# HEALTH AND STRESS

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# HOW ACCURATE ARE DEVICES FOR MEASURING STRESS?


KEYWORDS: "Cold feet", L. R. Hubbard, Scientology, Brainfingerprinting, fMRI, thermal imaging, laser Doppler vibrometry, CVSA, "truth specs", HeartMath, HeartTracker, Heart Tuner Pro, OmegaWave Sport, Physiolab


A plethora of products and procedures are available that claim to detect and measure emotional stress. They come in all shapes and sizes and vary in price from stress dots and cards that cost pennies or mood rings for a few bucks to laboratory tests, heart rate variability and functional magnetic resonance imaging instruments that can set you back hundreds or thousands of dollars. Some are based on various aspects of autonomic nervous system function and others utilize measurements of specific hormones, neuropeptide messengers and chemicals to rate stress levels and responses to stress. While not germane to this Newsletter, there are also a host of psychometric tests and questionnaires to assess anxiety, depression, anger, hostility as well as traits that have been linked to stress related disorders.

How accurate any of these are can be difficult to determine since stress is a highly subjective phenomenon that differs for each of us. Things that are very distressful for some can be an exhilarating pleasure for others or have little impact either way, as readily illustrated by observing passengers on a steep roller coaster ride. We may also respond differently to the same psychosocial stressor – some people blush, while others grow pale, perspire profusely, frown and scowl, or somehow manage to preserve an emotionless "poker face".

It is crucial to keep the above considerations in mind since attempts to prove the authenticity of various approaches are often based on how the subject responds to some standard stimulus that is assumed to be uniformly distressful or pleasurable. It is equally important to understand the mechanism of action of different devices to evaluate their appropriateness and accuracy for certain applications. I was prompted to discuss these issues partly because of the resurgent popularity of "biodots", "stress cards" and the explosion of free "E-meter" stress testing here and abroad, as well as some recent advances in the objective measurement of stress that have a much more solid and scientific basis.

**ALSO INCLUDED IN THIS ISSUE**

**Stress Dots, Squares, Cards, Thermometers And Mood Rings**

The term "cold feet" is believed to derive from an Italian expression "*avegh minga frecc i pee*" used in a very old proverb to signify not having any means or resources. Presumably, being very poor might mean that you could not afford shoes and were therefore likely to have cold feet. Its first English use as not having any money was in Ben Jonson's *Volpone*, a 1607 play that was set in Italy. It resurfaced in an 1862 novel about a card player who backed out of a game using the excuse of cold feet rather than the fear of losing his money and the expression came to mean to lose one's nerve or retreat from a difficult situation. "Cold feet" to describe being afraid appeared in America in the 1890's and may have been brought by Italian immigrants who were familiar with the old proverb. Some believe it might also refer to the association of fright with cold - chattering teeth, shivers, and chills, etc. Current synonyms for cold feet include anxiety, apprehension, distress, fear, fright and trepidation, as well as to "chicken out", avoid, beg off or bow out. These latter meanings, often used when someone wants to back out of a wedding, could also come from the practice of sticking a toe or foot in water to test its temperature and then deciding against "taking the plunge" because it was too frigid.

The proverb "cold hands, warm heart" infers that a seemingly reserved or cool exterior may often disguise a warm and kind heart. It is frequently said to someone with very cold hands in order to keep them from being embarrassed, especially when they are under stress. During stress, increased tension in the large muscles of the extremities and shunting of blood to vital organs reduces its flow to the hands and feet resulting in a reduction in temperature, particularly in the fingers and toes. These changes can be as much as 10 degrees (in the 82°F to 92°F range) depending on how relaxed or stressed you are. There are also thermometers calibrated to 1/10th of one degree that can be adhered to the hands to give direct temperature readings. Stress dots, squares, cards etc. that are applied to the extremities to assess stress levels contain thermal sensitive substances that vary in color depending on the temperature. The most common sites are the hands and fingers and one company offers the following interpretation for their products.

| COLOR | TEMPERATURE | STRESS LEVEL |
|---|---|---|
| Purple/Violet | 94.6 | Very Relaxed |
| Blue | 93.6 | Calm |
| Grass Green | 92.6 | Relaxing |
| Muddy Green | 91.6 | Involved |
| Light Gray/Brown | 90.6 | Unsettled |
| Dark Gray | 89.6 | Tense |
| Black | 87.0 | Very Tense |

Mood rings that were a fad three decades ago have also resurfaced, along with mood bracelets, pendants and earrings. These usually contain either a hollow glass shell filled with thermotropic liquid crystals or a clear glass stone sitting on top of a thin sheet of these crystals whose molecules twist or change position depending on the amount of heat they are exposed to. Temperature alterations in molecular structure affect the wavelengths of light that are absorbed or reflected by the crystals and this produces an apparent change in the stone's color. As the temperature increases, the resultant twist causes more absorption of the red and green portions of the visible light spectrum and more of the blue part is reflected, so that the stone now appears to be dark blue. When the temperature falls the molecules start to twist in the opposite direction and a different portion of the spectrum is reflected. There are also mood lipsticks that can change color but these operate on an entirely different principle that has relatively little to do with the wearer's mood. They contain weak acid pigments of one color conjugated with a base with a strikingly different color. Which of these prevails depends entirely on the amount of acid or base (pH) to which they are exposed. If you apply some of this lipstick to strips of filter paper and soak one in an acid like vinegar and another

in a solution of baking soda, a base, the color change will resemble what you see when the product is applied to your skin. However, in addition to stress, the pH of skin can depend on numerous factors, including diet, amount of physical activity and even the menstrual cycle. The great variety in natural skin colors can also cause differences in the color from application to application so the results are not consistent.

