The Future of Biofeedback Instrumentation

Guest Editor, Richard Sherman, PhD
Special Issue: The Future of Biofeedback Instrumentation

Guest Editor, Richard Sherman, PhD, and Newsmagazine Editor, Donald Moss, PhD

The cover of this issue of the Biofeedback Newsmagazine shows an elaborate hand-wired Coulbourn biofeedback system, typical for instrumentation in the early days of biofeedback, contrasted with today’s typical PC based biofeedback system.

This issue of Biofeedback Newsmagazine highlights the future of technology and instrumentation in biofeedback and clinical psychophysiology. Biofeedback research and practice, from their beginnings, have been intimately connected with advances in the technology of biological monitoring and feedback devices. Some of the founding pioneers of biofeedback were gifted individuals whose expertise bridged electrical engineering, electronics, and psychophysiological science. In 1989, the Biofeedback Society of America recognized several individuals as pioneers in biofeedback instrumentation: Les Fehmi, Rex Hartzell, Jan Hoover, Len Ochs, Jon Picchiottino, and Herschel Toomim. Tom Budzynski also deserves mention as a unique example of the practitioner/engineer/researcher, reflecting the central place of technology in the origins of our field.

Biofeedback instrumentation has come an enormous distance since the first conference of the Biofeedback Research Society in Santa Monica in 1969. The availability of high-powered micro processes in today’s computers, and advances in the instrumentation itself, has freed practitioners from many of the concerns with impedance, artifact, and data analysis, which absorbed so much time in the early years of biofeedback.

This issue draws on many of the developers and vendors of instrumentation, to convey their image of the future of biofeedback instrumentation. As editors, we have encouraged the authors to include discussion of their companies, the companies’ priorities in research and development, and their proudest achievements in instrumentation, education, and training. These articles are not intended as advertisements. However, the companies have contributed greatly to developing our field, and this issue conveys our recognition to these and other biofeedback companies.

Many of the visionary ideas presented in this special issue are already realities, and others will be in the near future. The articles range from discussions of new modalities, such as heart rate variability, to new modes of delivering service, such as tele-health. Richard Sherman opens the issue with a concern that practitioner training and competence remain a critical concern. Even the latest equipment is not completely foolproof, given the dismal depths of human folly! Sebastian Striefel has also contributed a helpful article on professional ethics and standards governing the selection and use of biofeedback instrumentation.

The Association News and Events Section includes the first message from AAPB’s new President Paul Lehrer, the final message from Past-President Donald Moss, as well as other Association news. Of special importance, we include a summary of the new joint AAPB/SNR Task Force Report on Methodology for Empirically Supported Treatments in Applied Psychophysiology. The full text of the report will be published in the AAPB journal, Applied Psychophysiology and Biofeedback, as well as in the SNR Journal of Neurotherapy, as well as on the AAPB website. The results of the elections for AAPB’s new officers are also included in this issue.

Proposals and Abstracts are invited for special issues on: Applied Psycho-physiology and the Performing Arts for Fall 2002 (Editor Marcie Zinn, PhD), and Mind/Body Pediatrics for Spring 2003. The editor also welcomes proposals for future special issues of the Biofeedback Newsmagazine.

The articles in this issue reflect the opinions of the authors, and do not reflect the policies or official guidelines of AAPB, unless stated otherwise.
Biofeedback is published four times per year and distributed by the Association for Applied Psychophysiology and Biofeedback. Circulation 2,100. ISSN 1081-5937.

Editor: Donald Moss PhD
Associate Editor: Theodore J. LaVaque, PhD
sEMG Section Editor: Randy Neblett, MA
EEG Section Editor: Dale Walters, PhD
Reporter: Christopher L. Edwards, PhD
Reporter: John Perry, PhD
Managing Editor: Michael P. Thompson

Copyright © 2002 by AAPB

Editorial Statement
Items for inclusion in Biofeedback should be forwarded to the AAPB office. Material must be in publishable form upon submission.

Deadlines for receipt of material are as follows:
- November 1 for Spring issue, published April 15.
- March 15 for Summer issue, published June 15.
- June 1 for Fall issue, published September 15.
- September 1 for Winter issue, published January 15.

Articles should be of general interest to the AAPB membership, informative and, where possible, factually based. The editor reserves 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 on disk, preferably Microsoft Word or WordPerfect, for Macintosh or Windows, together with hard copy of the manuscript indicating any special text formatting. Also submit a biosketch (30 words) and photo of the author. All artwork accompanying manuscripts must be camera-ready. 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 266dpi at final print size. TIFF or EPS preferred.

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

Biofeedback accepts paid display and classified advertising from individuals and organizations providing products and services for those concerned with the practice of applied psychophysiology and Biofeedback. Inquiries about advertising rates and discounts should be addressed to the Managing Editor.

Changes of address, notification of materials not received, inquiries about membership and other matters should be directed to the AAPB Office:

Association for Applied Psychophysiology and Biofeedback
10200 West 44th Ave., No. 304
Wheat Ridge, CO 80033-2840
Tel 303-422-8436
Fax 303-422-8894
E-mail: aapb@resourcenter.com
Website: http://www.aapb.org
Ethics and Instrumentation
Sebastian “Seb” Striefel, PhD, Logan, UT

Abstract: A number of ethical and legal issues related to instrumentation exist. First, is the importance of buying equipment that is safe and effective. FDA approval is one way of ensuring that the equipment is safe and effective. Second, practitioners are responsible for maintaining the equipment that they buy and being competent in its use. Third, practitioners should be aware of the potential risks associated with allowing clients to take equipment home for home training and with the rare occurrence of adverse reactions associated with biofeedback in general. Fourth, practitioners doing neurofeedback should be aware that the use of pre and post treatment EEGs and or QEEGs is still a decision that needs to be made by individual clinicians since little systematic data is available in this area. Last, those practitioners doing telebiofeedback and/or electronic billing should be familiar with relevant laws and procedures for ensuring client confidentiality.

Introduction
When biofeedback equipment is used for treatment purposes, it is generally classified by the Food and Drug Administration (FDA) as a Class II Medical Device (www.fda.gov/cdrh/dsmal/dsmclas.html). Medical devices have varying levels of risks and benefits and the degree of regulation is based on the level of control that the FDA considers necessary to assure the safety and effectiveness of the device. There are three levels of classification. Class I devices have the lowest level of regulation because they present a minimal level of risk for harm. General controls such as registration, following the Good Manufacturing Practices, and labeling are considered sufficient for ensuring safety and effectiveness. About 93% of Class I devices are exempted from the premarket notification process. Class II devices are those for which special controls are considered necessary by the FDA for assuring safety and effectiveness and where there are existing methods for providing such assurances. Special controls can include guidance documents, special labeling requirements, mandatory performance standards, and post market surveillance (www.fda.gov/cdrh/dsmal/dsmclas.html).

There is a process for getting the FDA to classify a Class II device as exempt from the 510(k) Premarket Notification requirements. As of September 1998, 62 devices are exempt from the Premarket Notification requirements (See the FDA Modernization Act Information at www.fda.gov/cdrh/dsmal/dsmclas.html).

These Class II devices are listed on the FDA’s Medical Device Exemptions page (www.fda.gov/cdrh/dsmal/dsmclas.html). Class III devices require the most stringent regulation because insufficient information exists for assuring safety and effectiveness and these devices are generally those that support or sustain human life. Because of the difficulty associated with writing about the complex and confusing FDA requirements, I am presenting information from FDA sources and am referring readers to those sources for clarifications and more information. For example, it is unclear to me based on what I have read, whether the FDA has any authority or regulations that pertain to the use of biofeedback equipment if it is used for non treatment purposes.

