



# *Psychophysiology today*

the magazine for mind-body medicine



**Things work out best for the people who make the best  
out of the way things work out.**

*Author unknown*

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## From the Editor



In this new issue, just published before the 10<sup>th</sup> Anniversary meeting of the Biofeedback Foundation of Europe, I hope to share excitement of this field and welcome you to my home town Vienna. This year I wore two hats, Editor-in-Chief of *Psychophysiology Today* and Program Chairperson for the 10<sup>th</sup> Anniversary meeting. Each job demanded more time than was available in the day. I am excited to have organized the meeting here in Austria and thereby contribute to the growth of Biofeedback and Neurofeedback here in my own country.

We have tried to make the Tenth anniversary meeting an unforgettable one. It includes an outstanding workshop and scientific program as well as an exposure to Austrian cultural experiences. The first informal evening gathering after the workshops will be at an original Austrian “Heurigen” (a typical local winery). The other evenings, participants and presenters can join each other at local dining places to experience the typical Austrian “Gemütlichkeit”. The highlight of the program, accompanied by the music of Strauss and Mozart, will be the Gala Dinner in the centre of town. Dinner will be followed by a dance performance by the famous Viennese Opera Ballet who will also teach the Viennese waltz. The evening will end in dancing to the music of a young piano player.

For more information about the meeting workshops and scientific program see: [www.bfe.org](http://www.bfe.org)

I want to thank the authors for their contributions and especially Martin R. Smith who made it possible to reprint a wonderful article by Majorie Toomim, one of the pioneers in the fields of biofeedback, who died last year. I also wish to thank Don Moss for writing the gentle and sensitive memorial note.

My special thank you is directed to our editor Jessica Cameron who was most helpful and spent much time on editing this issue.

I hope that the selected articles are beneficial and useful. I look forward to your future submissions on common interests, case descriptions, research articles and/or educational or diagnostic procedures. This information helps to disseminate Biofeedback/ Neurofeedback with the underlying premise that body and mind are much closer connected than many think. Please send feedback to ([editor@bfe.org](mailto:editor@bfe.org) )

We appreciate hearing from you.

Monika Fuhs  
Editor-in-Chief

## Note from the President of the BFE Scientific Advisory Board



Under the ongoing leadership of Editor-in-Chief Monika Fuhs, *Psychophysiology Today* shares the unlimited possibilities of applied psychophysiology and biofeedback. Besides being Editor-in Chief, she has taken on the additional daunting task of program chairperson for the BFE's 10<sup>th</sup> anniversary meeting in Vienna, Austria. She and the program committee have pulled together an outstanding faculty of international scientists and clinicians for the workshop and scientific programs. The topics of the workshops range from training in QEEG guided neurofeedback to pelvic floor sEMG. Specific workshops focus on well designed and tested treatment protocols for disorders such as ADHD, neuromuscular rehabilitation, repetitive strain injury, headaches, addiction and anxiety. The scientific program offers invited lectures, symposia and paper sessions ranging over peripheral bio-feedback and neuro-feedback. The EEG track of the program under the leadership of Professor Barry Sterman explores why SMR training is effective. It offers the physiological and functional basis of findings with SMR and slow cortical potential feedback training. It is a must for anyone interested in neurofeedback. While the peripheral biofeedback track offer the latest research finding in areas ranging from headache treatment to applications of heart rate variability.

The BFE looks forward to seeing each of you at the 10<sup>th</sup> Annual meeting in Vienna, February 14-18, 2006. For more information see: [www.bfe.org](http://www.bfe.org)

Finally, to make *Psychophysiology Today* dynamic and useful, I invite each of you to submit articles, short reports, clinical/educational procedures for possible publication.

I look forward to seeing you all in Vienna.

Erik Peper, Ph.D.  
President  
Scientific Advisory Board

## Guidelines for submissions to *Psychophysiology Today*

*Psychophysiology Today* is published and distributed by the Biofeedback Foundation of Europe as an e-magazine.

Items for inclusion in *Psychophysiology today* should be forwarded to [editor@bfe.org](mailto:editor@bfe.org)

Articles should be of general interest to the Biofeedback community.

The general interest of the BFE is to offer educational, informative and, where possible, factually based articles and information.

All articles are reviewed by our editor team, the editors reserve the right to accept or reject any material and to make editorial and copy changes as deemed necessary.

Feature articles should not exceed 2,500 words; department articles 700 words; and letters to the editor 250 words. Manuscripts should be submitted electronically, preferably Microsoft Word. PDF files and scanned documents can not be accepted.

If your files are too large to send electronically please submit on a disc to the address below.

For the authors section submit a biographical sketch (30 words) and photo of the author.

Graphics and photos may be embedded in Word files to indicate position only. Please include the original, high- resolution graphic files with your submission- at least 266 dpi at final print size. GIF or TIFF preferred for graphs and JPEG for photos.

BFE is not responsible for the loss or return of unsolicited articles.

***Articles in this issue reflect the opinions of the authors, and do not reflect the policies or official guidelines of BFE unless stated otherwise.***

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- Gabe Sella, Ph.D. USA
- Erik Peper , Ph.D. USA

### **Language editors:**

- Jessica Cameron, AUS
- Laurence Todd, GB

## We are pleased to introduce our team of editors

### Monika Fuhs, Mag.rer.nat., Dipl.Psych.

Monika Fuhs: Studied Psychology at the University of Vienna worked at the neuropsychiatric station for children at the Vienna AKH for many years as well as doing a study about kids and development of language for the Vienna Academy of science. Board member of the ÖBfP (Österreichische Gesellschaft für Biofeedback und Psychophysiologie), editor of the new BFE Journal 'Psychophysiology Today', author of articles with Erik Peper, Co- Director of Work Solutions for the “Healthy Computing and prevention at the worksite” program and Director of the Holistic Learning Institute. Monika Fuhs is a licensed teacher and trainer for dyslexia and perception problems (ReLeMaKo®) and brain-friendly learning. She teaches workshops in the fields of stress management, Holistic Health, Healthy Computing and optimum human functioning with Erik Peper and brain management and “brain – friendly” teaching and learning in different schools, workshops for “Stress Management and Success for Kids” as well as leading a private practice for kids and adults. Her main interests focus on mind body medicine and what it takes to make people change and how biofeedback and related therapies can help to make this process as successful as possible.

### Daniel Hamiel, Ph.D.

Daniel Hamiel, Ph.D. is head of the Cognitive-Behavioral and Psychophysiological unit, Tel-Aviv Mental Health Center, Tel-Aviv University, Medical School. Director of Cognitive-Behavioral Intervention, the Cohen Harris Center for Trauma and Disaster Intervention. He is a clinical psychologist, certified in biofeedback (BCIA), neurofeedback, and hypnosis. Past president of the Israeli Association of Biofeedback, he teaches workshops on cognitive psychology and biofeedback in many countries. He was in a clinical practice in Cincinnati, Ohio from 1992-1995. Currently, Dr. Hamiel is involved in developing and performing a stress management program in schools in Israel, Turkey and the USA, for schools that have suffered terror attacks.

### Don Moss, Ph.D.

Donald Moss, Ph.D., is adjunct graduate faculty in Health Psychology at Saybrook Graduate School in San Francisco, California, and a partner in West Michigan Behavioral Services in Grand Rapids, Michigan. He is Editor of the *Biofeedback Magazine* and Consulting Editor for the *Journal of Neurotherapy* and the *Journal of Phenomenological Psychology*. Dr. Moss has over 50 publications in the fields of psychophysiology, biofeedback, and mind-body therapies, including an edited book (*Handbook of Mind Body Medicine for Primary Care*, Sage, 2003). He has given lectures and workshops on these topics throughout the world, including recent presentations at the Association for Applied Psychophysiology and Biofeedback, the International Association for Cognitive Psychotherapy, the World Congress of Behavioral and Cognitive Psychotherapies, and the Biofeedback Foundation of Europe. He is also past-president of AAPB.

### Erik Peper, Ph.D.

Erik Peper, Ph.D. is an international authority on biofeedback and self-regulation. He is Professor and Co-Director of the Institute for Holistic Healing Studies / Department of Health Education at San Francisco State University. He is President of the Biofeedback Foundation of Europe and past President of the Association for Applied

Psychophysiology and Biofeedback (AAPB). He holds Senior Fellow (Biofeedback) certification from the (BCIA) Biofeedback Certification Institute of America. He received the 2004 California Governor's Safety Award for his work on Healthy Computing. He is an author of numerous scientific articles and books. His most recent co-authored books are *Healthy Computing with Muscle Biofeedback*, *Make Health Happen Training: Yourself to Create Wellness* and *De Computermens*. He is also the co-producer of weekly *Healthy Computing Email Tips*.

### **Gabriel Sella, M.D.**

Gabriel E. Sella, M.D. has been a member of AAPB for over 10 years. He has done research and clinical work in the area of biofeedback for over 10 years. Dr. Sella has published 85 peer-reviewed papers, 10 textbooks and 1 technical CD ROM. He has written chapters in several scientific textbooks and publications. Dr. Sella has given 267 international conferences and seminars, many of them in the area of SEMG investigation and neuromuscular rehabilitation as well as soft tissue injury and pain. Dr. Sella is a founding member of the Biofeedback Foundation of Europe. He is on the editorial board of several journals, including *Europa Medicophysica*.

### *Section Language and style:*

### **Jessica Cameron**

Jessica hails from Australia and holds a Bachelor of Arts in English Literature and a Post Graduate Diploma in Management. She is an enthusiastic advocate of biofeedback and works with her partner, Dr. Martin Brink, running an institute for the treatment of chronic pain patients in Berlin. Furthermore she is willing to serve as a volunteer in editing *Psychophysiology today* which ironically takes her back to her first career role as a book editor.

## Announcement of interesting Meetings

*February 14-18 2006*

### 10th Annual European Biofeedback Conference in Vienna:

*The 10th European Biofeedback Conference will be held in Vienna, Austria. This conference is organized by the Biofeedback Foundation of Europe (BFE) and the Austrian Society for Biofeedback and Psychophysiology (ÖBfP).*

Many well-known biofeedback and neurofeedback clinicians and researchers from Europe and North America will present workshops on February 14, 15, 17 and 18, 2006 and scientific lectures, papers and poster presentations on the evening of February 15 and on February 16, 2006.

The conference focuses upon presenting the most recent biofeedback and neurofeedback techniques, research, clinical and educational findings and training. These insights are of interest to many health care professionals such as physicians, physical therapists, occupational therapists, behavioral therapists, psychologists and psychotherapists.