The inside of a mood ring conducts heat from your finger to the liquid crystals and green is calibrated to approximately 82°F., which signifies "average" on the mood ring color rating scale. As the your finger temperature goes up and down there are corresponding changes in the ring's color that are claimed to reflect the following moods:

| COLOR | MOOD |
|---|---|
| Dark Blue | Happy, romantic or passionate |
| Blue | Calm or relaxed |
| Aquamarine | Somewhat relaxed |
| Green | Normal or average |
| Amber/Yellow | A little nervous or anxious |
| Gray | Very nervous or anxious |
| Black | Stress, very tense or agitated |

There are numerous variations of this chart that ascribe different feelings to other colors that can occasionally appear. In one version, red is believed to be the color of passion and anger but could also represent "an adventuresome spirit or major excitement over something that is happening or about to happen in your life." Although green is "normal", it is the color of living plants and is often associated with growth, or "might indicate a healing time, a feeling of love, etc." Other colors sometimes seen and their significance include pink (fear), purple (sensuality), orange (a state of wanting something) and white (feeling frustrated, confused or bored). If you take a mood ring off, its color usually changes to black, unless the ambient temperature is very high.

**While biodots, stress cards, mood rings and other thermal detectors can indicate physical reactions to your emotional state they do not reflect your mood with any scientific accuracy because of numerous other influences.** You can register a cooler temperature if you have consumed caffeinated beverages, smoked, just finished exercising, eating, have not eaten for a long period of time, and if you have vasospastic or occlusive peripheral vascular disease. Room temperature is also important.

**Galvanic Skin Resistance, Psychogalvanic Skin Responses And E-Meters**

In addition to cold hands, emotional stress may also cause sweaty palms and increased perspiration elsewhere in the body that can be detected by measuring the electrical activity of the skin. There are several methods, including skin resistance (SR), skin conductance (SC) and skin potential (SP). SR and SC are monitored by the external application of a weak voltage across the skin and measuring its resistance to the flow of electricity. SP is measured by recording the internal electrical activity of the skin in the absence of any external influence by using silver/silver chloride electrodes that are particularly sensitive to such changes. Electrodes are usually placed on the palms of the hand or soles of the feet because these have the most sweat glands per surface area in the body and also respond more to emotional stress than to increased heat compared to sweat glands elsewhere. Other terms used to describe electrodermal activities include galvanic skin resistance (GSR) and psychogalvanic skin response (PSR). However, these are often ambiguous since they may refer to skin resistance, conductivity, potential or some combination of these.

The most popular devices measure galvanic skin resistance, which reflects sweat gland activity and pore size, both of which are controlled by the sympathetic nervous system.

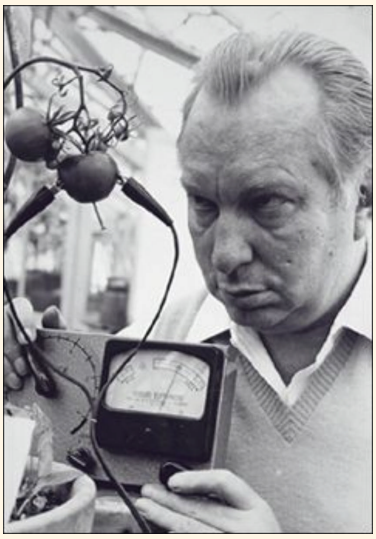
During psychological stress, stimulation of the sympathetic nervous system causes increased production of sweat composed of water and salt that reduces skin resistance, resulting in a fall in GSR. This can be measured using a Wheatstone bridge circuit that consists of electricity from a battery connected to a galvanometer that connects two parallel circuits. One circuit contains two resistors with a known resistance and the other has one of these and another whose resistance is not known. To determine this, the resistance of the other three are adjusted and balanced until the galvanometer reading decreases to zero. The Wheatstone bridge has been around since 1833 and its components can be purchased for a small fraction of the price of products that utilize this principle.

One popular instrument is the GSR II shown on the right. Instead of a meter, the GSR level is relayed by a tone that is generated when you rest two fingers on the sensing plates. It is often used as a biofeedback device since the tone rises and falls depending on your "stress level" and with practice you can learn how to relax and lower the tone. There are various enhancements including a meter that responds in a similar fashion as well as software to connect to a PC that has more elaborate color displays to improve its biofeedback capabilities.