For biofeedback equipment first manufactured after 1976 (Medical Devices Act of 1976, www.rma.org/REG/research/regulatory/mosein2ii.html), unless exempted from the requirements, manufactures are generally required to file a 510(k) Premarket Notification so that the FDA can determine if the equipment is “substantially equivalent” to a legally marketed device that does not require premarket approval. “Unless exempted from premarket notification requirements, persons may not market a new device, under section 510(K), unless they receive a substantial equivalence order from the FDA or an order reclassifying the device into Class I or Class II (section 513(I) of the Act)” (www.fda.gov/cdrh/modact/frclass2.html, p.2). There is now one exception, and that is for the selling of battery operated biofeedback equipment used for relaxation training or muscle reeducation. The FDA has the regulatory authority to exempt a Class II device from the 510(k) requirement and has done so for battery operated biofeedback equipment, which it evidently considers to be safe and effective (www.fda.gov/cdrh/modact/frclass2.html).

Other FDA requirements must still be met. One FDA website (www.fda.gov/cdrh/modact/143.html) states, and I quote, “Biofeedback devices to be promoted for indications other than relaxation require prescription legend pursuant to Title 21, Code of Federal Regulations, Section 801.109… “The FDA rules are far too complex to discuss further here and additional regulations that pertain to biofeedback exist. As such, readers are referred to the FDA website (www.fda.gov).

Manufacturer and Practitioner Responsibility
So what does this mean for the practitioner? It means that if a piece of equipment has been exempted or received Premarket Approval from the FDA, it is considered by the FDA to be safe and effec-
tive for the purposes filed with the FDA. Biofeedback equipment has been approved for relaxation training and muscle reeducation. Biofeedback equipment that is to be marketed for other purposes requires a separate Premarket Notification, a prescription legend or FDA approval (www.fda.gov/cdrh/node/143.html). All biofeedback equipment manufactures are strongly encouraged to go through the any required FDA Premarket Notification and/or approval processes and thus reduce their own legal risk, help ensure that the public is protected, and to help practitioners in ensuring that the equipment they purchase is in fact considered to be safe and effective by the FDA. Legally, the selling of a device classified by the FDA as a Class II Medical Device without meeting their requirements is a violation of law. Violation of existing law is also an ethical violation. At minimum, manufacturers should inform those who are considering purchasing a piece of equipment, of its FDA status, i.e., Premarket Notification filed and accepted (approved), Premarket Notification filed and pending, exempted, Substantial Equivalence Received, or Premarket Notification not yet filed.

Buy Approved Equipment

Practitioners are encouraged to ensure that the equipment that they buy has gone through the appropriate FDA process and has been approved or exempted by the FDA for the intended use(s). Why take an unknown and uncertain risk when good equipment that has gone through the FDA process is available? If a practitioner purchases a piece of biofeedback equipment that has not been approved by the FDA or exempted by them and it turns out that the equipment is defective in some way and not safe, e.g., a client gets an electrical shock because of faulty optical isolation, the practitioner shares in liability and could readily be considered negligent because he or she is ethically and legally responsible for what he or she does or fails to do.

Most, if not all, FDA approved Class II medical devices are supposed to be sold only to licensed health care professionals. They are not supposed to be sold to the general public. To market biofeedback equipment to someone other than professionals require the filing of other paperwork with the FDA and their authorization (approval) that it is safe to do so.

Responsibilities after Purchase

Once purchased, practitioners are ethically responsible for ensuring that the equipment is properly maintained (e.g., no frayed electrical cords, periodic recalibration as appropriate, etc.), used in accordance with existing ethical principles and practice guidelines and standards (e.g., AAPB, 1995; Striefel et al., 1999), and used in accordance with relevant law.

Practitioners are also expected to be competent in all aspects of using their equipment with clients. This means at minimum, reading the manual and practicing with the equipment until it can be used competently, before using the equipment with clients. Some equipment is either complex to use or the data obtained is complex to understand (e.g., EEGs). As such, practitioners should obtain additional training, supervision, or consultation, as needed. If fact, initially it may be a good idea to have ongoing supervision or even have someone else complete complex tasks. For example, removing artifacts and interpreting EEGs and/or QEEGs correctly requires considerable skill. Some groups offer such services for a fee. One useful training task is to have a competent, external source, conduct the EEG artifacting and interpretation of a protocol while one also does it oneself and then compare the results to see if they are the same or very different. The more similar the results, the more likely it is that the task has been completed correctly.

Home Training

Should biofeedback equipment be sent home with clients so they can practice at home and thus speed up the treatment process? The answer to this question depends on a number of factors related to client risk. Fortunately, adverse reactions to biofeedback training are overall rare, and when they occur they are relatively transient or readily dealt with by competent practitioners (Hammond, 2001; Schwartz & Schwartz, 1995). How can a practitioner deal with an adverse reaction if the practitioner is not available? Relaxation induced anxiety is reported to occur in up to 40% of individuals getting some form of relaxation training and the anxiety may be a sign of underlying pathology (Smith, 1985). Theta training can reportedly induce both seizures and extremely traumatic material (Stockdale & Hoffman, 2001), or even depression (Nash, 2001). Theta brain states can occur as a result of direct training using EEG biofeedback or it can occur as a result of deep relaxation training via some other mode of biofeedback training.

Clearly, before home training is considered, a practitioner should have a good clinical history; should have ruled out a history of seizures, post-traumatic stress disorder, identity disorders, or other conditions that might result in predictable, adverse side effects; and should have conducted enough office-based sessions to minimize the risk of adverse reactions during home training. In addition, informed consent should have been obtained that indicates that adverse reactions may occur, even if rare, and that if they occur, clients are to stop the home training and consult with the practitioner to determine the next step or steps in treatment. Sometimes, reassurance is all that is necessary, and other times, intervention requires that a practitioner have a good background in psychotherapy. Nash (2001) recommends that practitioners unlicensed in a mental health discipline, not provide treatment for DSM IV diagnostic conditions unless supervised by someone who is so licensed and thus competent to intervene if and when adverse reactions occur.

To Use or not Use an EEG and/or QEEG

One special area related to instrumentation is concerned with whether or not a practitioner doing neurofeedback training should first obtain a multi-site EEG (raw data) and/or a QEEG (computerized EEG analysis). Several practitioners have reported a variety of adverse reactions associated with neurofeedback training (Ayers, 2001; Hammond, 2001; Nash, 2001; Stockdale & Hoffman, 2001). Fortunately, the adverse reactions that do occur, are generally transient and easily dealt with when detected. Little is known about the frequency of such adverse reactions, but they appear to be rare. Rare or not, practitioners should make a concerted effort to detect adverse reactions. Perhaps they can be more easily
Telebiofeedback and Electronic Data

A number of groups are now doing biofeedback training at great distances using telephone lines and/or satellite system connections (Striefel, 2000a). Such practitioners must ensure that they are in compliance with the laws of the state in which they operate and in the state(s) in which the client who is receiving services is located (Striefel, 2000b). In addition, they must take extra precautions to ensure that client confidentiality is not compromised by inadvertently allowing unauthorized persons to access the session or client's data from the session. Carefully documented informed consent is also important when doing such training, e.g., if one is hundreds of miles from the client and he or she has an adverse reaction, how will it be dealt within an ethical and legal manner? See Striefel (2000a & b) for more info. By the way, Medicare will now pay for some telehealth psychotherapy services (Ballie, 2001). It requires two-way, audio and video, real-time interactive communication between the patient and practitioner and the patient must be receiving the service in a health care setting, such as a clinic, hospital, or doctors office.

Those who use computerized storage of data or electronic billing must also take precautions to ensure that unauthorized access to confidential information does not occur and that one does not send the information to the wrong email address. Encrypting files, passwords, and storing data on discs that can be taken out of the computer and locked up in storage files are all part of the process for ensuring confidentiality of client information.