The workshops are structured to provide in-depth mastery of applied psychophysiology skills for specific applications in areas such as:

- The use of sEMG (muscle biofeedback) in clinical practice
- Biofeedback and related treatments for recurrent headache disorders
- Breathing for mind-body balance
- Healthy computing with biofeedback
- HRV (Heart Rate Variability) biofeedback in cardiac rehabilitation
- Pain management with biofeedback and neurofeedback
- Biofeedback in central nervous system damage
- Integrating psychophysiology with psychotherapy
- Pelvic floor muscle sEMG for urogenital disorders
- Biofeedback and self-regulation in the class setting
- Optimizing children's chances for personal growth
- Fundamentals of neurofeedback and advanced neurofeedback
- Alpha-theta training for addiction
- Resilience for enhancing biofeedback results
- Hemo-encephalography (HEG) biofeedback
- QEEG guided neurotherapy

For more information about the conference

Visit <http://www.bfe.org/meeting.html>

there you will find information such as the Workshop Schedule, Scientific Program, Cultural Program, Travel and Hotel information, and how to register.



## IN MEMORIAM



### Marjorie Toomim: A Pioneer in Biofeedback Research

**D. Moss, Ph.D.**

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#### The Career of Marjorie Toomim

Marjorie Toomim, Ph.D., died January 18, 2005. Dr. Toomim was a pioneer in the use of biofeedback instrumentation, especially in psychotherapy and pain treatment. She was a clinical psychologist, licensed to practice in California since 1966. She began practicing biofeedback in 1970, less than a year after the founding conference of the Biofeedback Research Society, the first professional society in the field. She developed a strategic approach for using biofeedback instrumentation, especially the Galvanic Skin Response (GSR), during sessions as a guide to enhance the practice of psychotherapy. That approach is introduced very well in the following article originally published in 1975. Dr. Toomim's career was deeply intermingled with that of her husband and collaborator Hershel Toomim, who is the co-author of this paper.

Marjorie and Hershel Toomim founded the Biofeedback Research Institute, later known as The Biofeedback Institute of Los Angeles. Together they gave selflessly of their time, teaching and mentoring several generations of students and professionals in the practice of biofeedback.

Marjorie Toomim continued to make the practice of psychotherapy one of her highest priorities. She was a charter member of the International Society for the Study of Dissociation, and utilized the GSR to guide the understanding and resolution of post traumatic stress.

She also was proud of her approach to pain treatment, which she called *Myo-Kinetic-Training*. She utilized electromyography to assess muscle imbalance and overuse, during activities of daily life, and guided the patient's recovery through strengthening weak muscles, stretching contracted muscles, and correcting posture and muscle balance. She described that approach in a book, *Stretch your Pain Away*.

Most of all, Marjorie Toomim was a remarkable, warm, and compassionate human being, who is remembered with fondness by those who knew her.

...more Memories...

In the first months of the year, AAPB lost three of its pioneer members- people who made a mark on our association and whom will miss. Marge Toomim died in January. She was an active member and teacher in AAPB for 30 years. She and Herschel received the AAPB President's Recognition Award last year.

David Jacobs died suddenly on February 20. Dave served as Chair of BCIA in its formative years. A special memory is one evening when we decided to cook dinner for the entire BCIA Board and succeeded in setting off the smoke alarm in the hotel, thus evacuating everyone. On March 2, Jeff Cram succumbed to a rapid illness. Jeff was a powerhouse in AAPB, a prolific writer, teacher and clinician.

## **Marjorie Toomim: A Remembrance**

***M. R. Smith***

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When I was in graduate school in 1976, Albert Ellis's rational emotive therapy was beginning to have an impact on the practice of psychotherapy and I was well schooled in how present experiences, filters through a rigid belief system, could strongly influence subsequent thinking, feeling and behavior. My professors, however, also admired Carl Rogers, so the phrase "empathy, congruence and unconditional positive regard" was given equal emphasis as being critical to effective therapy. My practicum professor drilled us in the use of Cakhuff's scale of empathic responding, and I became fascinated with how delicate the dance of human interaction can be, how a simple verbal response can either invite people to risk revealing themselves, or can shut down the process of self- disclosure altogether.

When I first read that a voice stress analyzer could not only detect deliberate falsehoods, but could register the stress of self-protective denial as well, I immediately set about researching how biofeedback could be used to guide therapy, like an emotional Geiger counter, by gauging the level of empathic exchange between therapist and client. A number of articles focused on the use of biofeedback to measure and reduce the physical markers of tension and stress, particularly Budzinsky and Stoyva's idea of generalized muscle relaxation.

Only one article, "GSR biofeedback in psychotherapy: Some clinical observations", by Marjorie Toomim and Hershel Toomim (1975), had what I was looking for. The article spelled out in detail the principles and process of feedback- directed, continuously monitored therapy. The death of Marjorie Toomim on January 18 brought a flood of memories and emotions, and made me realize how much this remarkable and generous woman had taught me and given to me, and how extensive her contribution to the biofeedback community and psychology in general has been.

In April 1979, I arrived in Los Angeles to begin primal therapy with the goal of becoming a therapist at the Institute. While waiting to start, I reread Marge's article, which I carried with me everywhere I went. I knew Marge's Biofeedback Institute was also in L.A. so called to tell her how impressed I was with her work. She invited me to come by and sit in on a supervisory session of students taking her certification course. I was struck by the warmth and care with which she responded to questions and how gently she guided her class through the complexities of using what was, to more than a few, a daunting and mysterious technology. Several years

later I took her class and learned first-hand how skilled in biofeedback she and Hershel were, and how significant Marge's thinking was in shaping treatment approaches for people suffering from trauma based dissociative disorders.

Marge was a charter member of the International Society for the Study of Dissociation. In the 1980s, a number of researchers realized that the posttraumatic reactions seen in combat veterans were also evident in adult survivors of early and prolonged child abuse. The history of repeated trauma followed by a collapse into protective, compensatory shock, experienced by children in severely dysfunctional families, is frequently so hard to bear that it is walled off by an amnesic, dissociative barrier.

Marge discovered that autonomic indicators, particularly the skin conductance response, can "paradoxically flatten" when the history of abuse begins emerging into consciousness and the barrier starts breaking down. The apparent relaxation is actually a measure of defensive resistance. Marge called this "going 90 miles per hour with the brake on". This description of resistance is so clear and its measurement so simple that its importance regarding posttraumatic stress disorder (PTSD) cannot be overstated.

Ed Wilson, in a 1987 manuscript, "The dilemma of chronic pain: My pain has no name", explained how a reverberating circuit of pain develops in the hypertensed body of a person with chronic PTSD. Acid-filled trigger points throughout the body cause the muscles to brace in a protective splinting, creating more pain, which causes more bracing. This constant activation of the flexor withdrawal reflex prevents the muscles from relaxing enough for the waste products to be pumped out, leaving the spinal chord bombarded by an unceasing barrage of pain. This pattern of reflexive tensing perpetuates the vicious cycle of spasm and contraction.

Marge developed what she called active biofeedback to "melt" the body armor, using multiple EMG placements while carefully controlling the conscious reintegration of dissociated, traumatic material guided by autonomic indicators. This process allows a literal "reminding" and "re-membering" to take place.

She often used the fairy tale of Sleeping Beauty to describe the process of reintegration. The brambles surrounding Sleeping Beauty's castle represented the dissociative defence system, and their thorns pointed in both directions. The brambles would not come down until Sleeping Beauty was either strong enough to come out or it was safe enough outside. Active biofeedback was designed not only to carefully dismantle the defences but to address the underlying psychodynamic issues of dependency, trust, and control that kept the defences in place. The traumatized person could then grow in strength and independence while learning to find and relate to trustworthy people in the outside world.

It's been 30 years since Marge introduced her idea of resistance and guided therapy. With the sophisticated instruments available today, far more therapeutic possibilities exist to assist people in learning how to take their feet off both the brake and the accelerator so they can genuinely settle down, and feel safe and secure in the here and now. Pioneers like Marge not only had a vision but were willing to dedicate their lives to making their vision a reality.

Marge was a gifted therapist, thinker, and teacher who gave comfort and care to many people who were terribly wounded and hurt. She did all that she could to relieve their suffering and give them a chance to heal and be whole. Additionally, she and Hershel taught thousands of people the principles of applied psychophysiology and the exacting techniques of feedback

training and therapy. I think she would receive no greater joy and delight than to know her work and ideas are valued by her peers, and may serve as a foundation for the development of an even more effective therapy, equal to the needs of people struggling to make sense of an increasingly troubled and complex world.

Finding the right mix of highlights and details that accurately reflect a person's heart and soul is not easy, particularly in a short summary such as this. In looking back at a life, especially one as rich in experiences and accomplishments as Marge Toomim's, it's hard to decide what to include or leave out. However, I feel one instance captures the essence of integrity and passion that was at the center of her being.

I saw Marge start to cry when she was presenting a paper on child abuse. She apologized, saying that sometimes the violence and pain just got to her. Someone in the audience replied that it was OK, they didn't mind. Her compassion was obvious to anyone who met her. I believe this willingness to be open and responsive to herself, and to stay open and vulnerable to others, is what made her attractive and compelling, and defined who she was. One thing I do know for certain is that for everyone who knew and loved her, she will be deeply missed.

Briefly, I would preface the following article by saying that its historical significance lies in Marge's recognition that the battleground for Freud's intra-psychic conflicts is the body. Especially for people with difficult family histories, continuous feedback provides a way for both therapist and client to see how the intra-psychic battle is being waged, to gauge the physical distress it causes, and to discover how to safely disengage from the battle.

In the last 25 years a number of writers, particularly Alice Miller, have emphasized anew that the set of beliefs and conventions which guide families and cultures, and dictate and regulate how people relate to themselves and to one another, can be unduly harsh and have unintended harmful consequences. Marge's research on resistance and autonomic antagonism and her therapeutic approach to personal reintegration puts the "O" into "S-R" psychology in an observable, measurable way. Jim Sword says Marge's work helps to quantify and demystify the therapeutic process.

Feedback-directed therapy lets us see more clearly and directly the harmful effects of inflexible social prescriptions on the organism, how they can be healed and the culture transformed in the process.

In this era of enhanced and instant communication, people can immediately see the results of their decisions and behavior and take steps to stop hurting themselves and one another both inside and outside of therapy.