There are many similar products, such as the Micronta Biofeedback Monitor that works on a similar principle but utilizes sensors contained in Velcro wrapped around two fingers of one hand. An oscillometer emits a high-pitched buzz due to decreased GSR when you are tense and nervous and this progressively changes to a slow popping sound when you become very calm and relaxed. Like the GSR 2, this device is also used to reduce stress as well as assist with such things as smoking cessation using supportive audiocassettes.

Hundreds of thousands of stress tests using an "E-meter" have been administered here and abroad by employees and volunteers from the Church of Scientology in an effort to sell copies of *Dianetics*, written by its founder L. Ron Hubbard. The back of the book, first published in 1950, promises advice for "living without insecurity, negative thoughts, depression and irrational behavior. Following the 9/11 tragedy, brightly colored booths advertising **"Free Stress Testing"** and a copy of *Dianetics* for $8.00 have increasingly sprung up at Times Square and other heavily trafficked subway hubs in New York and other cities, in front of Marshall Field's department store on State Street in Chicago, Old Navy and other popular stores on Market Street in San Francisco, in the middle of Cambridge's Harvard Square and other Boston gathering places and Buffalo's Lafayette Square, to name just a few. In Oregon, children are used to distribute flyers about the free stress tests at busy bus and other Portland transportation sites during rush hours. Booths can be found at numerous locations in Los Angeles, which is not surprising, since one street is named "L. Ron Hubbard Way". Visitors here and elsewhere are constantly reminded that Church of Scientology members who have fervently followed its teachings and encouraged everyone to do so include John Travolta, Tom Cruise, Kirstie Alley, Lisa Marie Presley, Chick Corea, Isaac Hayes, Sonny Bono and so many other celebrities that one local paper referred to Scientology as the "power religion of Hollywood." Hubbard, a pulp science fiction writer, founded the religious philosophy of Scientology in 1951 and the first Church of Scientology a few years later. To aid in recruiting members, he used an E-meter, which is an abbreviation for electro-encephaloneuromentimograph. Although Hubbard's name is on the patent application for the E-meter it was invented years earlier by Volney Mathison, a chiropractor. It was originally called the Mathison Model B Electropsychometer and was designed to be used as an aid during psychotherapy.

Hubbard's first E-meter, shown on the right, consisted of two metal cylinders connected to a galvanometer. A cylinder is held in each and the subject is asked to think about people or things that have a great deal of personal importance. When there is a high or low meter reading the subject is asked, "What were you thinking about?" Church counselors called auditors can quickly identify the source of any problems and teach the subject how to eradicate and prevent them by using the E-meter.



Scientologists state that the E-meter is so sensitive that it will react not only to people but also if it is connected to a vegetable, since all living things have feelings. One study allegedly showed that a tomato, when pierced with a nail, showed "definite emotional anxiety reactions" similar to those exhibited by the E-meter in humans suffering from anxiety. Hubbard also believed that tomato plants had past lives and that by "auditing" he could regress the plant into a former life to make it grow faster and yield more fruit. The photo on the left shows him giving spiritual counseling to a tomato plant using an E-meter adapted for this purpose. Since, according to Hubbard the device measured "electrical charges associated with thought", it can also be utilized to teach people how to think more clearly and constructively and even raise their I.Q. However, it is simply a GSR device.

Hubbard described Scientology as the science of "knowing how to know" and said that the E-meter auditing process could raise your abilities to the point where you "know" something directly because of supernatural powers, rather than having to discover or learn it. He claimed to have developed such abilities and boasted that he had transported himself to the planet Venus where he was nearly run over by freight locomotive and that people who looked like Eskimos inhabited Jupiter. **He also believed that smoking would prevent lung cancer since nicotine would turn into nicotinic acid (niacin) that could "drive out radiation and cancer from the body" and also prevent damage in the event of nuclear war.** The New Jersey Board of Medical Examiners instituted proceedings against Hubbard's Dianetic Organization for operating an unlicensed medical school and letting people append an "M.D." after their names to represent "Master of Dianetics." The Internal Revenue Service stripped Scientology's mother church of its tax-exempt status in 1967. A federal court also ruled in 1971 that Hubbard's medical claims were bogus and that E-meter auditing could no longer be called a scientific treatment. The government had previously determined that an E-meter cost only $12.50 to make but that Scientology organizations bought it wholesale for $47.00 and sold it for $162.00.

Hubbard responded by seeking First Amendment protection for Scientology's strange rites. His counselors started sporting clerical collars. Chapels were built, franchises became "missions," fees became "fixed donations," and his comic-book cosmology became "sacred scriptures." The FDA was also skeptical of the E-meter and required that it bear a warning stating it could not to be used for medical purposes but only as part of a religious activity. A FDA lawyer called the device "**a couple of juice cans that you'd hold in your hands, and the sweat would generate this electrical charge between, and it would show on a little gauge**." A reporter described its appearance as a "**cross between a car speedometer and a practical joker's electric shock machine**."