References


Footnote

1 Several members of AAPB raised questions about an earlier draft of this article that I became aware of indirectly and, two individuals contacted me directly, Margaret Ayers and Lynda Kirk. The questions and comments were useful in making some needed revisions in the article to make it more helpful to readers. I thank all of you.
Abstract: The author praises the sophistication of today's biofeedback instrumentation, which provides many features simplifying clinical practice in biofeedback. He cautions on the continued need for adequate practitioner training, and careful adherence to basic quality control, including such principles as skin preparation, equipment maintenance, physiologically appropriate electrode placement, bandwidth selection, and use of up to date assessment protocols. He applauds the future of biofeedback but warns that incompetence will undermine that future.

Here's how I was going to start this really upbeat article: “Remember the days when you used to have to scrape the top layer off patients’ skins with abrasive soap and sand paper in order to get impedance down low enough to get good EMG and EEG recordings? We all gave thanks to the manufacturers when those days disappeared forever so all anybody had to do to get a decent signal was rub the skin with some alcohol and push in a bit of conducting gel. With the new equipment and sensors you don't even have to do that! There's been another revolution! All you need to do is wash the patient with soap and water – or perhaps not even that. No more messy jells to worry about drying out. No more need for lots of double stick tape to hold on weird little cups. Lots of systems don't have noise generating, tangling wires – some don't even have wires at all. Just slap on the sensors and go for it. And that's just the beginning. These gems can tell you when the signal is bad, operate without noisy / tangling wires, tell you where to plug sensors into the equipment, and still more! The new equipment will just take your breath away.”

But I'm not going to start that way. Want to know why? It's mostly because I got a real punch in the head from reality a couple of weeks ago -- direct from a therapist who has been doing “biofeedback” for umpteen years. This therapist sent me a patient who has mysterious headaches. She has no obvious traumatic onset, no trigger points, reasonable posture, tenses her jaw when she gets upset, has an apparently normal jaw joint but grinds her teeth at night, and feels her shoulders and neck tense up before her headache begins. From the symptoms, the therapist thought the headaches should be at least somewhat related to muscle tension in the jaws and shoulders. Wouldn't you? But when the therapist did sEMG recordings of the jaws and shoulders, the muscles were virtually silent. So what could be causing the pain? Thus, the referral to me.

Communication being what it is, I didn't get the word that an exam incorporating sEMG recordings had been done. So, after hearing the patient's symptoms, I did my typical recordings of the jaw and shoulders. The jaw muscles were three times normal and the upper traps were four times normal – and she couldn't recognize tension in nor relax them to normal levels with coaching. When I compared notes with the referring therapist, we were both surprised to find that we had both apparently done the same evaluation and had gotten very different results.

So, what happened? Was the patient just tense as a charging rhino for me but loose as a sleeping puppy for the therapist? Could have been – but it wasn't. What really happened was a whole litany of fiascos that led to a “garbage in - garbage out” result. First, the therapist didn't do any site preparation at all. Skin impedance was so high that the signal was attenuated to about one tenth of its actual size - so the values looked pretty normal. Second and third, the sensors were not applied along the bodies of the muscles of interest – just in the general area. They were partially over irrelevant muscles and at random angles to their lengths so all kinds of extraneous signals crept into the recording – which accounted for most of the power the sensors picked up. Fourth, the therapist had not checked to see if the machine and sensor cables were intact and working properly for years. One of the leads tuned out to have an intermittent loose connection at the sensor head. Fifth, the device was set to the wrong bandwidth to show proportional tension in the trapezius muscle. Sixth, the patient was just sitting there during the recording. No stress response profile, no movements, no postural adjustments were done to elicit muscular responses relevant to the situation at hand. I've got to tell you that this just about made me want to drop biofeedback equipment into a hole. Here our manufacturers are creating nearly miraculous equipment which:

• checks itself for improper functioning and noise – if you run the sub-routine.
• shows you the raw signals (even with power spectra) for each signal so you can easily spot artifacts – if you look.
• has displays showing which leads go to which parts of the body and plug into which socket on the equipment – if you look at the display.
• has displays which show when leads are out of impedance range – if you run that routine before starting your recording.

continued on Page 18

FEATURE ARTICLE

Hooray! The Revolution Is Here! (But Don’t Stop It in Its Tracks)

Rich Sherman, PhD, Suquamish, Washington

Rich Sherman, PhD, Suquamish, Washington
A Living Compendium of Information on Biofeedback Devices

Richard A. Sherman, PhD, BCIAC
Chair, AAPB Research and Instrumentation Committee
Behavioral Medicine Research and Training Foundation
Suquamish Washington

Nanny H. Christie, MA, LPC, BCIAC
Weatherford, Texas

Amy Coleman
Chapman University, Bangor Washington

It has been nearly ten years since AAPB’s research & instrumentation committee compiled a list of available biofeedback devices and their characteristics. An incredible amount has happened during that decade. Instruments – especially their sensors, software, and capabilities – have undergone a revolution so even the questions on the old list are obsolete.

Questions for the new survey of equipment capabilities were generated by the authors and then sent for comment by three manufacturers. The highly revised list of questions was incorporated into a survey sent to all biofeedback equipment manufacturers known to AAPB. Data from the respondents has been incorporated into a spreadsheet which is summarized below and which will be available on AAPB’s website (www.aapb.org) indefinitely.

A major strength of maintaining the survey on the web site is that manufacturers can update the information as their equipment changes and as new equipment comes out. One of the first columns in the spreadsheet is the date the data were updated so readers will know how current the information on the particular item is.

The spreadsheet is vertically organized into four categories:
A. Computer-Based, Multichannel Systems not intended for ambulatory or home use
B. Ambulatory / Home Trainers
C. Stand alone Single / Dual parameter non-computer based systems
D. Software not supplied with the equipment

Within each section, each of the spreadsheet’s rows is used for one item of equipment. A manufacturer selling several devices within one category would have one row for each device. The questions for each category are spaced horizontally across the width of the spreadsheet. The full list of questions are shown on the following page, followed by an abbreviated sample of the spreadsheet which appears on AAPB’s website.

Manufacturers please note:
If we failed to contact you or somehow didn’t include your information, please contact the senior author (rsherman@nwinet.com) for a survey and we will add your information to the spreadsheet appearing on the website.
If you want to change or add material, just contact the senior author and the new material will be incorporated.
### Association for Applied Psychophysiology and Biofeedback

**Survey of Instrumentation and Software for Biofeedback/Applied Psychophysiology**

#### Section I: Biofeedback Devices

1. Name of Manufacturer: 
2. Phone number: 
3. Power Source (circle all that apply): Battery AC power line power from computer other 
4. Types of biofeedback provided (circle all that apply): audio / visual computer monitor vibration other 
5. Visual display output (circle all that apply): raw sEMG other raw data bar graph moving line digital templates games other 
6. Audio output: pulsed tone pitch music CD other 
7. Parameters recorded (circle all that apply): EEG EMG TEMP GSR RESP BVP UI HR ECG Pressure BP other 
8. Number of channels of input: 
9. Devices supported: 
10. Suppliers of software: 

#### Section II: Software not supplied with original equipment

1. Name of Manufacturer: 
2. Name of software: 
3. Intended Use: Data storage Biofeedback Reports Statistics Other: 
4. What does this software package do that the software supplied with the unit does not do? Be very specific: 
5. Screens: Default Create your own 
6. Training Protocol?: Yes No 
7. HRV / RSA Protocols?: Yes No 
8. Printable (circle): Notes Graphics Other 
9. Devices supported: 
10. Suppliers of software:
Association for Applied Psychophysiology and Biofeedback
Survey of Instrumentation and Software for Biofeedback/Applied Psychophysiology

Section 1: Biofeedback Devices “A. Computer-Based, Multichannel Systems not intended for ambulatory or home use”