# GSR Biofeedback in Psychotherapy: Some Clinical Observations

**M. K. Toomim & H. Toomim**

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*Source: Psychotherapy: Theory, research and practice. 12, (1), spring, 1975, Reprint authorized by Hershel Toomim*

The traditional function of the psychotherapist has been to help the patient move from conflict and anxiety toward free and effective functioning. In order to do this the therapist has relied largely on:

- (1) the client's subjective report as to what is and is not relevant material;
- (2) the client's sensitivity to, perception of, and readiness to report sensations associated with changing emotions;
- (3) the therapist's theoretical orientation, his value system, and his sensitivity to, perception of, and interpretation of both verbal and body language. If the therapist and patient disagree on the importance of a particular word, concept, or body movement, the therapist often blames the patient for "resisting." The subjective nature of the therapeutic process has perhaps correctly left it vulnerable to attack from more experimentally oriented psychologists. The process may often be likened to one "black box" relating to another "black box."

Another problem in psychotherapy has been that of attempting to alter a psychophysiological system such as emotional responsivity with purely psychological means (verbal interaction). Some efforts have been made to make changes in these systems by addressing the physiology primarily, as in Reichian therapies. Psychophysiologicals have attempted to correlate specific emotions with specific physiological responses, but have found the human organism too complex for such codification. Some autonomic organ systems are stimulated in a sympathetic direction, some in the parasympathetic direction with arousal (Lacey, 1967); there are marked differences among individuals as to which organs are activated with stress and the effects of various stressors on any one organ system (Ax, 1953, 1969); and dynamic processes of inhibition and excitation create variation in organ function so that any one visceral response does not necessarily reflect a single behavioral dimension (Gelhorn, 1967). As noted below, individuals may respond to the experience of helplessness or severe conflict with a paradoxical drop in skin conductance (Toomim & Toomim, 1975), though such a drop is usually associated with relaxation.

While no instrumentation has been developed which quantifies and identifies specific emotions, most people respond to emotional arousal with at least one peripheral organ system. Inexpensive, battery-powered biofeedback instruments now make it possible to monitor one or more of these systems continuously during psychotherapy sessions so that body-mind relationships may be clearly and immediately established. The therapist may then use his knowledge of the client, his therapeutic skills, instrumental readings, and changing client responses to vary content and therapeutic process so as to increase or decrease affective states. Continuous monitoring of otherwise subliminal physiological changes allows the therapist to recognize significant content during the session.

While inter-individual variance in psychophysiological response systems is large, the therapist soon learns the organic response pattern of individuals and attends, then, to intra-individual variation in effecting therapeutic change.

Both EMG and GSR instrumentation have been used successfully in systematic desensitization therapy. Wolpe (1967) reports using the GSR in creating hierarchies where patients can not clearly define their subjective experience for the correct ordering of anxiety-provoking stimuli. Budzinski and Stoyva (1969) used continuous monitoring with EMG in a biofeedback paradigm. Here, the patient gains continuous awareness of the physiological process being measured-in this case, the frontalis muscle-that he may learn voluntary control of the function. The control involves changing both body tension and mental set.

The following paper reports the use of GSR feedback as an integral part of a dynamic psychotherapy process. The therapeutic process was eclectic, with emphasis on emotional flooding (Hogan, 1967). Peaks in reactivity or paradoxical response patterns were emphasized in order to intensify the client's experience and facilitate emotional release. Desensitization techniques call for manipulations which reduce organic arousal (Jacobson, 1939; Wolpe, 1958).

### **PHYSIOLOGY OF SKIN RESISTANCE AND THE GSR**

The reader is referred to Martin (1961), Lang (1971) and Prokansky & Raskin (1973) for comprehensive reviews of GSR research relevant to use in psychotherapy. Briefly, the Galvanic Skin Response is a measure of sweat gland activity. While sweat glands are innervated by only the Sympathetic branch of the Autonomic Nervous System, their reactivity is mediated by cholinergic transmission at the end organ. Darrow (1943) notes that conditions which alter cholinergic activity may limit the magnitude of the GSR response to stimulation. These conditions include the amount of available acetylcholine, the concentration of cholinesterase, the presence of adrenalin, and antidiuretic hormone.

Changes in skin resistance form part of the emergency reaction of the Sympathetic Nervous System, and may thus be used as a rough measure of an individual's physiological stress pattern. This measure has also been used to indicate general arousal, activation level (Schlosberg, 1954) and energy mobilization (Duffy, 1951).

Several investigators have found various aspects of the GSR within subjects reliable over time. Freeman and Griffith (1939), Lacey & Lacey (1962), and Block (1965) find its magnitude reliable; Bull & Gale (1971) find its latency, magnitude, and recovery reliable. Hughes & Shean (1972) find the interaction of feedback and awareness an effective means of modifying ongoing GSR reactivity in both high and low neurotic Ss.

The GSR has been criticized as a monitor of internal change because it so readily responds to such psychologically irrelevant functions as coughing, deep breathing, body and hand movements. However, the GSR feedback technique described below makes use of these functions which confound the experimentalist. They are included in computing the individual's baseline measure. They contribute to an understanding of the general GSR activation pattern of each individual. GSR responses which are defined as therapeutically relevant must cause a change in the GSR which is both greater than and more persistent than that created by these extraneous factors. In addition, the therapeutically relevant GSR response may be manipulated by further exploration of the anxiety-provoking or conflictual material which accompanies the skin-conductance rise or suppression. Thus, if the individual laughs or breaths deeply while talking about, for example, his mother, and the GSR feedback tone rises (skin conductance increases), it will soon return to baseline if the *material* is not emotionally arousing. If it is emotionally arousing, the GSR will continue to respond as long as the relevant content is

foreground and emotionally stimulating. Or it may "flatten"-stop responding and then respond again when the disturbing material is no longer foreground.

The skin conductance instrument used for this work\* accurately quantifies the skin conductance level in micromhos. It has a psychotherapy scale in which amplified rate of change of conductance is added to the ongoing conductance level. This provides the necessary sensitivity to relevant small changes and maintains the indications within the usable dynamic range of the instrument. With this technique the therapist is free to attend to relevant psychological material without being distracted by necessary instrument adjustments for under- or over-range activity.

## METHOD

The GSR is introduced to the client in the following way. He is shown the instrument, and its function as a monitor of general nervous system activation is briefly explained. If the client is willing to use this device, electrode cream is placed on the electrodes and they are connected to the palmar surface of the dominant hand. The client is then instructed that he may move his hands at will. As he moves, he notices a rise in the GSR feedback tone which signifies a rise in skin conductance. This familiarizes him with the sound of the instrument and the effect of movement on the GSR

He is then asked to take a deep breath. Again, there is usually a rise in the GSR feedback tone. The intensity of this response, as well as the length of time it takes for the GSR to decrease, are observed. A few minutes of relatively light conversation ensues while the client adapts to the new situation. The conversation also includes teaching about the instrument, exploration of feelings about its use, and evoking fantasies about what it might reveal about his inner or "secret" being. The client's attention is directed to changes in the feedback tone and he is asked to describe any physical sensations which correlate with large changes in the tone. This process forms a basis for interpreting the GSR response of each individual. It also establishes a baseline for that session.

Both the client and the therapist hear the feedback tone. This allows the client as well as the therapist to maximize understanding of the ways the individual responds to both external and internal stimuli. Also, the client becomes more involved in directing the content of the therapeutic hour to areas which are potentially most difficult for him to deal with. His own internal responsivity is the measure of significance. Therapist and client together are guided by the GSR feedback in focusing their efforts. Defensive maneuvers are reduced. Questions of "Who is right" about the importance of certain data are eliminated.

The GSR serves as an impartial third party in the therapist-client relationship. For example: a large increase in GSR conductance was found to accompany a client's habitual pattern of placing his right hand on his left biceps. He thought this was irrelevant. However, no skin conductance rise accompanied his touching any other part of his body. He then willingly explored the factors which might be related to this particular body posture. It was found that he always sat at the dining table with his father at his left. Further, he always felt uncomfortable about the people who sat at his left in classes and meetings. He expected them to be critical of him. Without the GSR feedback this "body language" would not have been "decoded."

## GSR REACTIVITY PATTERNS

According to observations made in this study, most individuals may be described along three GSR reactivity dimensions. They may be seen as over-reactors, under-reactors, or variable reactors. When attempting to place individuals in one of these categories, it is important to observe them in a number of circumstances. For example, a person whose GSR freely varies (a variable reactor) in ordinary circumstances may become an under or paradoxical reactor when very tired or hungry, or when stressed in a particular manner. The following description reflects reactivity patterns in an ordinary conversation condition.

*Over-reactors:* These are people who respond to stimuli excessively. A deep breath results in a marked rise in skin conductance which persists for a minute or more. A change from a neutral to a mildly exciting or emotionally charged stimulus results in a sharp rise in skin conductance which persists beyond the time that the subject matter is under consideration. The rise from a baseline of 10 micromhos might be as much as three micromhos. The over-reactor may not be able to lower his skin conductance (the GSR feedback tone) at will. This individual feels uncomfortable when he lowers his skin conductance level below baseline through ordinary relaxation procedures (being quiet for a few minutes, attending to breathing, etc.). He may describe the subjective state which accompanies lowered skin conductance as "a feeling of deadness," or "This is how I feel when I am depressed." A typical over-reactor may be described as follows:

*Clara, a 24 year old wife and mother, was unable to feel satisfied with anything. She fought constantly with her husband; she could not concentrate more than a few minutes on any subject: she felt anxious most of the time. GSR levels fluctuated in wide swings of three micromhos or more in general conversation, 10 or more when dealing with emotional material. Using the GSR feedback tone she learned to differentiate her feelings when skin conductance was relatively high and relatively low. She was quite uncomfortable at first at the low level, but soon was able to tolerate relaxation as measured by a low, relatively stable GSR. She would not practice quieting procedures at home, for they made her feel depressed. It appeared that much of her angry, fear inducing, erratic behavior was designed to maintain a high level of arousal. It was as if she were addicted to her own high arousal state. At first she was encouraged to explore activation behavior that was less damaging to her interpersonal relationships. She began to substitute shopping, telephoning, etc. for fighting and complaining as a way of staying "high". Her husband, who reacted to her hyperactivity by withdrawing, was encouraged to accept "constructive" activity and to do more with her. She thus felt less frustrated and rejected. Gradually, along with the ordinary psychotherapeutic process which relieved some of her internal psychodynamic stress, she learned to tolerate being quiet for longer and longer periods of time. She found she could feel alive with less sympathetic nervous system activation. When she left therapy, she was still highly responsive, but was able to channel her activity into areas that were constructive; she could be comfortably quiet when she wanted to be.*

*Under-reactors:* These are people whose skin conductance changes very little with changes in attention, body movement, or emotional stimulation. A deep breath may result in little more than a rise of one micromhos from a baseline of 10 micromhos. Even laughter, clapping the hands sharply in front of the individual's face, or the gentle touch of a hand may leave the GSR relatively unaffected. These individuals tend to have little awareness of the subjective feelings which accompany internal body processes and emotions.