The E-meter subsequently underwent a number of upgrades culminating in the **Quantum Super VII on the right that sells for over $4,500.00**. Although it is based on the same GSR methodology, auditing sessions with such newer E-meters can cost up to $1,000 an hour or $12,500 for a 12 1/2-hour "intensive" session. **The full range of courses and all the "auditing" required to reach the highest level in Scientology could set you back as much as $360,000.**

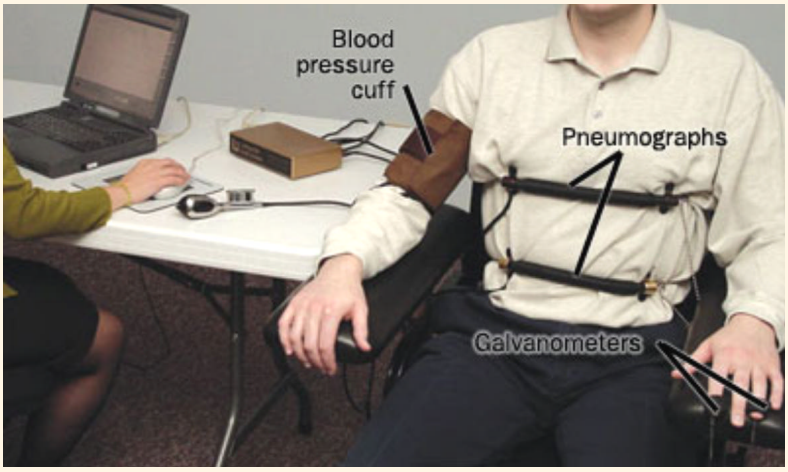
Church members swear by the device and use it constantly to make important decisions. As John Travolta explained to one reporter, "'You hold two metal rods in your hands, and an experienced teacher can tell from the movements of the needles on the meter where the problem is in your body and soul. I use it every day, at home or in the celebrity center in Hollywood. I also take a machine with me when I'm on location. It's a religious device and I enjoy it. I'm always totally refreshed by it." That seems strange, since **the E-meter was originally designed to aid in the treatment of psychiatric disorders, which is anathema to scientologists**. Tom Cruise almost came to blows on the *Today* show after host Matt Lauer told him he knew of patients who had been helped with medications for depression and other emotional problems. Like other ardent Scientologists, Cruise doesn't believe in drugs or any kind of therapy for psychiatric disorders since following the Church's approach is more effective and safer. The heated debate received a great deal of media attention and some believe it may have been staged to promote the upcoming *War of the Worlds* movie in which he stars.

**The problem with GSR devices is that some people inherit a tendency to sweat excessively, especially on the palms and the soles of their feet, beverages containing caffeine and alcohol and spicy foods can increase sweating and various medications as well as common drugs like aspirin and Tylenol also influence perspiration.** Increased sweating may occur in obesity, hyperthyroidism, diabetes, infections, lymphomas and other malignancies and during menopause. **The E-meter metal cylinder electrodes can produce significantly different results depending on how much sweaty skin they come in contact with and how tightly they are held.** Because of polarization, E-meters may also require periodic recalibration, which can be expensive.

**The Polygraph And Other Devices To Detect The Stress Of Lying**

It seems incredible to some authorities that so many law enforcement agencies as well as the U. S. Government continue to rely on the polygraph as a truth verification device. This is especially true since a 2003 report by the National Academy of Sciences recommended that the use of the polygraph should be discontinued because of its high rate of inaccuracy. Serious polygraph failures that have been very costly have been recognized for some time. Aldrich Ames, who had a very sensitive position at the CIA, became a traitor and over a long period of time, sold information as well as the names of operatives working in the Soviet Union to the KGB. He was able to continue his treachery because he was easily able to pass his periodic polygraph examinations. As he said, "There is no trick to it, just smile and make the examiner think you liked them." The KGB executed eleven CIA operatives identified by Ames and untold harm was done to our national security because of the CIA's reliance on the polygraph. Leon Ridgeway pled guilty to murdering 48 women in the Seattle area over a twenty-year period. Ridgeway was given a polygraph exam following the murder of his fourth victim, was dropped as a suspect after he passed it, and went on to kill another 44 women. Charles Cullen, "The Angel of Death Nurse" nurse murdered more than 40 patients over a ten -year period by giving them lethal injections. After his first victim's death he was asked to take a polygraph test because he was considered a prime suspect. After passing the polygraph he was exonerated and went on to kill at least another 39 people. Several Internet

sites offer ways to beat the polygraph and in one study, 50% of college sophomores learned how to do this successfully after just 30 minutes of training. Others have found that taking sedatives to dampen sympathetic responses, smearing antiperspirant on their fingertips to fool GSR detectors and putting tacks in their shoes or biting their tongues or cheeks to create abnormalities at whenever they choose to can invalidate the test.