<table>
<thead>
<tr>
<th>Name of manufacturer</th>
<th>Date data updated</th>
<th>Power Source: AC power line</th>
<th>Battery</th>
<th>AC power line</th>
<th>Audio input type</th>
<th>Audio output type</th>
<th>Visual display output</th>
<th>Types of Biofeedback provided</th>
<th>Visual display output</th>
<th>Parameters recorded</th>
<th>Are there isolated inputs for external equipment?</th>
<th>Scanning option</th>
<th>Can the system be used to turn on external equipment such as a stimulator?</th>
<th>Can this device use only the sensors provided by the manufacturer?</th>
<th>Number of channels of input:</th>
<th>Flexibility of channel settings:</th>
<th>Skin preparation requirements for equipment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comptronics Devices Ltd.</td>
<td>9038-51st Avenue Edmonton, Alberta Canada T6E 5X4</td>
<td>1-800-661-4643</td>
<td><a href="mailto:info@comptronics.com">info@comptronics.com</a></td>
<td>rechargeable</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph</td>
<td>moving line</td>
<td>digital games</td>
<td>using computer programs</td>
<td>animations</td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>photic stimulator</td>
<td>no</td>
</tr>
<tr>
<td>Brainmaster Technologies, Inc.</td>
<td>24490 Broadway Ave, #2</td>
<td>Oakwood Village, OH 44146</td>
<td>440-232-6000</td>
<td><a href="mailto:sales@brainm.com">sales@brainm.com</a></td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph</td>
<td>moving line</td>
<td>digital games</td>
<td>using computer programs</td>
<td>animations</td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Biofeedback Systems Incorporated</td>
<td>CAPSCAN/NBF Inc. Consortium</td>
<td>2736 4th Street</td>
<td>Boulder, CO, 80301</td>
<td>303-444-1411</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph</td>
<td>moving line</td>
<td>digital games</td>
<td>using computer programs</td>
<td>animations</td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Neurotechnics, Inc.</td>
<td>817-397-7050</td>
<td>ggoldstein@</td>
<td>neurotechnics.com</td>
<td>AC power line</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph</td>
<td>moving line</td>
<td>digital games</td>
<td>using computer programs</td>
<td>animations</td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>EMG</td>
</tr>
<tr>
<td>Neuropathways ECG Imaging</td>
<td>Suite 208</td>
<td>Beverly Hills CA 90210</td>
<td>310-276-9181</td>
<td>margaret@</td>
<td>neuropathways.com</td>
<td>AC power line</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>all digital</td>
<td>real-time</td>
<td>EEG feedback</td>
<td>EMG</td>
<td>no</td>
<td>no</td>
<td>EMG</td>
</tr>
<tr>
<td>Thought Technology Limited</td>
<td>(ProComp/BioGraph 2.0)</td>
<td>2180 Belgrade Ave.</td>
<td>Montreal, CANADA H4B 2L8</td>
<td>514-489-8251</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EMG</td>
<td>no</td>
<td>no</td>
<td>EMG</td>
</tr>
<tr>
<td>Thought Technology Limited</td>
<td>(ProComp/BioGraph)</td>
<td>2180 Belgrade Ave.</td>
<td>Montreal, CANADA H4B 2L8</td>
<td>514-489-8251</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EMG</td>
<td>no</td>
<td>no</td>
<td>EMG</td>
</tr>
<tr>
<td>Thought Technology Limited</td>
<td>(Myocare 3)</td>
<td>2180 Belgrade Ave.</td>
<td>Montreal, CANADA H4B 2L8</td>
<td>514-489-8251</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EMG</td>
<td>no</td>
<td>no</td>
<td>EMG</td>
</tr>
<tr>
<td>J&amp;L Engineering (330C0)</td>
<td>22767 Holgar Court NE</td>
<td>Poulsbo, Washington 98370</td>
<td>360-779-3853</td>
<td>J&amp;L engineering.com</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>EMG</td>
</tr>
<tr>
<td>Ambulatory Monitoring, Inc.</td>
<td>914-693-9040</td>
<td>ambulatory-monitoring.com</td>
<td>AC power line</td>
<td>audio visual</td>
<td>bar graph</td>
<td>digital</td>
<td>LED &amp;</td>
<td>EMG</td>
<td>no</td>
<td>no</td>
<td>EMG</td>
<td>n/a</td>
<td>EEG</td>
<td>n/a</td>
<td>EEG</td>
<td>n/a</td>
<td>EEG</td>
</tr>
<tr>
<td>Lexicor Medical Technology</td>
<td>2840 Wilderness Place</td>
<td>Suite A</td>
<td>Boulder, Colorado 80301</td>
<td>303-443-9848</td>
<td>external power supply</td>
<td>audio visual</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>J11330</td>
</tr>
<tr>
<td>Lairobe Medical Technologies</td>
<td>800-878-1110</td>
<td><a href="mailto:l.c@labobe.com">l.c@labobe.com</a></td>
<td>AC power line</td>
<td>audio visual</td>
<td>computer monitor</td>
<td>other raw data</td>
<td>bar graph moving line</td>
<td>digital</td>
<td>EMG</td>
<td>no</td>
<td>yes</td>
<td>can control</td>
<td></td>
<td></td>
<td></td>
<td>EMG</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Digital resolution (12, 14, 16, bits): 10 slow: 3
Number which have high speed A/D: 23
Maximum sample rate per channel: 512
Digital resolution (12, 14, 16, bits): 12

---

**Biofeedback**

**Spring 2002**
### Biofeedback Devices

| Method of transmitting the signal from the sensors to the device: | Built in quality checks for: | Computer Requirements: | Warranty period (years): | Usual turn around time for repairs: | "Availability of technical (software, hardware advice) support:" | Are firmware/software updates accomplished via: | Which computing operating systems are supported by the system? | How is the biofeedback device interfaced with the computer? | What kind of data can be stored in the device? | Can the data be accessed by standard programs? | How long has this device been on the market? | Does the device have FDA approval? | "If yes, what is it labeled for?" | Suppliers of this unit: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| wires | loose sensors: yes | Impedence: no | Battery: yes | Other: | 1 | 2 weeks or less | during warranty: good | after warranty: good | diskette | CD | Windows | not | not | 16 years | no | clinicians |
| wires | loose sensors: no | Impedence: no | Battery: no | Other: Raw | 2 days | during warranty: yes | after warranty: yes | diskette | CD | Apple MAC | optical isolated | RS-232 | raw EEG statistical summaries | yes | 5 years | yes | "IEEE, biofeedback/relaxation" |
| wires | loose sensors: yes | Impedence: yes | Battery: yes | Other: | 1 | 2 days | during warranty: yes | after warranty: yes | diskette | CD | 5 channel = DOS 6.0 | 1 channel = Windows 95 and up | 5 channel = A/D card | 1 channel = RS 232 port | raw and average | yes | 5 years | yes | biofeedback |
| fiber optic | loose sensors: no | Impedence: no | Battery: yes | Other: | 48 hours | during warranty: yes | after warranty: yes | diskette | CD | serial port | raw summary | no | 11 years | yes | relaxation |
| wires | loose sensors: yes | Impedence: yes | Battery: yes | Other: | 3 years | 2 days | during warranty: yes | after warranty: yes | CD | built from scratch | All in one package | raw | yes | 5 years | no | Neuropathways EEG Imaging |
| wires | loose sensors: yes | Impedence: no | Battery: yes | Other: EEG signal quality | years: 1 | 2 weeks | during warranty: yes | after warranty: yes | diskette | CD | Factory reconfiguration | protocol | Windows | ProSB interface | F.O. cable | raw statistics | yes | 2 years | yes | class 2 |
| wires | loose sensors: no | Impedence: no | Battery: yes | Other: | years: 1 | 2 weeks | during warranty: yes | after warranty: yes | diskette | CD | Factory reconfiguration | protocol | Windows | F.O. cable | RMS | yes | 2 years | yes | class 2 |
| wires | loose sensors: yes | Impedence: yes | Battery: yes | Other: | years: 1 | 1 week | during warranty: yes | after warranty: yes | diskette | CD | Factory reconfiguration | protocol | Windows | USB port | raw and any average | yes | Dec. 01 | yes | thought Technology and worldwide distribution |
| wires | loose sensors: no | Impedence: no | Battery: yes | Other: | years: 1 | 3 weeks | during warranty: yes | after warranty: yes | diskette | CD | IBM PC, Windows | serial connection or modem | raw | yes | 21 years | no | Ambulatory Monitoring |
| wires | loose sensors: yes | Impedence: no | Battery: yes | Other: | years: 1 | 3 weeks | during warranty: yes | after warranty: yes | diskette | CD | DOS Windows | accessory DSP card | raw | yes | 12 years | yes | Electroencephalography, spectral frequency analysis |
| wires | loose sensors: no | Impedence: no | Battery: n/a | Other: | years: 1 | 1 week | during warranty: yes | after warranty: yes | CD | Windows 98, ME | Serial RS-232 cable | patients demographics average data protocol settings | yes | 1 year | yes | Urostym biofeedback/ Simulation system for tx of urinary inconti- nence used by urologists/uro- gynecologist |