*Alan, a 35 year old business executive, came to therapy because he felt that he was missing out on things. His wife complained he was not sufficiently responsive to her. He did not feel she was justified in her complaint, for he believed he was very much in tune with her. His GSR level varied no more than three-tenths micromhos during the greater part of the first interview, rising only briefly when he mentioned sex. He began to understand what he was missing, namely his own body responsivity. He now understood and accepted his wife's complaint. He began to break up his compulsive work pattern and to focus more on his feelings. Therapy centered on his fear of losing control, and gradually his GSR activity level increased. He is now finding ways to allow himself to feel emotionally alive, rather than pushing himself to feel alive through constant intellectualization and compulsive working.*

*Dick, a 27 year old student, appeared extremely active and alive. He was almost manic in his rapid speech, ready laugh, and optimistic, positive view of life. He felt, however, that he was out of touch with people somehow. The GSR baseline was high about 15 micromhos, but changed little, even when he laughed. Asked to be quiet for a few minutes, to speak more slowly and go beneath surface thoughts and feelings, the GSR became more reactive and he began to feel sad. Using the GSR feedback, he soon learned the difference between defensive and meaningful laughter. His activity and his laughter activated the GSR only when it was genuine. As Dick quieted, the GSR baseline lowered to around 2.5 micromhos and he felt comfortable over a wide range of GSR levels.*

**Variable-reactors:** These people's GSR reactivity pattern moves up and down in an undulating manner which clearly reflects changes in attention, excitation, and emotional involvement. A deep breath results in a marked increase in skin conductance which returns to baseline rather quickly. Changes of two or more micromhos are common. These individuals easily learn to recognize changes in internal states which accompany emotion.

Awareness of GSR reactivity patterns adds an important dimension to psychotherapy—the immediate awareness of subliminal psychophysiological processes. Such phrases as "I feel turned off," "I seldom get angry," "I have to keep active," "I feel funny inside when I think of...", "I freeze under stress" become clear at an objective, physical level. Both therapist and client become more accepting of the individual's quality of being and the extent to which his Sympathetic Nervous System reactivity patterns limit his range of overt behavioral patterns in relationships with himself and others.

## **GSR BIOFEEDBACK TRAINING**

The immediate awareness of Sympathetic Nervous System reactivity through GSR feedback allows for retraining of maladaptive patterns. (Crider et al., 1971; Hughes & Shean, 1971; Johnson & Schwartz, 1971; Shapiro et al., 1971; Shapiro & Crider, 1971). The individual decides what levels or patterns of activation he deems positive and negative. The feedback tone then serves as the reinforcer which moves him to alter thoughts, attitudes, and body mechanisms so as to increase the likelihood that he will respond—at least at the electrodermal level—in a way which he positively values.

A paradoxical GSR response proved extremely valuable in the case of a 35 year old man who was unable to maintain an erection. Four years of conventional psychotherapy had resolved most other problems, but made no impact on this one. He claimed his sex drive was quite high

and reported often feeling sexually aroused. When GSR feedback was introduced, we found however, the feedback tone *dropped* with every mention of sex, despite a high level of muscular tension, particularly in his legs. He defined this physiological state as "sexual arousal." The GSR was then used to train a new and more usual definition of the sexually aroused state with increase in skin conductance.

## GSR FEEDBACK AS GUIDE TO RELEVANT CONTENT

There are two GSR patterns which indicate that the therapeutic material at hand is important: (1) a sharp rise in conductance level beyond that which is usual for the individual indicates that emotionally meaningful material is at or near the conscious level and is ready to be dealt with; (2) a *paradoxical flatness* or *drop* in skin conductance, especially in the context of obvious emotional distress, indicates deeply repressed material is coming to awareness and that the individual is strongly resisting. An essential condition of relevance is that the GSR reactivity pattern closely follows the material at hand. So long as the emotionally arousing material is foreground, the tone continues to stay high or go higher, or it maintains its paradoxical flatness until a breakthrough in awareness occurs, at which point it rises precipitously.

An example of the first instance, where material is close to the surface, is that of a 42 year old man who has spent some years in therapy and who is a variable reactor.

*Jim has blamed much of his present difficulty with women on his mother, who indeed did contribute a great deal to his poor life adjustment. However, the gently undulating tone of the GSR during mother-blaming stories and mother-destruction fantasies indicated that this material was now relatively comfortable for him. His apparent anger was an "acting" of feeling, rather than true feeling. A reference to his sister, however, was accompanied by a 3.5 micromhos rise. Motivated by his understanding that such a rise in the GSR feedback tone indicated important material was at hand, he explored his feelings for his sister and found them important in his relationships with women. He had previously felt this relationship was not relevant to his present problem and resisted dealing with it since his relationship with his sister was now satisfactory.*

The following is an example of the paradoxical GSR response in which the skin conductance level remains flat or decreases when the individual is obviously distressed:

*Susan woke in panic every morning at 4:30-5:00, and the anxiety did not subside until after breakfast. In a hypnotherapy session, she remembered being eight years old and hearing the screams of a neighbor dying of cancer. Tears came to her eyes and she reported feeling fear and tension, but the GSR was flat. Asked to be quiet and go deeper into the hypnotic state, the GSR tone suddenly rose precipitously. Questioned, she stated that the lullaby from Hansel and Gretel was running through her head. She thought it unimportant. The words to the remembered portion are "14 angels guard my rest." Further exploration revealed a repressed childhood fantasy that she must be very bad to need 14 angels to guard her rest every night, and that death was in the closet waiting to get her when she masturbated. Yet she was in conflict. She could not stop masturbating. Further exploration revealed an elaborate fantasy of which only a few elements had previously surfaced in dreams. After working through this material, she was able to sleep and wake normally.*

The GSR feedback tone represents a guide to both therapist and client as to the value of the content in a therapeutic transaction. The therapist is less likely to be led into blind alleys and trapped by defensive maneuvers. Most clients appreciate this objective evidence of relevance. It cuts down their time in therapy and deepens the level at which they work. The client's resistance to threatening material is reduced, thus smoothing the flow of the therapeutic experience for both therapist and client.

## CONCLUSION

GSR biofeedback is a useful aid in dynamic psychotherapy. It increases the effectiveness of the therapist through providing immediate awareness of body-mind relationships and Sympathetic Nervous System reactivity patterns. It further provides the client with a fuller awareness of himself, encourages the cooperation of the client, and reduces the hit or miss quality of the therapeutic process. It increases the likelihood that relevant content will be dealt with and accompanying emotions elicited. It adds a new dimension to the practice of psychotherapy—the direct training of dysfunctional Sympathetic Nervous System reactivity patterns and some of the attitudes that maintain the stress response.

The introduction of continuous monitoring of internal processes within the therapeutic setting reduces the body-mind dichotomy. It is particularly valuable to the primarily verbal therapist who wants direct access to the body.

\*Biofeedback Research Institute Model 505.

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*Since 1972, the Toomim 505 GSR has been in daily use in our Psychotherapy Center, and has been developed and refined principally for use by psychotherapists. Since its clinical introduction, and the pioneering clinical research here by Majorie Toomim, Ph.D., Director of Psychological Services, the Toomim 505 GSR has become the most widely used professional GSR in the U.S.*

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## Prevent computer related symptoms with micro-breaks: A Biofeedback derived systems approach<sup>1</sup>

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### Summary

Twenty to 30% of employees who work at the computer experience discomfort, commonly referred to as repetitive strain injury and which could also be labeled as stress immobility syndrome (Chauhan, 2003). While more than 50% of employees who work greater than 15 hours per week at the computer reported musculoskeletal symptoms during the first year after starting a new job (Gerr, et al, 2002). A significant component of this discomfort and injury is the static muscle efforts that inhibits blood flow; while dynamic muscle effort, which involves the alternation of tension and relaxation, allows for sufficient blood flow and reduces discomfort. Taking micro-breaks during static muscle activity, such as working at the computer, changes the effort from static to dynamic. The graphics illustrate the available and required blood flow and lymph flow during rest, dynamic and static efforts. Portable equipment, such as a MyoTrac™ (<http://www.thoughttechnology.com>) with a 60-second feedback delay, can be useful devices to signal the person to take a micro-break if the muscle has been held contracted continuously for 60 seconds. Common electrode locations are illustrated for the use of working at the computer and suggestions are offered to promote a healthy computing work style.

*Two years after his first ergonomic assessment Mark was still suffering from muscular pain. His employer had followed the recommendations of the ergonomist, purchasing a new chair and keyboard, lowering the monitor, and installing an adjustable workstation with a slant table. Yet, with all these changes, Mark continued to complain of severe and chronic neck pain, tingling down his arms, and aching in his forearm. In fact, his discomfort had increased.*

Mark's story is, unfortunately, a very common one. Why, after spending so much money and making the ergonomic corrections, do Mark and thousands of other workers still suffer from computer-related disorders? State and federal health and safety agencies, along with employers and workers, struggle to find the answer. If it is not just ergonomics, then what causes computer-related discomfort?

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<sup>1</sup> This article has been synthesized from two articles by Peper and Gibney (2000) and Peper and Gibney (2005) and is reprinted with permission of the Association for Applied Psychophysiology and Biofeedback.

<sup>2</sup> We thank Vietta S. Wilson, Ph.D. for her feedback on the manuscript and Christopher Gibney, L.A.C., DHOM and Laura Peper for generously volunteering to be models.

## Work Style and Awareness

Research at the Institute for Holistic Healing Studies at San Francisco State University by Erik Peper, Ph.D., and colleagues (Peper et al, 2003; Peper, Gibney & Wilson, 2004, Peper and Gibney, 2000) have shown that an employee working at the computer usually holds chronic and unnecessary muscle tension—tension of which the worker is usually ignorant. The researchers used biofeedback to measure muscle tension, respiration patterns and hand temperature. They found that 95% of employees automatically raised their shoulders as well as maintained low-level tension in their forearms while keyboarding and mousing (Peper et al, 2003). Sustaining a posture of tension—raised shoulders, arms reaching forward, quick breathing, and, sometimes, cool fingers—inhibits the body from relaxation and places one at risk of injury. Think about how often you wait in anticipation, with your arm extended, ready to click the mouse button. At the same time, breathing becomes more shallow and rapid which is associated with discomfort at the workstation.

Equally important to chronic tension is the lack of awareness. In many cases, employees are captured by their work and are unaware of, or ignore, physical discomfort until they feel pain. Almost all employees studied thought that their muscles were relaxed when they were sitting correctly at the computer. However, the actual physiological data showed a different picture. Even when resting on the wrist rest, they did not totally relax their arms and shoulders.