As shown on the right, the polygraph attempts to detect the stress that is induced by lying through measuring changes in blood pressure, heart rate, galvanic skin resistance as well as chest and abdominal breathing. The procedure requires a trained investigator to administer the test and to interpret the results. Costs can range from $400 to $1600 or more/test depending on where it is being conducted and who is doing it. It can also be very time consuming and take up most of the day, depending on the number of questions asked and how difficult it is to interpret the results.

The polygraph is not much better at detecting the truth. Chicago police arrested four men in 1978 on charges of brutally murdering a suburban man and his fiancée. All the suspects maintained that they were innocent but there was little doubt of their guilt since three had failed a polygraph exam. Largely because of this, all were convicted and two received death sentences. However, in 1996, incontrovertible DNA evidence completely exonerated all four. More recently, a week before Saddam Hussein's sons were killed in a shoot-out, an informant told military intelligence that he could show them the house in Mosul where they were hiding. However, this information was ignored because he failed the polygraph test. One week later, the owner of the same Mosul hideout the tipster had identified also told authorities that the two sons had been hiding there for some time. Special Operations subsequently raided the house and Uday and Qusay Hussein were killed after putting up fierce resistance. It is not clear who will collect the $15 million bounty offered for information leading up to the apprehension of each of Saddam's sons.

As a result, there have been attempts to develop more accurate lie detectors that the courts would accept as valid evidence. In one known as Brainfingerprinting, relevant words, pictures or sounds intermixed with irrelevant and control stimuli are presented to a subject whose brain waves are being monitored on a computer. The data is then analyzed to determine if the pertinent information is present in the subject's memory. A specific, measurable brain response known as P300 is emitted by anyone who has the relevant information stored in his brain but not by individuals having no memory of the same stimulus. This P300 response occurs in fractions of a second after the relevant stimulus is presented and long before the subject is able to formulate or control any response. According to the inventor, simply presenting evidence associated with a crime to a suspect would produce a pattern indicating innocence or guilt with 100% accuracy. Brainfingerprinting has already been approved in at least two States for utilization in court as admissible, factual evidence and is also increasingly being used by the FBI.

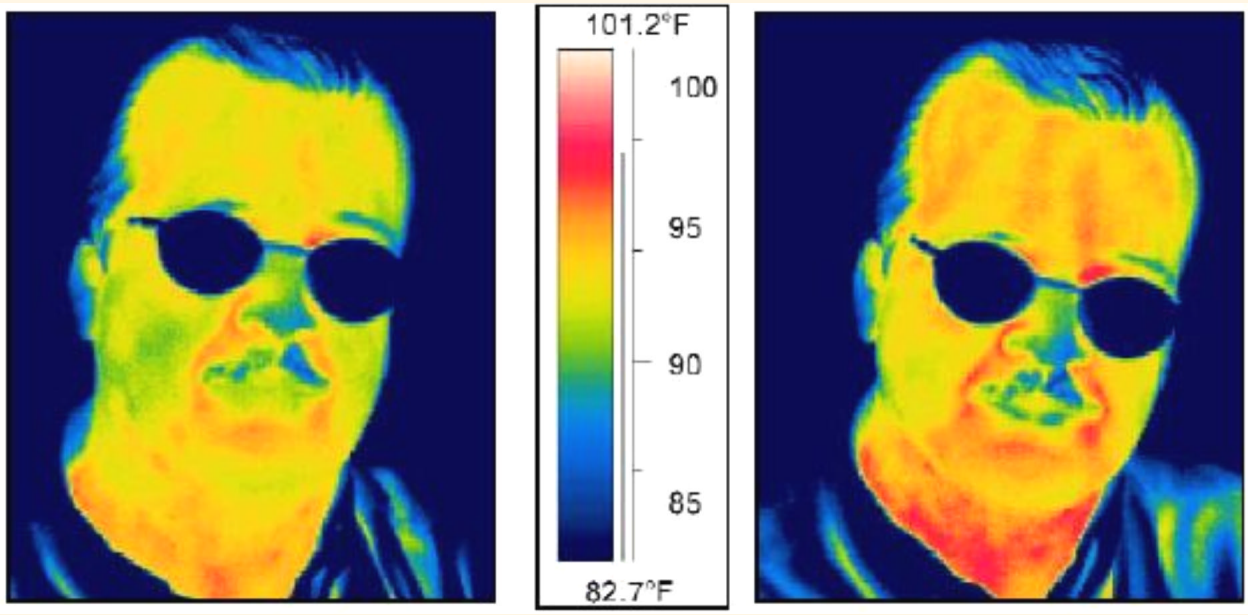
Terry Harrington was convicted of murder in 1978 and was serving a life sentence in an Iowa prison. In 2000 a Brainfingerprinting test showed that the record stored in his brain did not match the crime scene but did match his alibi. Confronted with this evidence, the only alleged witness to the crime recanted. In a sworn statement, Harrington's accuser confessed that he

had lied in the original trial to avoid being prosecuted for the crime. During Harrington's appeal, a District Court Judge ruled that Brainfingerprinting testing met the legal Daubert Standard for admissibility in court as authentic scientific evidence. In 2003, the Iowa Supreme Court reversed his conviction. In Macon County, Missouri a Brainfingerprinting test on J. B. Grinder, who had been a suspect in an unsolved murder case for 15 years showed that the record stored in his brain matched critical details of the crime scene that only the perpetrator would have known about. Faced with an almost certain conviction and a probable death sentence, Grinder pled guilty in exchange for life in prison without the possibility of parole. He then also confessed to the previously unsolved murders of three other women.