**Notes:**
- Spring 2002
- "Other:" fields provide additional information relevant to each device.
### Section 1: Biofeedback Devices "A. Computer-Based, Multichannel Systems not intended for ambulatory or home use" continued

| Name of manufacturer | Date data updated | Power Source: Types of Biofeedback provided | Visual display output | Audio output: | Parameters recorded: | Are there isolated inputs for external equipment? | Can the system be used to turn on external equipment such as a stimulator? | Number of channels of input: | Flexibility of channel settings: | Scanning option: | Can this device use only the sensors provided by the manufacturer? | Skin preparation requirements for equipment? |
|----------------------|-------------------|--------------------------------------------|-----------------------|----------------|----------------------|-----------------------------------------------|---------------------------------------------------------------------|--------------------------|-----------------------------|-------------------------------|-----------------------------------------------|
| AM Biotech Information Unicomp 1330 | Plug in | audio vibration visual computer monitor | EMG, TEMP GSR, HR RESP UI BVP systolic/diastolic pressure | 8 channels simultaneously and 16 alternatively | yes yes | yes | yes | standard preparation |
| AM Biotech Information CAPSCAN Prism 5 | Plug in | audio vibration visual computer monitor | EMG, EEG | 5 channels (four channel synchrony plus yes a single amplitude 80 built in) | no | no | yes | Prep pads |
| AM Biotech Information CAPSCAN C80 | Plug in | audio vibration visual computer monitor | EMG, EEG | 5 channels (1 amp four bandwidths simultaneously) | yes yes | yes | yes | Prep pads |

#### Survey of Instrumentation and Software for Biofeedback/Applied Psychophysiology

| Name of manufacturer | Date data updated | Power Source: Types of Biofeedback provided | Visual display output | Audio output: | Parameters recorded: | Are there isolated inputs for external equipment? | Can the system be used to turn on external equipment such as a stimulator? | Number of channels of input: | Flexibility of channel settings: | Scanning option: | Can this device use only the sensors provided by the manufacturer? | Skin preparation requirements for equipment? |
|----------------------|-------------------|--------------------------------------------|-----------------------|----------------|----------------------|-----------------------------------------------|---------------------------------------------------------------------|--------------------------|-----------------------------|-------------------------------|-----------------------------------------------|
| Comptronic Devices Ltd. Mind Alive 9008-51st Avenue Edmonton, Alberta, Canada T6E 3X4 1-800-661-6483 info@comptronic.com | battery AC power line | audio visual | bar graph | CD pitch pulsed tone | EEG GSR AVE | no | Number of channels of input: 1 Number which have high speed A/D: Maximum sample rate per channel: Digital resolution (12, 14, 16, bits): | no | EMG EEG: abrades |
| Brainmaster Technologies, Inc. 2444 Broadway Ave, #2 Oakwood Village, OH 44146 440-232-6003 sales@brainm.com | rechargeable battery | audio visual computer monitor vibration | other raw data bar graph moving line digital games | pulsed tone pitch music midi synthesizer | EEG | no | Number of channels of input: 2 Number which have high speed A/D: 1 Maximum sample rate per channel: 120 Digital resolution (12, 14, 16, bits): 8 | yes yes no | EMG: EEG minimal skin prep with gel |
| Biocomputer Systems Incorporated CAPSCAN/BFS Inc. Consortium 2736 47th Street Boulder, CO 80301 303-444-1414 | battery AC power line | audio visual | digital analog meter | pulsed tone | EEG TEMP GSR | no | Number of channels of input: 1 Number which have high speed A/D: Maximum sample rate per channel: Digital resolution (12, 14, 16, bits): | no yes yes | EMG: skin prep pads EEG |
| Neurocyberetics, Inc. 818-379-7050 gordon@neurocyberetics.com | battery AC power line | audio computer monitor | bar graph moving lines games | pulsed tone pitch music | EEG | no | Number of channels of input: 2 Number which have high speed A/D: 2, slow 6 Maximum sample rate per channel: 256 hz Digital resolution (12, 14, 16, bits): 12 | no no no | EMG: EEG: paste |
| Peak Achievement Training Single Channel Peak Achievement Trainer 1103 Hollendale Goshen, Kentucky 40026 | battery power from computer | audio computer monitor | other raw data bar graph moving line digital templates fast fourier transforms spectrograms | pitch music | EEG | no | Number of channels of input: 1 Number which have high speed A/D: 1 Maximum sample rate per channel: 128 hz Digital resolution (12, 14, 16, bits): 8 | no no no | EMG: EEG: sensor bands, sensor phones |
| Peak Achievement Training Two Channel Peak Achievement Trainer 1103 Hollendale Goshen, Kentucky 40026 | battery power from computer | audio computer monitor | other raw data bar graph moving line digital templates fast fourier transforms spectrograms | pitch music | EEG EGM GSR HR | no | Number of channels of input: 3 Number which have high speed A/D: slow 3 Maximum sample rate per channel: 128 hz Digital resolution (12, 14, 16, bits): 8 | yes no no | EMG: cleaning with prep EEG: sensor bands, sensor phones |
| HeartMath Freeze-Framer 14700 West Park Avenue Boulder Creek, CA 95006 | power from computer | audio computer monitor | bar graph moving line games | none | HR Hrv | no | Number of channels of input: 1 Number which have high speed A/D: slow 1 Maximum sample rate per channel: n/a Digital resolution (12, 14, 16, bits): n/a | no no yes | EMG: n/a EEG: n/a |
| Thought Technology Limited (U Control) 2180 Belgrade Ave. Montreal, CANADA H4L 2L8 514-869-8251 mail@thoughttechnology.com | battery | audio visual computer monitor | rtbar graph moving line digital RHE EMG | pulsed tone | EEG | no | Number of channels of input: 1 Number which have high speed A/D: Slow Maximum sample rate per channel: 20kHz Digital resolution (12, 14, 16, bits): 14 | no no yes | EMG: pre-gelled electrodes EEG: n/a |