The graph in Figure 1 is a physiological recording in which muscle tension from the neck-shoulders and forearms was recorded, as well as respiration rates from the chest and abdomen. This graph demonstrates a common pattern found in computer workers: unnecessary tension in the shoulders, rapid breathing and a lack of breaks when working.

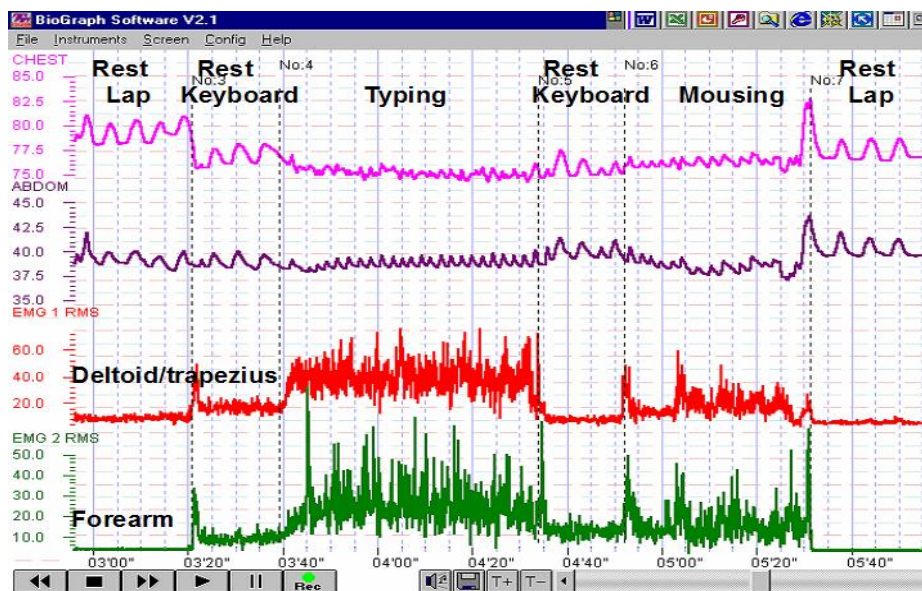


Figure 1: A representative recording of a person working at the computer. Note how trapezius-deltoid and forearm extensor muscle tensions increase without microbreaks as well as an increase in respiration rate. Yet, the person is totally unaware of these major physiological changes.

## No Breaks and Increased Stress

Muscles are designed to alternate between tension and relaxation. When held in chronic contraction, discomfort and referred pain is more likely to occur. Working at the computer without a break is analogous to holding your arm out in front of you for a very long time without rest. How long could you hold your arm up without developing discomfort? Five minutes? Ten minutes?

The ‘conscientious’ employee who does not take breaks—micro, large movement or lunch—denies himself regeneration. In addition, the near-visual stress of working at the monitor tends to increase arousal and chest breathing, exacerbating the tension in the upper back, neck and shoulders, as well as decreasing peripheral circulation. This lack of breaks, added tension, and increased arousal leads to an injurious cycle of discomfort and higher reactivity to work stress.

## Microbreaks

Microbreaks are 1-2 second interruptions of muscle tension every 60 seconds. During use, muscles contract around the blood vessels inhibiting blood flow. If tension is maintained without interruption (static effort), blood as well as lymph flow is continuously inhibited at a time when more flow is required. When effort is dynamic—that is the alternation of tension and relaxation—blood and lymph are pumped through the muscles and health is maintained. A common example of dynamic effort is standing and walking: we can stand or walk for extended periods of time without discomfort (resting or dynamic effort) because our blood/lymph flow matches our effort. However, if we were to stand holding our leg up (static effort), we would experience discomfort quickly because static effort demands similar blood/lymph flow as dynamic effort but none is being supplied. Chronic static effort (stress immobility syndrome) can result in injury and discomfort, such as found in repetitive motion injury (RMI). Figure 2 is a simple illustration of the body’s need for blood and lymph flow during activities<sup>3</sup>.

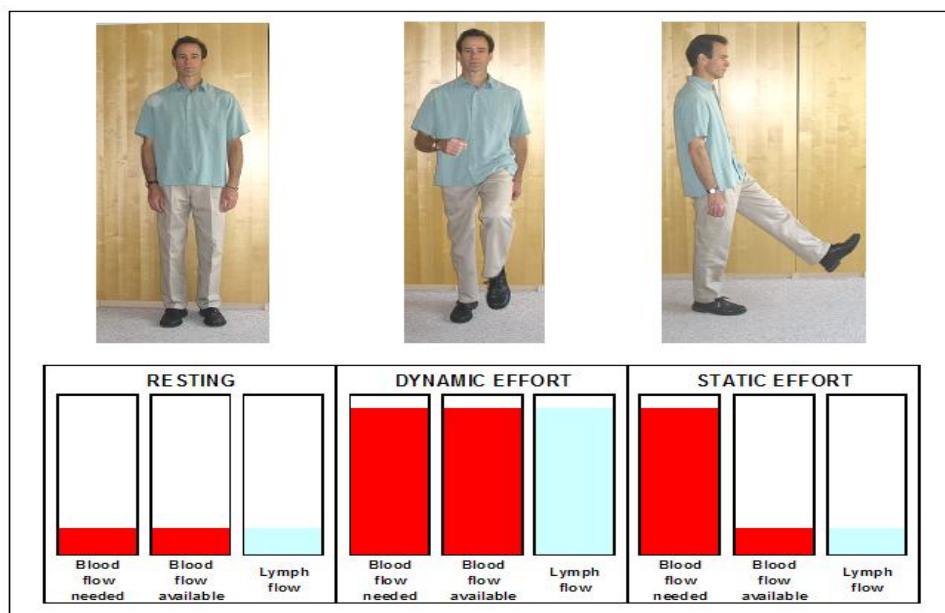


Figure 2: Graphic illustration of how blood flow and lymph circulation is reduced during static efforts.

<sup>3</sup> Adapted from Grandjean, E. (1987). *Ergonomics in Computerized Offices*. New York: Taylor and Francis.

Taking microbreaks during static muscle activity, such as working at the computer, changes the effort from static to dynamic. A portable electromyography (EMG) biofeedback machine with a 60-second delay alarm, such as the MyoTrac™ produced by Thought Technology, Ltd. (<http://www.thoughttechnology.com>), is a superb trainer for learning micro-breaks while working at the computer. A threshold for relaxation is set and, as one works at the computer, the EMG gives an auditory signal whenever the muscle activity is above the set threshold for more than 60 seconds. The 60-second timer resets itself each time the muscle activity drops beneath the threshold. With this feedback, employees can be trained for microbreaks at the worksite. As they work, they can ensure dynamic effort by taking a micro-break or performing an activity that drops the EMG beneath threshold. If they forget, the feedback signal reminds them to do so.

Common electrode placements for training micro-breaks include forearm extensors or flexors, upper trapezius and anterior/medial deltoid as illustrated in Figure 3. Detailed electrode placement instructions and strategies on how to use a portable EMG to promote healthy computing and prevent RSI are found in Peper and Gibney (2000) (<http://www.mindgrowth.com>)



Figure 3: Illustration of the three common electrode locations

Many patients and clients whom we have trained report a significant increase in energy combined with a decrease in discomfort when taking microbreaks during keyboarding and mousing. Although brief breaks are commonly recommended by ergonomists, equipment manufacturers and health care professionals, people generally do not relax muscles when more work is sitting in front of them, even though they may be resting their hands in their laps. The portable EMG, with a 60-second alarm, can help them develop awareness of what is truly a resting muscle state.

### **New Employee Training in a Systems Perspective**

Prevention and remediation of computer-related disorders must address the whole picture in a systems perspective, utilizing real-time, objective measurements. A systems approach to prevention should include proper ergonomics as well as training in work style, somatic (mind/body) awareness, regeneration, stress management, vision care, fitness and corporate support. Biofeedback takes the guesswork out of ergonomics by providing objective muscle tension measurements, and helps employees become aware and change their work habits.

Employee computer training should expand beyond information training to include how to work at the computer while maintaining health and productivity. We urge employers to implement a



healthy computing prevention program for new employees such as has been developed at San Francisco State University. A 9-month follow-up of employees who participated in a 6-week training period utilizing biofeedback found that symptoms decreased by 73%. When employees develop awareness and acquire the skills to work healthfully at their peak, this alarming epidemic will abate (Peper et al, 2003). Using a group training model that included muscle biofeedback for microbreak training, Peper, Gibney & Wilson (2004) found that trained employees, as compared to the control group, reported a significant overall reduction in work-related symptoms. This included significant reduction of muscle strain of the head, neck and shoulder, wrist and hands, arms, and overall tiredness. To reduce computer-related discomfort, implement the following:

1. Take microbreaks. Every 60 seconds drop your hands to your lap and let your shoulders relax for one second and then relax again for a second before returning to work.
2. Breathe slower and more in your abdomen instead of your chest.
3. Take large movement breaks. Every 20 minutes get up and move.
4. Use a split keyboard without the number pad, if your work allows it, so that the mouse is more central.
5. Blink at the end of every sentence or every column of numbers.
6. Mentally scan you body for tension. Relax unnecessary tension and wiggle in your chair.
7. Check your stress level. If you feel stressed, take action steps to eliminate the stress, such as asking for help with your projects or talking with someone to let off steam.
8. Exercise daily; remember that computer work is an athletic event and maintaining fitness will help prevent discomfort.

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## Testing Telepathy: A new application for Biofeedback?

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*Biofeedback data taken from identical twins, showing a stress response in one twin at the same time the other twin was experiencing fear, while sitting in another part of a building. This may possibly suggest that physiology can indicate the presence of telepathy.*

### Background

This summer I was asked by Dutch television to perform a biofeedback test for a television show. The show called “De Tweelingtest” (the twin test), was broadcast in May 2005 and was a search for the most identical twins. The pairs of twins were assessed with numerous of psychological and physical tests. Twins with different test scores were eliminated until 7 identical twins were left. These twins were submitted to a so-called “telepathy test”. The protocol consisted of the oldest twin (twin A) sitting in a room, attached to biofeedback equipment. His or her younger identical twin (twin B) sat in another room and was confronted with scary animals: a tarantula spider, a poisonous toad, a large snake and a scorpion. The researcher sat in the room with twin A collecting the biofeedback data, while being able to observe on a monitor what happened with twin B in the other room.