There are numerous other applications including the ability to accurately and immediately identifying terrorists. Although evidence such as fingerprints or DNA may not be available, the brain of the perpetrator always retains memories of planning, executing or recording the crime that can be detected. Brainfingerprinting can also be used for the early detection of certain disorders and to accurately access the efficacy of treatment. Research studies suggest that analysis of the P300 brainwave is extremely effective at identifying the onset of Alzheimer's and its degree of severity. Testing at periodic intervals would allow measuring disease progression as well as response to therapy. Such a capability would allow manufacturers to more accurately determine the effectiveness of promising drugs for Alzheimer's and reduce research and development costs by getting them approved more rapidly. Specific information that people retained from a media campaign could also be identified, adding a whole new dimension to measuring advertising and marketing efficacy that would be far superior to subjective surveys and focus groups.

In addition, scientists at the University of Texas Research Imaging Center are mapping which parts of the brain are being used when a person lies by using advanced MRI technology. As the lead researcher explained, "We can tell if people are lying or telling the truth. The brain has a difference, a blood flow change, and people who have to think about how they lie use the calculation center of the brain." Because the technique measures brain responses, he believes it would be far superior to the polygraph because "the brain is where the lie comes from." Using the same functional magnetic resonance imaging (fMRI) scan that picks up brain tumors, Temple University Medical school radiologists similarly found that different areas of the brain were activated when a person told the truth as opposed to when they lied and that more areas of activity were noted when the person was trying harder to be deceptive. In one experiment, six of 11 volunteers were asked to fire a toy gun and then lie about whether they had pulled the trigger. The other five were asked to tell the truth about what had happened. Each of the participant’s brain was then scanned using fMRI while being asked questions about the incident. A polygraph test was simultaneously conducted to compare the accuracy of the two methods. Unlike the polygraph, the fMRI accurately distinguished between subjects who were telling the truth and those who were lying in all cases. Unfortunately, fMRI imaging is too costly at present to permit widespread use but this may change.

Another new technology being explored is a thermal camera that can detect minute changes in temperature. Mayo Clinic researchers had a thermal camera trained on a subject’s face when an accident caused a large slab of marble to come crashing to the floor. They noted that the unexpected noise resulted in an explosion of heat in parts of the face and neck due to a surge of blood. Since this reaction to sudden stress was clearly visible with the camera, they speculated that a similar response might be elicited in other types of acute stress, such as that caused by lying. Subsequent studies have now confirmed this.



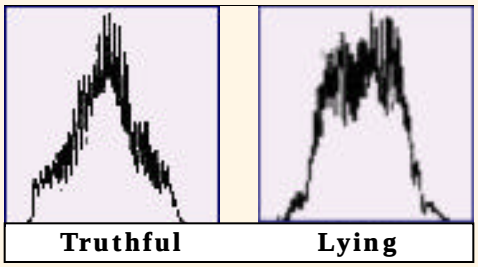

**Normal Facial Thermogram** **Facial Thermogram When Lying**

The thermogram on the right shows marked facial color changes indicating that the man may be lying. The camera, which is the size of a postage stamp, can be concealed and trained on a subject without their knowledge. Since the results are available immediately, it could be used on someone trying to enter the country who is being questioned by a customs agent or when going through check-in procedures prior to boarding a plane.

Another surreptitious device that the Defense Department is studying is a computer screen embedded with infrared light sensors that tracks a person's eye movement in a way that can elicit the truth without anything being said. The technology is based on the principle that people's eye movements will betray whether the person or place they're staring at is familiar to them. By flashing pictures of people and places onto the screen, the computer can detect whether a subject has seen a particular person such as a crime victim or has been to a specific location like the crime scene. This may be especially useful in situations like child abductions when authorities are often dealing with a known population of offenders. If these individuals are shown images of a missing child or place where the abduction occurred, the guilty party is apt to betray himself through the movements and reactions of his eyes that can be recorded with great accuracy. This approach is also based on a serendipitous observation made 6 years ago when a University of Illinois researcher found that by tracking where you look, the number of places you look at and how long you view each area, he could tell whether you had seen a face or scene before. He found that people move their eyes over fewer areas when viewing familiar scenes, and gravitate to areas of previously viewed scenes that have been modified. The following year, he published a paper showing that that this was true even in people with amnesia. This means that even accomplished liars would find it tough to beat the eye-tracker because it's easy to see when subjects don't follow the instructions. As he warned, "If you're not looking at the image or you're blinking, we'll know. If you stay fixated on one point and don't move your eyes, we'll know. Or, if you look too little at a particular region, we will know, because that's exactly what we're measuring."