---

**Biofeedback**

Spring 2002
<table>
<thead>
<tr>
<th>Method of transmitting the signal from the sensors to the device:</th>
<th>Built in quality checks for:</th>
<th>Computer Requirements:</th>
<th>Warranty period (years):</th>
<th>Usual turn around time for repairs:</th>
<th>&quot;Availability of technical (software advice, hardware advice) support:&quot;</th>
<th>Are firmware/software updates accomplished via:</th>
<th>Which computer operating systems are supported by the system?</th>
<th>How is the biofeedback device interfaced with the computer?</th>
<th>What kind of data can be stored in the computer?</th>
<th>Can the data be accessed by standard programs?</th>
<th>How long has this device been on the market?</th>
<th>Does the device have FDA approval?</th>
<th>&quot;If yes, what is it labeled for?&quot;</th>
<th>Suppliers of this unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>wires</td>
<td>loose sensors: yes</td>
<td>DOS Windows</td>
<td>years: 1</td>
<td>2 weeks or less</td>
<td>during warranty: good</td>
<td>diskette CD</td>
<td>Windows</td>
<td>AVE or biofeedback camera</td>
<td>16 years</td>
<td>no</td>
<td>clinicians</td>
<td>American Biotech Corporation</td>
<td>American Biotech Corporation</td>
<td></td>
</tr>
<tr>
<td>wires</td>
<td>loose sensors: no</td>
<td>any windows with external com port</td>
<td>2 days</td>
<td>during warranty: &quot;phone, email unlimited&quot; after warranty: &quot;phone, email, limited&quot;</td>
<td>diskette CD</td>
<td>Windows Apple MAC with virtual PC</td>
<td>optical isolated RS-232</td>
<td>raw EEG statistical summaries</td>
<td>yes</td>
<td>5 years</td>
<td>yes</td>
<td>&quot;EEG, biofeedback/relaxation&quot;</td>
<td>manufacturer, distributors, affiliates</td>
<td>American Biotech Corporation</td>
</tr>
<tr>
<td>fiber optic</td>
<td>loose sensors: no</td>
<td>2 computers Sound blaster Sound card ATI video card</td>
<td>48 hours</td>
<td>during warranty: 8 - 5 PST Mon. - Fri after warranty: 8 - 5 PST Mon. - Fri</td>
<td>diskette CD</td>
<td>serial port</td>
<td>raw summary</td>
<td>3 years</td>
<td>yes</td>
<td>relaxation</td>
<td>Peak Achievement Training</td>
<td>Peak Achievement Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wires</td>
<td>loose sensors: no</td>
<td>486 DX with 4 M RAM any Pentium</td>
<td>2 weeks</td>
<td>during warranty: free after warranty: free</td>
<td>diskette CD</td>
<td>Windows serial port</td>
<td>raw</td>
<td>yes</td>
<td>4 years</td>
<td>no</td>
<td>Peak Achievement Training</td>
<td>Peak Achievement Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wires</td>
<td>loose sensors: yes</td>
<td>90 days</td>
<td>1 week</td>
<td>during warranty: yes after warranty: yes</td>
<td>CD internet protocol</td>
<td>Windows serial port</td>
<td>HIV</td>
<td>yes</td>
<td>2 years</td>
<td>no</td>
<td>Heartmath LLC, Q-38 Corp., American Biotech, EEG Spectrum, Phaze</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wires</td>
<td>loose sensors: no</td>
<td>32 MB RAM, 800x600 screen resolution, serial port</td>
<td>90 days</td>
<td>during warranty: 9 - 5 EST after warranty: 9:5 EST</td>
<td>Factory reconfiguration internet protocol</td>
<td>n/a</td>
<td>n/a</td>
<td>yes</td>
<td>2 years</td>
<td>yes</td>
<td>class 2</td>
<td>Thought Technology and various dealers worldwide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| continued on page 32
Morphing Beyond Recognition: The Future of Biofeedback Technologies

Olafur S. Palsson, PsyD, Chapel Hill, North Carolina
Alan T. Pope, PhD

Abstract: The authors provide a description of the likely near and long-term future of biofeedback technologies. They predict that biofeedback will soon pervade everyday life, and will become an integral and expected part of the human living and work environments of the future. Biofeedback will be automatically delivered through most ordinary work tasks and embedded in recreational activities. Wearable sensors and wireless transmission will in the near term be important technologies mediating the permeation of biofeedback in society. These biofeedback technologies will eventually be replaced by remote sensors built into human surroundings and household objects and controlled by omnipresent computer networks.

Predictions of future technologies traditionally have a dismal record of accuracy. More often than not their fate is merely to become a source of amusement for future generations. However, futurist predictions serve a vital and generally underestimated purpose in any technical field. For these detailed visions of future realities direct innovation and encourage people to reach beyond what is convenient or conventional today to build a different tomorrow.

With this value of prognostications in mind, we will risk ridicule from our descendants and the attendees at the 2020 Annual AAPB Meeting, and outline what we believe is the foreseeable future of biofeedback technologies. We will begin by outlining the monumental change in the applications of biofeedback which we believe is currently on the horizon. To sum it up in one sentence, biofeedback is about to escape, once and for all, from our labs and specialty clinics, to infiltrate everyday life in myriad ways. We will then discuss the technological changes that both drive and will result from this change.

1. In the future, biofeedback training opportunities will pervade the daily lives of most people.

Most experts on future technologies agree that, in the coming decades, we will live in “intelligent” home and work environments. Our homes and offices will be unobtrusively run by sophisticated computers, which will constantly adapt and respond to the inhabitants. It is almost inevitable that biofeedback technology will join computers as they are woven this way into the background fabric of our everyday lives. “The computer of the year 2020 will basically be invisible. It will be completely distributed and decentralized and omnipresent in all the objects around us. It will be part of your clothes, of your glasses, of your shoes, of the chairs, etc. We will be continuously living in this computer-based world” (Maes, 2001). Biofeedback technology will disappear into the woodwork—in many cases, literally. Our surroundings will listen to our bodies and brains through remote sensors built into walls and household objects, and by means of sensors in our clothes, and react to physiological signals as well as voice and presence to make adaptive changes in our experience. “I think in the future that if you were to walk into a room that didn’t react to your presence there, that didn’t know you had come into it, and somehow done something to customize itself for you, or something like that, that will feel as primitive to people then as it would feel to us now to walk into a log cabin. It will feel ancient, and, I think, in some sense people might even be uncomfortable in spaces like that” (Coen, 2001).

“Life-pervasive” games, which are the latest hot development in computer games, provide “the thrill of being harassed by a mysterious conspiracy via phone, e-mail, instant messaging and the Web” (Grossman, 2001). Biofeedback in the future will similarly utilize a variety of objects and methods which will "conspire" to deliver corrective feedback to individuals to help them maintain the desired mental and physical states. “We are moving into a world where most objects will have microprocessors in them, and all these processors will interconnect wirelessly through the Internet” (CNN Productions, 2001). People will only have to state their mental and physical goals, and, wherever they go, the recreational games, computer workstations, thermostats, music delivery systems, television, etc., within their reach will band together under the control of remote computer servers to help achieve and maintain those biofeedback goals.

Just as we now take air conditioning for granted and expect our buildings to maintain a temperature where we can function comfortably, we will in the future expect our environments to help us optimize our psychophysiological functioning and will eventually come to think of living quarters which do not have those amenities as primitive and uncomfortable.
The feedback provided by the omnipresent biofeedback systems of our future environments will happen in many different ways: by observing reactions to particular environmental events and adjusting subsequent events (i.e., their nature, intensity, or frequency) accordingly; by adjusting the ambience of the environment to drive physiological changes; by giving verbal or visual advice and coaching (your watch may soon tell you to “watch it” if you are working too hard); and by delivering stimuli known from past data to produce specific psychophysiological reactions in the individual. For patients with chronic health conditions, such biofeedback may additionally take the form of internet-controlled adjustments in the flow rate of wearable medication pumps and automated scheduling of doctor appointments when the environment detects it is timely. “Medicine will be transformed with the introduction of cyberspace. Not only are we going to make the transition to preventive medicine, where our clothes, our rings, our jewelry will monitor our health and tell us years ahead of time what we’re going to expect in the future, but also surgery itself could be affected” (Kaku, 2001).