### Description of the test

Twin A was attached to a multi-channel biofeedback device. The stress response was measured by muscle tension (sEMG) recorded from the right trapezius muscle, hand temperature, blood volume/heart rate, respiration and skin conductance. Twin A could not see the biofeedback readings, nor did he know what was happening to twin B at the time. Twin A was told that we wanted to measure if he could feel the emotions of twin B, but he did not know what kind of emotions twin B was experiencing. He was asked to describe any change in emotions. The test took about 15 minutes. We started with a 2-minute baseline, then twin B entered the other room, sat down and was confronted with the 4 stressors one after another. On the monitor we time marked the events and we made notes of the emotions of twin B and twin A.

### Results

In 3 of the 7 tested pairs of twins there was clearly no physiological indication of concurrent physiological reaction; namely, the emotions of twin A did not correlate in any way with the emotions of twin B. They had no idea what their twin brother or sister was doing while they were sitting in the room attached to the biofeedback equipment and felt quite comfortable and relaxed, although we could see on the monitor that the B-twin was experiencing fear. Only two pairs of twins described fear at moments the other twin was indeed experiencing fear, although the biofeedback readings did not show a clear stress response in these occasions. It could be that they were guessing about their twin brother or sisters emotions.

In two pairs of twins there was a distinct physiological response when the distant twin was exposed to the stressors which resulted in a physiological response in the monitored twin and each will be described separately.

Male 45-year old identical twins. His stress response occurred at the same time his brother was experiencing fear while being confronted with the spider. His skin conductance increased, finger temperature rise stabilized, respiration became irregular and faster and he tightened his shoulders. In addition to the physical changes in his body he described a feeling of extreme fear and restlessness. At a certain point tears came into his eyes, He could not explain his reaction, as it happened while he was sitting in a chair and nothing was happening in the room at that time as shown in Figure 1.

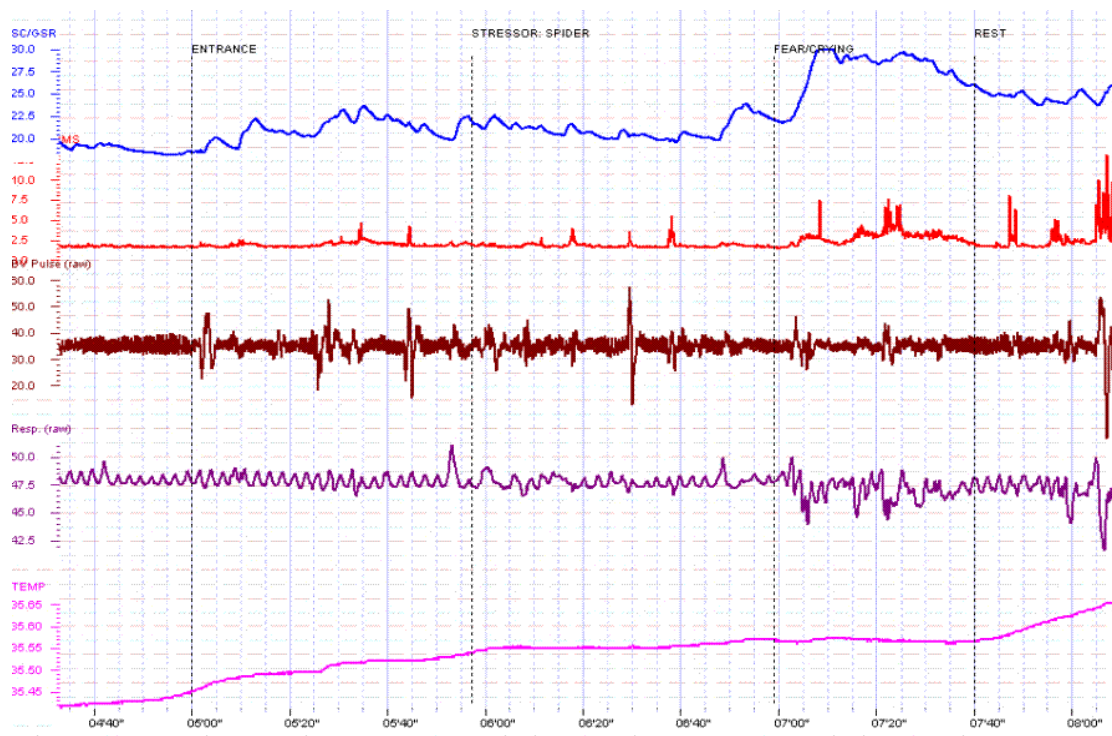


Figure 1: Physiological response monitored from one twin while the other twin at a distance was exposed to a stressor.

Female 50-year old identical twins. The monitored twin described a feeling of fear at the same time her twin sister was confronted with the snake. Her skin conductance increased, hand temperature dropped, blood volume decreased also, she started sighing and showed increased EMG activity in her shoulders. She recovered from this response. Then the snake was taken out of the box and her sister was so scared that she ran out of the room. At that same moment she showed another increase in skin conductance, another drop in hand temperature and a second episode of irregular breathing. The tension in the shoulders remained high. After 40 seconds her sister reentered the room.

Twin A sighed again a few times and the tension in her shoulders dropped instantly. When the box with the snake was removed from the room and her sister, Twin B, became more relaxed, she sighed again and her hand temperature started increasing as shown in figure 2.

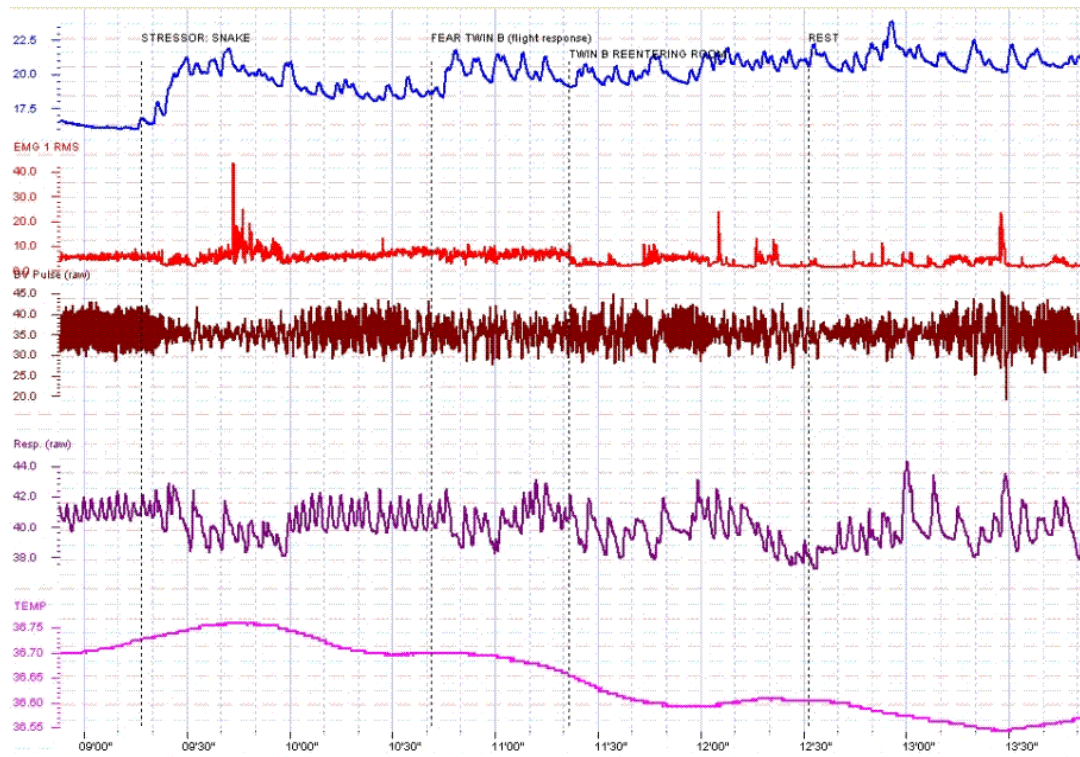


Figure 2: Physiological response monitored from one twin while the other twin at a distance was exposed to a stressor.

## Discussion

The study is suggestive that for some twins there seems to be an emotional response that occurs simultaneously. As this was done for a TV show, the measurements were not done in an ideal setting. To stimulate twin A to describe their emotions, the interviewer asked suggestive questions, like “do you think that your brother is feeling fear right now?” Although the interviewer did not know what happened in the other room with twin B as he also could not see the monitor, this could theoretically influence the responses of twin A. Nevertheless the two examples of telepathy-like responses are quite dramatic. Physiological monitoring may be a methodology to identify telepathy. Once reactive twins are identified, the study should be replicated in a controlled environment by measuring the physiological responses of both twins at the same time.

## **The Story of the Trunk (part 2): SEMG and the Breathing Challenge**

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Part 1 of this article referred to the evolution of the trunk and its muscles and various relationships to muscular pain with special reference to SEMG investigation and neuromuscular reeducation.

It was meant as a general qualitative description, since the quantitative analysis could be found in the pertinent texts and articles.

Part 2 of this article will aim to render a qualitative description of the muscular components of the human trunk and their relationships to the physiology of respiration and its expressive behavior.

As will be shown in the article, SEMG can be utilized to analyze the tonus of the trunk muscles involved in the process of respiration and also to re-educate them to act in the most optimal fashion for the body's energetic needs and economy.

The quantitative aspects of the SEMG analysis of most trunk muscles could be found by the interested reader in a number of textbooks and articles published by the author and other researchers.

For the purpose of the discussion to follow, it is relevant to remind the reader that the human trunk has several dimensions and three diaphragms.

The anterior aspect is divided between the thorax above the diaphragm and the abdomen below the diaphragm and above the pelvis. The human evolution was such that the anterior aspect of the trunk evolved from its position facing the ground to the present erect position. The principal change is that of the weight disposal pattern, i.e. from 'hanging down' passively with gravity to placing the pressure of the thorax & its contents downwards on the abdominal and pelvic cavities.

The posterior aspect is divided between the posterior thorax above the diaphragm and the lumbo-sacral area below the diaphragm. The inferior aspect of the trunk is the inguinal area and it is the domain of the pelvis proper. It is clear that most of the weight of the trunk impinges, in the vertical position, on the pelvic floor.

The lateral aspect of the trunk is divided between the lateral thoracic components of the rib cage and the lateral aspect of the abdominal muscles above the diaphragm and the iliac alae surrounding the pelvic cavity.

The three diaphragms are:

- (i) the laryngeal diaphragm,
- (ii) the diaphragmatic muscle and
- (iii) the pelvic floor, comprising the pubo-coccygeus muscle and its components.