The eyes are not the only part of the human body that may reveal lies and deception. Another new technology gaining interest is based on new evidence that muscle tissue in certain locations have different vibration patterns when people are experiencing stress compared to when they are completely relaxed. Laser Doppler vibrometry testing involves pointing a laser at a person's carotid artery to obtain a baseline pattern during a conversation in which neutral questions are answered. When loaded questions are interspersed a change

in vibrations" can indicate if the subject is lying or being deceptive since these patterns are different due to stress. Vocal muscle vibration changes are also the basis for the Computer Voice Stress Analyzer (CVSA), currently used by over 1400 law enforcement agencies.




A microphone is attached to a state of the art computer that can analyze each voice pattern response to detect certain inaudible tell tale vibrations. Voice is made up of audible amplitude (AM) and inaudible frequency (FM) modulated sound waves. Microtremors are tiny frequency modulations and when someone is under stress, as occurs with lying, the involuntary nervous system causes an inaudible increase in microtremor frequency that the CVSA can detect, measure and graphically display as shown on the left.

For less than $150.00 you can buy the Handy Truster, which, according to the manufacturer, monitors the level of stress in a person's voice and can distinguish true and false statements with 82% accuracy. It can be used in person or over the phone, works in any language and displays nine different levels of stress on a LCD screen as noted below.

**The Handy Truster**

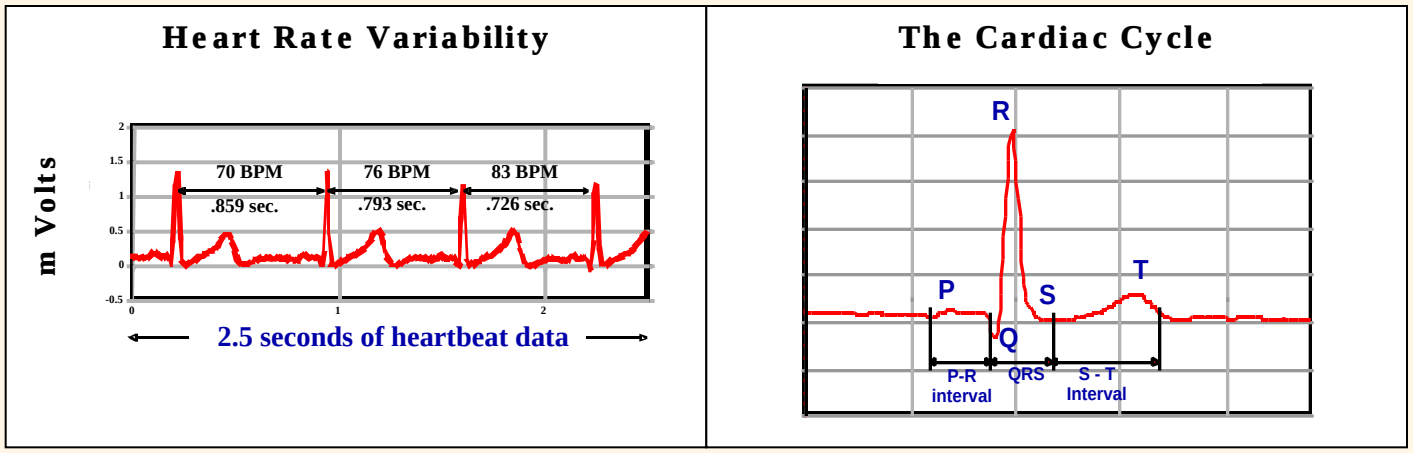
| | Result Display | Stress Indicator |
|---|---|---|
| Level | Results Displayed by Nine Different Levels | Stress Indicated by Nine Different Levels |
| 1st | Truth | Stress 90% |
| 2nd | Outwit | 80-90% |
| 3rd | Excited | 70-80% |
| 4th | Unsure | 60-70% |
| 5th | Very Excited | 50-60% |
| 6th | Avoidance | 40-50% |
| 7th | Extreme Tension | 30-40% |
| 8th | Inaccurate | 20-30% |
| 9th | False Statement | 10-20% |

For around $400, you may soon be able to buy "truth specs", or voice analysis glasses.

An invisible chip inside the glass uses 8,000 algorithms to measure 129 aspects of the sound produced when someone speaks. These are analyzed and the results are displayed on the inside of the frame as a red, yellow or green light to indicate a lie, possible lie, or the truth. Accuracy is allegedly better than 95 percent. The Israeli-developed technology is being used for applications varying from anti-terrorism and law enforcement to insurance and workers compensation claim assessment. Also available is a PC program that can analyze telephone or TV voices to detect whether witnesses during trials or candidates in presidential debates are telling the truth.