2. In the future, biofeedback training experiences will be fully integrated into all our primary daily activities.

People’s primary activities, in which they engage continually for several hours and where they repeat the same activity day after day, provide the best opportunities for systematic influence with biofeedback. Twenty years from now, biofeedback will be embedded in most common work tasks of adults and will be integral to the school learning and play of children. Interactions with computers or computer-controlled objects will be the predominant daily activity of both adults and children, and biofeedback will be embedded in these activities to optimize functioning and to maintain well-being and health.

The foreshadowing and early beginnings of this trend can already be seen, and it will gather momentum rapidly in the next few years. Computer software which simultaneously trains cognitive abilities directly relevant to academic performance and delivers brainwave biofeedback is used in school settings and is commercially available (Freer, 2001). Biofeedback-enrichment of popular videogames (Palsson et al., 2001) has already been demonstrated to work as well as traditional clinical neurofeedback. And NASA is actively working on ways to blend biofeedback into the normal cockpit activities of professional pilots (Palsson and Pope, 1999; Prinzel and Freeman, 1999). Efforts are also under way to use physiological monitoring and biofeedback to guide complex cognitive work tasks. For example, the recent proposal for NASA’s Intelligent Synthesis Environment (ISE) project included an animation of a computer-aided design system responding to a user’s satisfaction about a design iteration, measured via remote sensing of brainwaves. The proposal was drafted by engineers—an indication of that field’s expectations for psychophysiological science. One PhD engineer was astounded to learn that remote sensing of brainwaves was not already routine.

Embedding biofeedback into people’s primary daily activities, whether work or play, is a largely untapped and rich opportunity to foster health and growth. It may soon be regarded to be as natural and expected as is the addition of vitamins to popular breakfast cereals. Toymakers of the future might get unfavorable reviews if they offer computer games that only provide “empty entertainment.” In the same vein, worker unions may frown upon computer workstations that do not help safeguard the health and well-being of employees through physiological monitoring and protective biofeedback.

3. In the future, most biofeedback training will occur in the background and out of conscious awareness.

In the coming decades, psychophysiological self-regulation skill will generally not be acquired through effort nor involve deliberate and time-consuming systematic practice. Conscious or effortful biofeedback learning will typically be unnecessary because our adaptive computer-controlled environments

---

Figure 1. NASA’s research at Langley Research Center in Hampton, Virginia, on integration of EEG psychophysiological monitoring and feedback into cockpit flight tasks, is an example of emerging efforts to build biofeedback into common work environments.
and everyday objects will train us automatically to maintain optimal mental and physical states. Learning physiological self-mastery through concentrated effort will be viewed as antiquated, impractical, and as eccentric as insisting on struggling to do math by hand instead of using calculators. We have recently seen from our own research (Palsson et al., 2001) that blending biofeedback training into an entertaining task so that it becomes effortless and is learned automatically as a background experience is as effective as the same amount of clinical training requiring full concentration. It would seem obvious that automatic and subtle biofeedback, which occurs effortlessly in the course of doing what you want to be doing, will be the preferred way of tomorrow.

Deliberate and effortful biofeedback training will most likely exist only for highly specialized purposes in the future, where motivation and potential rewards are high enough to warrant the special efforts, and where the goal is achievement of physiological states far above normal health and functioning. Thus, outstanding athletes and highly prized “corporate warriors” may receive specialized training from biofeedback experts. Even in those situations, however, systematic coaching sessions would be supplemented with automated biofeedback in the home and work environment.

The Technologies of Future Biofeedback

It should be apparent from the above description that the technology that will be used to deliver biofeedback in the future is not currently lying about in our laboratories and clinics. However, the implementation will not require any extraordinary technological leaps. All the elements of these future biofeedback technologies do, in fact, already exist. They will simply be integrated in new ways, and some will be applied to biofeedback systems for the first time.

A. Future sensor technologies

1. Wearables

“Wearable computers will be the big development of the near future” (CNN Productions, 2001). Until remote sensing becomes a standard component of offices and homes, and sufficiently refined for biofeedback use, it is likely that wearable computers will have an important role. Physiology-sensing garments and wrist-watches have already been developed for life-signs monitoring, and, combined with wireless transmitters, they can be used for walkabout biofeedback. These wearables may in the near term store the training goals and training history. “The main issue of a wearable is it knows so much about you—it senses your everyday environment. In theory, it could know … even your emotional state. And that could all be stored” (Rhodes, 2001). In the near term, wireless networking, enabled by Bluetooth and “Wi-Fi” (IEEE 802.11b) technologies, will allow people to move about unencumbered by wires while their embedded microprocessor-based wearable biofeedback appliance stays in touch with other processors for record-keeping and protocol adjustments.

Lightweight wireless EEG-monitoring headsets are currently emerging and will entirely replace the cumbersome wired EEG caps except for limited use in specialty clinics and in research. The demands of wearable sensor/transmitter devices will drive changes in the sensors used for biofeedback. The sensors most commonly used in today’s biofeedback will be seen as unacceptable as biofeedback spreads to homes and offices. This is already foreshadowed in the convenient brush-type EEG electrodes that are currently finding their way into biofeedback products.

Optical sensing technology for physiological monitoring holds out the promise of photonic, non-contact EKG (over clothing) and dry contact EEG measurement, requiring no skin preparation, gels, or adhesives. These all-optical (optrode) sensors would be convenient to use and well-suited to electrically noisy or hazardous environments. If their development proceeds sufficiently quickly, they are likely to be principal components of the wearable sensor/transmitter devices in the transitional phase until remote sensing takes over.

Forerunners of these ever-vigilant wearable technologies include current web-based physical activity and body composition monitors, and Internet and telephone-based remote vital-sign monitoring systems that regularly contact participants to feed back their health status and provide coaching.

2. Remote sensing

It seems to us inevitable that the biofeedback sensors of the future will almost exclusively be remote (non-contact) sensors, following a transitional phase of the next few years, where wearable sensors will be utilized, as described above. The reason for this takeover will be the convenience (they can be built into walls and objects out of the way) and because they do not encumber trainees. Although considerable developmental work is ahead to make remote sensing practical for biofeedback, it is not nearly as much science fiction as it might sound to some people. In fact, many of the technologies needed for remote biofeedback sensing are already becoming sufficiently sophisticated and affordable for such use.

Thermography. Remote measurement of temperature is already in practical use. Non-contact “point-and-click” thermometers for measuring the temperature of nearby objects are now available at your neighborhood consumer electronics store. The potential of infrared thermography has yet to be exploited in biofeedback technology for the remote sensing of skin surface temperature (Sherman, 1987), but its application is overdue and foreseeable as one of the earliest biofeedback applications of remote sensing.

Facial scanning and remote pupillometry. Remote facial scanners are already highly refined and can be used by law enforcement to identify criminals from a distance in a crowd of people. A system is now under development that can scan the iris of a person walking ten feet from a camera. Similar pattern recognition technology can be designed to read facial expressions and pupil responses and will soon be used for biofeedback purposes to assess emotional reactions to stimuli and the mood states of people.

Radar monitoring. A pulse-echo radar monitor can detect the movement of internal body parts such as the heart, lungs, and arteries. A prototype “flashlight” device, developed for law enforcement and rescue workers, uses a narrow radar beam and a specialized signal processor to discern respiration up to three meters behind a wall, detecting a few millimeters of movement even through heavy clothing. This technology is likely to be used for remote sensing of respiration and heart rate for biofeedback...
and physiological monitoring in the near future.

Microwave back-scattering. Heart and breathing signals may be extracted from the back-scattering of a low-intensity microwave beam. This capability may be realized soon for physiological monitoring and biofeedback use. It has been recently discovered that pulse and breathing rate can be detected by utilizing the Doppler shift in microwaves transmitted by a cell phone's antenna that bounce back to the phone from the user's chest, heart and lungs. Cell phones, or the small wearable communication devices which will replace them, will likely be employed to pick up the vital signs of individuals to counter stress by adjusting their schedules, advising work breaks, or blending relaxing biofeedback into work tasks. Eventually, brainwave signals will similarly be derived from the interference waveform created from the modulation of a transmitted electromagnetic field by a person's brain waves, enabling non-contact reading of brainwaves.