The laryngeal diaphragm and the diaphragm muscle divide the thoracic cavity from the abdominal and pelvic cavities. The bony components are the rib-cage and the thoracic column.

The diaphragmatic muscle and the pelvic floor muscle complex contain the abdomen and pelvic cavities. The bony components are the lumbo-sacral-coccygeal column and the innominate bones.

The laryngeal diaphragm and the diaphragmatic muscle can close the thoracic cavity by simultaneous action and increase the air pressure at any moment of respiration. The best example is that of 'the Valsalva maneuver' of applying maximal closing pressure after maximal inspiration. This action will result in a change in the venous & lymphatic volume return to the heart and to a change in the cardiac rhythm. Further intra-thoracic pressure can be derived not only by a simultaneous contraction of the thoracic muscles but also by the contraction of the pelvic floor diaphragm and the infra- diaphragmatic muscles.

The summary anatomic reminder above serves to clarify the physiological and behavioral respiratory functions to follow.

Breathing is an essential body function. It is initiated above the trunk. Quiet, effortless breathing is mainly a diaphragmatic function, with little active input from the intercostal muscles. As the depth, frequency and intensity of the breathing increases for a variety of needs, the 'accessory' muscles of respiration contribute to the effort to the extent required by the physiologic or behavioral needs.

The accessory muscles may comprise those of the neck, the superficial muscles of the thorax, the abdomen, the lumbosacral area, the paraspinal region and the pelvis.

The effort of the breathing is a direct and proximate function of the electrical output/consumption of all the muscles involved in the process.

SEMG dynamic protocols can be utilized to document and analyze the muscular electric aspect of the effort of the respiratory function.

Depending on the dynamic protocols chosen and the number of electrode placements available, it is possible to assess simultaneously the electric 'effort' of neck, thoracic, abdominal, lumbosacral, paraspinal and pelvic floor muscles involved in intensive breathing.

Furthermore, when relevant, it is possible to assess quantitatively various trunk muscles effort ratios.

SEMG/biofeedback or muscular re-education could be aimed specifically at redressing muscular imbalances and optimizing various ratios. Such ratios may include the neck versus the thoracic muscles inspiratory versus expiratory rate ratio, the thoracic versus the abdominal muscles inspiratory versus expiratory rate ratio, right sided versus left sided muscles ratio through the breathing cycle, etc.

The overall aim of the SEMG re-education is to optimize the process, i.e., in this case the breathing pattern & its components by training it to utilize the least amount of energy from all the active muscles involved and to improve oxygenation at the same time.

The qualitative aspect of the optimization of the breathing process comprises the individual perception of position along the continuum between 'effortless breathing' and 'fatigue'.

The quantitative aspect can be assessed via the SEMG measures of potentials of activity during breathing as well as by the metabolic assessments of pulmonary functions, e.g. the tidal volume, expiratory & inspiratory volume minute, oxygen consumption minute, etc.

Whereas the typical pulmonary functions render valuable information regarding essentially the respiratory volumes and oxygen consumption per unit of time, they impart no information regarding the contribution of various muscles to the respiratory consumption and effort. SEMG is the methodology that may provide that information by utilizing judiciously dynamic quantitative protocols.

As such, it can provide useful answers to several questions involving the contribution of trunk muscles to the respiratory function and effort. The answers to the questions below may be different at different tidal volumes, rates of breathing/ minute and different rates of oxygen consumption/ minute, etc.

Of the large number of questions possible, the following are particularly relevant to the subject of SEMG investigation and muscular re-education:

1. What is the electric potential output necessary during (a) inspiration and (b) expiration of any supra-diaphragmatic or infra-diaphragmatic muscle?
2. Are the homologous contra-lateral muscles providing a similar pattern of effort of activity or
3. Do they differ by more than 20% in the activation pattern? Is the symmetry similar in the muscles above and below the diaphragm?
4. Do the muscles show a return to a minimal resting electric potential tonus during the time-frame of resting between inspiration and expiration?
5. How long does it take to return to the minimal resting tonus level? Is the return to that level symmetrical between the homologous muscles per unit of time? Is it similar in the muscles above and below the diaphragm?
6. What tidal volume is associated with the perception of 'effortless breathing' for an adequate sample of individuals? What is the SEMG derived assessment of different muscles electric potentials contribution to the 'effortless breathing' pattern? Is muscular symmetry maintained during inspiration and expiration through the breathing cycle of least effort of respiration?
7. What tidal volume is associated with the perception of 'fatiguing breathing' for an adequate sample of individuals? What is the SEMG derived assessment of different muscles electric potentials contribution to the 'fatiguing breathing' pattern? Is muscular symmetry of activity potentials between homologous muscles maintained during such effort?
8. Can a SEMG muscular re-education program change the pattern of muscular behavior such that more muscles could function in concert at a lower level of electric potential effort to produce a larger tidal volume and increased oxygen consumption at a lower level of perceived effort or fatigue?

The answers to the questions above will come first from pilot studies followed by more definite answers from larger population sample studies.

The answers will serve not only to document important issues of respiratory physiology but also related issues of behavioral or psychophysiology and pathology.

After all, the breathing pattern is also an important parameter of behavior. An important aspect of breathing is the utilization of the accessory muscles of respiration during labored breathing and during periods of sympathetic overflow such as in moments of anxiety or split-second decisions of 'fight or flight'.

Muscles embryologically derived from the branchial arch of the muscles of the gills, function unconsciously as accessory muscles of respiration. The simple act of frowning can instantly stop the activity of breathing, whether during inspiration or expiration.

SEMG testing during frowning of the frontalis or other muscles innervated by the 7<sup>th</sup> cranial nerve (nervus facialis) can demonstrate the simultaneous arrest of the electrical activity potentials of the diaphragm or intercostalis muscles.

A 'faulty' breathing pattern such as that exhibited by smokers shows on SEMG as an overuse of the muscles of the neck, including especially the sternocleidomastoid (SCM) and the upper trapezius, both muscles innervated by another cranial nerve, the spinal accessory. This pattern continues even during the time that a person doesn't smoke, demonstrating thus a change from the normal engram of breathing.

It is of common knowledge that states of anxiety lead to a thoracic pattern of breathing, involving several accessory muscles of respiration, even during quiet breathing with low tidal volumes.

The muscle tension headaches and 'pain in the neck' resulting from the faulty pattern of facial gestures, neck and upper thoracic muscles overuse and tension from lack of rest can become a vicious circle that can be 'broken' by SEMG biofeedback aimed at re-establishing an appropriate diaphragmatic rather than thoracic breathing pattern.

It is of interest that abnormal breathing patterns are found in persons who have a history of chronic anxiety or tension headaches, even at such times when these people do not exhibit such symptoms.

This may document an actual change in the psychomotor engram related on one hand to the chronic muscular tension state and on the other hand to the limbic system and respiratory center. Such empiric evidence may blur the boundary between the conscious and the unconscious, conscious motor control and autonomic system.

SEMG is a neuro-motor investigative technique that needs to be applied rigorously with well documented dynamic protocols.

At the same time, within the realm of respiratory physiology and psychophysiology investigation, it opens a window on the various ancient and evolutionarily more modern patterns of behavior of the muscles of the trunk.

The breathing patterns can be modified with accurate re-education, leading to improved oxygenation at a lesser effort and perceived fatigue.

SEMG may become an integral technique not only in modifying the breathing behavior and neuromotor engram during states of anxiety but also in other physiologic states involving the interplay between the diaphragm and the pelvic floor diaphragm.

Such interplays involve the need for a controlled gradual increase of the intra-abdominal and pelvic muscle pressure, needed for micturition, defecation, child-birth or female sexual excitement.

The volume and air pressure in the thorax during inspiration may modify the venous & lymphatic blood volume in the thorax, abdomen and pelvic cavity as well as the position of the viscera. The trunk muscles, functioning simultaneously in concerted contraction and relaxation modify further the abdominal & pelvic cavity pressures and the functional consequences.

Whenever necessary, SEMG dynamic studies of the pertinent trunk muscles may show whether they exhibit normal behavior during activity and rest.



SEMG re-education of the abnormal muscles may bring back normal function not only to those muscles but also to the myostatic units and vectors to which those muscles pertain.

The whole testing process starts with the assessment of the target muscles during various states of breathing.

The re-education or biofeedback process ends by re-establishing the engram of effortless breathing where all the participating muscles function at a minimal level of effort and produce together a perceived as effortless appropriate result.

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## Interesting abstracts from scientific journals

### A shorter workday as a means of reducing the occurrence of musculoskeletal disorders

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Source: [\*Scand J Work Environ Health. 2003 Dec;29\(6\):488; author reply 489.\*](#)

#### Objectives

The study examined the relation between daily work hours and the occurrence of neck-shoulder or back pain in physically demanding care work.

#### Methods

Unpublished data were obtained from three intervention projects in care institutions. The projects had been conducted independently in Oslo (46 participants, 175 referents before and 158 referents after the intervention), Helsingborg (60 participants, 89 referents) and Stockholm (41 participants, 22 referents) between 1995 and 1998. The intervention was a reduction of daily work hours from less than or equal to 7 to 6 hours (or 30 hours weekly). Full-time salary was retained, and extra personnel were employed to compensate for the reduction in work hours. Data were collected by self-administered questionnaires before and during the intervention periods, lasting from 12 to 22 months.

#### Results

The prevalence of neck-shoulder pain decreased from 40.9% to 25.6% in Oslo and from 57.1% to 39.1% in Helsingborg after 1.5 years with a 6-hour workday; for Stockholm the decrease was from 81.6% to 68.3% after 1 year. No decrease was observed in the reference groups. The prevalence of back pain did not show the same consistent pattern.

#### Conclusions

The shortening of regular workdays from less than or equal to 7 hours to 6 hours may considerably reduce the prevalence of neck-shoulder pain among persons with physically demanding care work. The potential health benefits should encourage intervention studies also in other occupations with increased risk of work-related musculoskeletal disorders.

### Effect of acupuncture treatment on chronic neck and shoulder pain in sedentary female workers: a 6-month and 3-year follow-up study

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Source: [\*Pain. 2004 Jun;109\(3\):203-4\*](#)

The study was carried out to examine whether acupuncture treatment can reduce chronic pain in the neck and shoulders and related headache, and also to examine whether possible effects are

long-lasting. Therefore, 24 female office workers (47+/-9 years old, mean+/-SD) who had had neck and shoulder pain for 12+/-9 years were randomly assigned to a test group (TG) or a control group (CG). Acupuncture was applied 10 times during 3-4 weeks either at presumed anti-pain acupoints (TG) or at placebo-points (CG). A physician measured the pain threshold (PPT) in the neck and shoulder regions with algometry before the first treatment, and after the last one and six months after the treatments.