**Is HRV The Answer To Measuring Stress Levels And Reducing Them?**

HRV (heart rate variability) literally means that the heart does not always beat at the same rate. Your pulse is lower during sleep and deep relaxation and increases with physical or emotional stress. Heart rate also fluctuates with breathing. It rises when you inhale and falls when you breathe out in a normal response known as RSA (respiratory sinus arrhythmia). Unlike heart rate, which is easy to measure, the change in time from heartbeat to heartbeat during respiration is difficult to detect on physical examination since it is only a few milliseconds. HRV was originally measured manually by calculating the mean interval between successive heartbeats and their standard deviation from ECG monitoring over periods ranging from 5 minutes to 24 hours. Since then, computer analysis has led to at least two dozen different arithmetic manipulations to measure HRV in consecutive cardiac cycles, including cycle length variability, heart period variability, R-R wave variability, and R-R interval tachogram. These complicated terms emphasize that **HRV really refers to analyzing the interval between consecutive beats rather than actual changes in heart rate**. The R wave is an upward deflection in the electrocardiogram that reflects the ventricular contraction of each beat as noted below. (Illustrations courtesy of www.heartmath.org)




The normal HRV above that occurs with respiration is a measure of how well you adapt to changes in both the internal and external environment. A decrease in HRV reflects a relative inability to maintain homeostasis that could be potentially dangerous. The effects of emotions have been vividly demonstrated in studies showing that public speaking, solving mathematical problems or making complex decisions under time pressures and other stressful tasks lower HRV. Even thinking about something very stressful diminishes HRV whereas feelings of deep appreciation and love have an opposite and immediate effect.

In addition to these dynamic stress responses to stress, HRV also seems to be a marker for the cumulative wear and tear that occurs with aging. Although resting heart rate does not change significantly with advancing years there is a progressive decline in HRV. Conversely, regular physical activity, which can slow down the aging process as well as reduce stress, raises HRV. Lack of HRV is often seen in infections ranging from AIDS and herpes to flu and the common cold that have been shown to be associated with stress induced reduction in immune system defenses. Low HRV has been demonstrated in patients who are depressed, hostile as well as anxious, particularly in those suffering from panic or posttraumatic stress disorders as well as certain phobias.

HRV has already been recognized as an accurate and objective tool to evaluate the significance of stressors as well as the severity of cardiovascular and other stress related disorders. A recent conference on the relationship between occupational pressures and heart disease included six papers in which HRV was used to prove this link that correlated with results from the demand/control and effort/reward approaches used to quantify job stress. Lack of HRV is often seen in coronary heart disease and hypertension and several prospective studies have

shown that low HRV independently predicts mortality within the next two years following a heart attack and especially from lethal arrhythmias. It may also explain why depression following a heart attack is associated with increased cardiac morbidity and mortality. HRV is significantly depressed in patients with heart failure and those with the lowest values have the poorest prognosis. Certain cardiac drugs that prevent heart attacks and arrhythmias improve HRV. So do fish oil supplements, wine and exercise, all of which can have cardioprotective as well as stress reduction effects. In one report of over 7,000 individuals with normal blood pressures at baseline, low HRV also predicted greater risk of developing hypertension over 9 years of follow-up.

There are also very important metabolic correlations. Low HRV is found in patients with obesity, insulin resistance and metabolic syndrome that can result from stress related increases in cortisol and HRV is reduced when tumor necrosis factor (TNF) is elevated. TNF is a proinflammatory cytokine that has adverse effects on insulin resistance, lipid metabolism, coagulation, and the function of endothelial cells lining blood vessels. Coronary atherosclerosis and many other disorders are now thought to be due to increased inflammation and blocking TNF has been shown to be beneficial in rheumatoid arthritis, ileitis and other inflammatory diseases

In addition to various time measurements that reflect autonomic nervous system and baroceptor activity, recent HRV research has focused on frequency domain methods using spectral analysis of power components. The three major components are VLF (very low frequency), LF (low frequency) and HF (high frequency) oscillations. These are associated with different parasympathetic and sympathetic system influences but may also be affected by the renin-angiotensin system and other hormonal and neuroendocrine activities too complicated to discuss here but will be reviewed in a future issue. In a Newsletter written about ten years ago, I described the HeartMath Freeze-Frame technology that allows subjects to view HRV in real time, see how it is lowered by stressful feelings, and learn through biofeedback how to correct this. This technique has been found to be successful in reducing job stress, improving performance and creativity in school children and to provide a variety of other benefits.

Since then, Heart Rhythm Scanner, HeartTracker, Heart Tuner Pro, Omegawave Sport, Physiolab and various instruments that monitor HRV in addition to other stress parameters have been used for similar purposes, as well as others ranging from assessment of athletic fitness and biological age to assisting in smoking cessation by reducing the stress associated with such attempts. New enhancements such as analysis of pulse signals using photoplethysmography and improvements in frequency domain measurements promise to provide additional valuable information on the clinical significance of various HRV components. Stay tuned for information on the use of HRV for assessing stress and alleviating stress-related disorders from new devices and novel approaches developed here and abroad that we plan to feature in a future Newsletter devoted to heart rate variability.



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