support please refer to the Thought Technology Ltd. website at www.thoughttechnology.com for frequently asked questions. If your support issue is not covered please e-mail or telephone at the number below.

☎ (514) 489-8251 💻 techsupport@thoughttechnology.com

Repair Return Form

Name: _____

Company: _____

Address: _____

_____

_____

Telephone Number: _____

Fax Number: _____

Date Purchased: _____

From: _____

Model Name: _____

Serial Number: _____

Problem: _____

_____

_____

_____

_____

_____

During the Math Task step of the Stress Assessment, use one of these tables of numbers to select a starting number and verify the performer's response.

1081	941	801	661	521	381	241	101
1074	934	794	654	514	374	234	94
1067	927	787	647	507	367	227	87
1060	920	780	640	500	360	220	80
1053	913	773	633	493	353	213	73
1046	906	766	626	486	346	206	66
1039	899	759	619	479	339	199	59
1032	892	752	612	472	332	192	52
1025	885	745	605	465	325	185	45
1018	878	738	598	458	318	178	38
1011	871	731	591	451	311	171	31
1004	864	724	584	444	304	164	24
997	857	717	577	437	297	157	17
990	850	710	570	430	290	150	10
983	843	703	563	423	283	143	3
976	836	696	556	416	276	136	
969	829	689	549	409	269	129	
962	822	682	542	402	262	122	
955	815	675	535	395	255	115	
948	808	668	528	388	248	108	

During the Math Task step of the Stress Assessment, use one of these tables of numbers to select a starting number and verify the performer's response.

2048	1908	1768	1628	1488	1348	1208	1068
2041	1901	1761	1621	1481	1341	1201	1061
2034	1894	1754	1614	1474	1334	1194	1054
2027	1887	1747	1607	1467	1327	1187	1047
2020	1880	1740	1600	1460	1320	1180	1040
2013	1873	1733	1593	1453	1313	1173	1033
2006	1866	1726	1586	1446	1306	1166	1026
1999	1859	1719	1579	1439	1299	1159	1019
1992	1852	1712	1572	1432	1292	1152	1012
1985	1845	1705	1565	1425	1285	1145	1005
1978	1838	1698	1558	1418	1278	1138	998
1971	1831	1691	1551	1411	1271	1131	991
1964	1824	1684	1544	1404	1264	1124	984
1957	1817	1677	1537	1397	1257	1117	977
1950	1810	1670	1530	1390	1250	1110	970
1943	1803	1663	1523	1383	1243	1103	
1936	1796	1656	1516	1376	1236	1096	
1929	1789	1649	1509	1369	1229	1089	
1922	1782	1642	1502	1362	1222	1082	
1915	1775	1635	1495	1355	1215	1075	

During the Math Task step of the Stress Assessment, use one of these tables of numbers to select a starting number and verify the performer's response.

2001	1861	1721	1581	1441	1301	1161	1021
1994	1854	1714	1574	1434	1294	1154	1014
1987	1847	1707	1567	1427	1287	1147	1007
1980	1840	1700	1560	1420	1280	1140	1000
1973	1833	1693	1553	1413	1273	1133	993
1966	1826	1686	1546	1406	1266	1126	986
1959	1819	1679	1539	1399	1259	1119	979
1952	1812	1672	1532	1392	1252	1112	972
1945	1805	1665	1525	1385	1245	1105	965
1938	1798	1658	1518	1378	1238	1098	958
1931	1791	1651	1511	1371	1231	1091	951
1924	1784	1644	1504	1364	1224	1084	944
1917	1777	1637	1497	1357	1217	1077	937
1910	1770	1630	1490	1350	1210	1070	930
1903	1763	1623	1483	1343	1203	1063	923
1896	1756	1616	1476	1336	1196	1056	
1889	1749	1609	1469	1329	1189	1049	
1882	1742	1602	1462	1322	1182	1042	
1875	1735	1595	1455	1315	1175	1035	
1868	1728	1588	1448	1308	1168	1028	

During the Math Task step of the Stress Assessment, use one of these tables of numbers to select a starting number and verify the performer's response.

1098	958	818	678	538	398	258	118
1091	951	811	671	531	391	251	111
1084	944	804	664	524	384	244	104
1077	937	797	657	517	377	237	97
1070	930	790	650	510	370	230	90
1063	923	783	643	503	363	223	83
1056	916	776	636	496	356	216	76
1049	909	769	629	489	349	209	69
1042	902	762	622	482	342	202	62
1035	895	755	615	475	335	195	55
1028	888	748	608	468	328	188	48
1021	881	741	601	461	321	181	41
1014	874	734	594	454	314	174	34
1007	867	727	587	447	307	167	27
1000	860	720	580	440	300	160	20
993	853	713	573	433	293	153	
986	846	706	566	426	286	146	
979	839	699	559	419	279	139	
972	832	692	552	412	272	132	
965	825	685	545	405	265	125	