Questionnaires on muscle pain and headache were answered at the same occasions and again 3 years after the last treatment. The intensity and frequency of pain fell more for TG than for CG ( $P_b < \text{or} = 0.04$ ) during the treatment period. Three years after the treatments TG still reported less pain than before the treatments ( $P_w < 0.001$ ) contrary to what CG did ( $P_b < 0.04$ ) The degree of headache fell during the treatment period for both groups, but more for TG than for CG ( $P_b = 0.02$ ) Three years after the treatments the effect still lasted for TG ( $P_w < 0.01$ ) while the degree of headache for CG was back to the pre-treatment level ( $P_b < 0.001$ ) PPT of some muscles rose during the treatments for TG and remained higher 6 months after the treatments ( $P_w < 0.05$ ) which contrasts with the situation for CG. Adequate acupuncture treatment may reduce chronic pain in the neck and shoulders and related headache. The effect lasted for 3 years.

### **Muscle activity in professional classical singing: a study on muscles in the shoulder, neck and trunk.**

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*Source: Logoped Phoniatr Vocol. 2004;29(2):56-65*

This study aimed to examine whether changes in the activity of shoulder and neck muscles have consequences for the activation of primary breathing muscles. It further aimed to compare muscle loading levels of professional and student singers. Four professional opera singers participated in the study. Previous unpublished recordings of 4 to 16 student singers and one opera singer were included to allow comparison of EMG loading levels between student and professional singers. Electromyographic (EMG) recordings of trapezius (TR), sternocleidomastoideus (STM), intercostals (INT), rectus abdominis (RC) and the lateral abdominal muscles (OBL) were performed. EMG biofeedback (BF) was performed on TR and STM to lower the activity in these two muscles and the potential change in EMG activity of INT, RC and OBL were examined. Three singing tasks were performed: aria, sustained tones and extreme tones. Each task was performed three times with variation in volume or pitch. Following the first performance of the singing tasks, the BF session was carried out and muscle activity recorded in a repeat performance of the same tasks. The EMG activity levels of all muscles were compared before and after BF. We found no significant effect of reduced TR/STM activity on the activation of INT, RC and OBL. Professional opera singers activated the TR, INT, RC and OBL muscles to higher levels than the student singers did. Another finding was large inter-subject variation in muscle usage, showing an idiosyncratic composition of the muscle contribution to sub glottal pressure.

## Commission asks workers and employers what action should be taken to combat musculoskeletal disorders

Source: [http://europa.eu.int/comm/employment\\_social/news](http://europa.eu.int/comm/employment_social/news)

*Brussels, 12 November 2004. The European Commission is seeking the views of workers' and employers' representatives on how best to tackle the growing problem of musculoskeletal disorders (MSD). These ailments, which include back pain and repetitive strain injury, are the biggest health and safety problem facing European workers today. Studies show that they affect over 40 million workers in all sectors across the EU and account for 40 to 50 per cent of all work-related ill-health. They are costing employers across the EU billions of euros. The problem is eroding Europe's competitiveness and leading to losses of 0.5 to 2 per cent of GNP each year.*

In a consultation document issued today, the Commission says that whilst such disorders are in principle covered by general EU health and safety legislation, most of it is over a decade old and does not apply specifically to work-related MSDs. Some Member States have passed laws to tackle the problem and others have not. The Commission is asking workers and employers to say how they think these gaps in the law at national and Community level should be plugged to prevent such ailments from developing.

The Commission highlights the problems for business that arise from these disorders: production losses, sick leave, medical, compensation and insurance costs, the loss of experienced staff and the cost of recruiting and training new staff, and the impact on the quality of work. The main cause of these disorders is poor ergonomic conditions. The three main risk factors are lifting and moving heavy loads, repetitive movements, and strenuous working postures.

The problem affects men and women alike, in all sectors across the EU. Figures show that it is increasing: in 2000 over a third of European workers complained of back-ache – a three-point increase from the 1995 level. Agricultural workers are the worst affected overall, with 57 per cent suffering from MSDs. The highest increases are being seen amongst professionals (up from 18 per cent to 24 per cent) and technicians (up from 23 per cent to 31 per cent).

Workers' and employers' groups have six weeks from now to reply to the Commission's paper. They are being asked whether they would like to see new Community legislation or whether they would prefer voluntary measures, or a combination of binding and non-binding measures, and what the main focus of the preventive measures should be (e.g. ergonomics, work organisation, psychosocial aspects). They could also decide to draw up an agreement themselves to tackle the problem.

MSDs are one of today's major modern workplace issues being dealt with as part of the "social dialogue" between the two sides of industry which is being promoted by the Commission. As a result of this dialogue, an agreement on combating stress at the workplace was recently reached.

## Malignant melanoma of the skin – not a sunshine story!

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*Source: Med Sci Monit, 2004; 10(7): CR336-340*

### Summary

In an earlier study on malignant melanoma incidence in Sweden, Norway, Denmark and the USA, we found a strong association between the introduction of FM radio broadcasting at full-body resonant frequencies and increasing melanoma incidence. The purpose of the current study was to review mortality and incidence data for malignant melanoma of the skin in Sweden and its temporal relation to increased “sun-traveling”, and to the introduction of FM and TV broadcasting networks.

### Material/Methods

Official, published information was collected and displayed graphically. These data included incidence rates of malignant melanoma, death numbers, charter travel statistics, and data on the expansion of the FM broadcasting network in all counties of Sweden.

### Results

A good correlation in time was found for the rollout of FM/TV broadcasting networks while the increased amount of “sun travel” by air (charter) did not start until 7 years after the melanoma trend break in 1955. Counties that did not roll out their FM-broadcasting network until several years after 1955 continued to have stable melanoma mortality during the intervening years.

### Conclusions

The increased incidence and mortality of melanoma of skin cannot solely be explained by increased exposure to UV-radiation from the sun. We conclude that continuous disturbance of cell repair mechanisms by body-resonant electromagnetic fields seems to amplify the carcinogenic effects resulting from cell damage caused e.g. by UV-radiation.

## *Decoding the visual and subjective contents of the human brain*

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The potential for human neuron-imaging to read out the detailed contents of a person's mental state has yet to be fully explored. We investigated whether the perception of edge orientation, a fundamental visual feature, can be decoded from human brain activity measured with functional magnetic resonance imaging (fMRI). Using statistical algorithms to classify brain states, we

found that ensemble fMRI signals in early visual areas could reliably predict on individual trials which of eight stimulus orientations the subject was seeing. Moreover, when subjects had to attend to one of two overlapping orthogonal gratings, feature-based attention strongly biased ensemble activity toward the attended orientation. These results demonstrate that fMRI activity patterns in early visual areas, including primary visual cortex (V1), contain detailed orientation information that can reliably predict subjective perception. Our approach provides a framework for the readout of fine-tuned representations in the human brain and their subjective contents.

## Helpful exercises for teaching clients awareness and self-control

### Healthy Computing email tip 420: Happiness Breather

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*Source: Weekly tips distributed by The Institute for Holistic Healing Studies and Human Resources. For subscription contact: [healthco@sfsu.edu](mailto:healthco@sfsu.edu)*

Do you ever have one of those days that seem like you're just putting out fires? By the end of the day, do you feel as if the only thing you've done is address problems? Focusing on resolving problems often gets us into a mental state of thinking only of obstacles. Before we know it, we have a frown on our face and a desire to snap at others. Avoid the collective stress of daily problems by taking a HAPPINESS BREATHER.

#### **How to take a HAPPINESS BREATHER**

If you can, close the door to your office and put your phone on do not disturb. Sit quietly in your chair, resting your back. If you can, close your eyes. Watch your breath flow in and out for 3 or 4 breaths as you breathe diaphragmatically.

Now, think of a time when you were really happy when the feeling of laughter and contentment bubbled through your being. As you breathe, let the feeling of contentment and joy permeate your body and mind. Now, visualize yourself addressing the next problem as you smile at your co-workers. See yourself bringing lightness and clarity to the problem. Breathe a few more relaxing breaths before you go about your business.

If you find yourself getting caught up in the problems of the day, remember to smile and feel joy within you by taking control.

**"I have noticed that folks are generally as happy as they make up their minds to be."**

Abraham Lincoln

## Story at the end:

**Starting with the thought that time runs so incredibly fast, this is a nice message to the world to end this issue:**

*The paradox of our time in history is that we have taller buildings but shorter tempers, wider freeways, but narrower viewpoints.*

We spend more, but have less, we buy more, but enjoy less.

We have bigger houses and smaller families, more conveniences, but less time.

We have more degrees but less sense, more knowledge, but less judgment, more experts, yet more problems, more medicine, but less wellness.

We drink too much, smoke too much, spend too recklessly, laugh too little, drive too fast, get too angry, stay up too late, get up too tired, read too little, watch TV too much, and pray too seldom.

We have multiplied our possessions, but reduced our values.

We talk too much, love too seldom, and hate too often.

We've learned how to make a living, but not a life.

We've added years to life not life to years.

We've been all the way to the moon and back,  
but have trouble crossing the street to meet a new neighbor.

We conquered outer space but not inner space.

We've done larger things, but not better things.

We've cleaned up the air, but polluted the soul.

We've conquered the atom, but not our prejudice.

We write more, but learn less.

We plan more, but accomplish less.

We've learned to rush, but not to wait.

We build more computers to hold more information,  
to produce more copies than ever, but we communicate less and less.

These are the times of fast foods and slow digestion,  
big men and small character, steep profits and shallow relationships.

These are the days of two incomes but more divorce, fancier houses, but broken homes.

These are days of quick trips, disposable diapers, throwaway morality, one night stands,  
overweight bodies, and pills that do everything from cheer, to quiet, to kill.

It is a time when there is much in the showroom window and nothing in the stockroom.

It is a time when technology can bring this letter to you, and a time when you can choose either  
to share this insight, or to just hit delete.

Remember to spend some time with your loved ones, because they are not going to be around  
forever.

Remember, say a kind word to someone who looks up to you in awe, because that little person  
soon will grow up and leave your side.

Remember, to give a warm hug to the one next to you, because that is the only treasure you can  
give with your heart and it doesn't cost a cent.

Remember, to say, "I love you" to your partner and your loved ones, but most of all mean it.

A kiss and an embrace will mend hurt when it comes from deep inside of you. Remember to  
hold hands and cherish the moment for someday that person will not be there again.

Give time to love, give time to speak, and give time to share the precious thoughts in your mind.

*Life is not measured by the number of breaths we take, but by the moments that take our breath  
away.*

(Author unknown)