Implants. Although implants will have a smaller role than wearables and remote sensing in the future history of biofeedback, they will almost certainly be an important element in highly specialized medical biofeedback. Implantable biotelemetry systems have been used in animal research since the 1970's. As surgical techniques become less and less invasive and sensors are miniaturized, injections of tiny but durable physiological sensing and transmitting pellets coated with biocompatible materials will soon be a simple matter. Patients with serious diseases will have implants which measure blood chemistry, muscle electrical activity, temperature, etc., and feed the information into receivers on the body surface or in the patient's vicinity. The information from these implants will guide verbal instruction or physiological training of the patients by computers, adjustments in the environment, meals and entertainment, and modulation in the dose rate of subdermal drug delivery devices, and will also provide health information to their doctors. Elite athletes are also likely to benefit from biofeedback implants in learning self-regulation for optimal functioning and development of their bodies, such as the training of specific muscles and control of nutritional intake.

B. Delivery systems

Three aspects of the biofeedback delivery systems of the future will be different from the predominant use of biofeedback to date and deserve mention here.

1. Virtual reality

Virtual reality biofeedback technology is likely to be used extensively in the coming years to enhance training effects in specialized types of training, especially in medical biofeedback and for athlete and flight crew training purposes, where physiological responses are highly situation-specific and need to be trained repeatedly in the simulated performance environment. In medical use, virtual reality will probably prove more motivating and more effective in teaching self-regulation skills by helping patients visualize real-time physiological responses. Furthermore, virtual reality physiological representations will also prove useful as a diagnostic aid to physicians doing physical examination of heart function, for educating patients with physiological disorders, and for observing the progress of a disease process and the effects of a treatment intervention.

2. Adaptive computing

Until now, biofeedback has almost exclusively relied on “brainless” computing. In other words, biofeedback computers have not been programmed for reasoning or learning. This will be very different in future biofeedback technologies. With no therapists in the loop to make decisions about the nature of training or adjustments to the interventions, biofeedback computers will be endowed with sophisticated pattern recognition and artificial intelligence abilities. Biofeedback computers will in a way become virtual health-care or health-maintenance providers. They will carry out ever-vigilant mental and physical health monitoring on all people within their reach and recommend training as they detect needs emerging. Once they receive input from each individual about the desired psychophysiological training goals, these computers will decide on the best way to intervene to help the person achieve that goal and then carry out and constantly adapt the training based on observed experience.

Even today, microprocessors embedded in feedback devices are capable of administering adaptive protocols of biofeedback training, such as shaping schedules. Such microcontroller-mediated control of training will be important for stand-alone training devices for home and office use in the coming years.

3. Multisystem/multilocation training

When network-connected remote sensing has become the primary mode of obtaining biofeedback information, which we anticipate will happen within the next two or three decades, a multitude of objects and systems will also collaborate in the biofeedback training of the same person as he or she moves from room to room and building to building. A computer network connecting all these objects and systems will orchestrate the training of each person across time, training modalities, and locations.

In summary, we predict that biofeedback will be widely employed in maintaining the health and well-being of coming generations. Unlike the biofeedback implementations we know today, almost all of tomorrow’s biofeedback will take place in everyday life in society rather than in clinics or labs.

The changes which will move the field in this direction are already beginning, and they will continue at an accelerating pace due to the increasing availability and affordability of suitable technologies and the irresistible value of biofeedback enhancement to settings with special training demands and to the consumer market.

It seems at the present time that the morphing of biofeedback into a common commodity could happen quite separate from, and independent of, the long tradition of clinical biofeedback. In our opinion, however, it would be more advantageous for society if today’s biofeedback experts play an active role in guiding the evolution and implementation of tomorrow’s biofeedback technologies.
stops the session automatically if a lead comes loose or impedance gets too high for a good signal – but can’t stop your looking at the screen when you aren’t actually recording so that you never realize that the machine has stopped.

The incredible new equipment can do all these great things – and more - but they can’t defend against people who don’t record from the correct muscles, don’t put the sensors along the length of the muscle (or don’t keep the temperature thermistor at a constant pressure against the body, etc.), ignore all the great built in routines to tell them when the system isn’t working, and don’t incorporate the recording into a clinical assessment.

What I’m saying in a nut-shell is that our manufacturers are supplying us with incredible equipment. They are going way, way out of their ways to prevent as much of the “garbage in – garbage out” syndrome as is possible – but they can’t defend against pure ignorance. We therapists still need to do our part. We need to know what we are doing – and especially not treat the equipment as a black box.

Remember that the incredible new equipment still can’t put the sensors in the correct place on the body or incorporate the recordings into a good clinical assessment. And – one last limitation – remember that this incredibly sophisticated equipment isn’t approved by the FDA for any more applications than show on its label. That means that most of our applications are still considered experimental by the FDA and you need to act accordingly when you use a device “off label” by telling the patient that you are doing so and giving a fair and accurate description of the strengths and weaknesses of the evidence supporting your use of the equipment for that particular application.

So, go ahead and fall in love with all the new capabilities – but use the quality routines, set the equipment to the correct bandwidth, put the sensors where they belong – yata, yata, yata (you know the drill)! So, please don’t just slap on the sensors and go for it – because you’ll still get garbage out after you put garbage in!


does AAPB have your e-mail address?

• e-mail communications enable AAPB to communicate better with members.
• E-mail communications also save AAPB money, and enable the Association to use your dues money for other critical activities.

Please send your e-mail address today to the following address:
aapb@resourcenter.com
Abstract: This article identifies two trends in the development of biofeedback instrumentation, toward more sophisticated systems for professional use, and toward simpler devices for home use. The author discusses the current generation of equipment developed by Thought Technology, and highlights breakthroughs in telemedicine and virtual reality. He reviews current standards in quality assurance, and suggests criteria for selecting instrumentation systems. Further, he highlights the increasing opportunities for worldwide education in biofeedback, and the emergence of new applications based on today’s hardware and software systems.

In 1988, Dr. John Basmajian said in a speech: “Just as surgery and pharmaceuticals were important to Medicine in the 19th and 20th century, Behavioral Medicine will take its place in the 21st century, and Biofeedback is an important component of Behavioral Medicine” (Basmajian, 1988). This was a defining moment for me, filling me with unbridled optimism.

Current Directions in Biofeedback Technology

There appear to be two trends in the field: One is towards more sophisticated and expensive systems for professionals and the other is towards simpler, cheaper devices for home use.

In the professional area, there is Thought Technology’s best selling ProComp+/BioGraph™ system which includes such features as automated work/rest periods, Boolean functions, a wide variety of tones and visual displays, and easily programmable protocols. This system was designed by a team of clinicians and software and hardware engineers to ensure that the system would be responsive to actual clinical needs.

Because of its easy programmability, BioGraph has opened the door of possibilities for creative clinicians. Since, for example, EEG bandpass nomenclature (e.g., Delta, Theta, Alpha and Beta) has been replaced with completely customizable bandpass settings, the BioGraph has enabled clinicians to create feedback screens which can inhibit 3-5 Hz., and enhance 6-8 Hz. activity, while providing a ping for each 7 Hz crossover, or discordant music when producing too much Theta. This level of sophisticated feedback was impossible with previous technology.

Another useful feature of BioGraph is that, because it is Windows® based, multiple monitors can be used to display feedback information to the client while showing clinically relevant information to the clinician.

Clinicians will also appreciate the newest innovation in our EEG sensors as you can now perform an impedance check on all three extender leads simultaneously. The sensor, called EEG-Z, which includes the E-Z connect software, performs five impedance checks in 10 seconds, then automatically switches to a regular EEG reading mode. This obviates the need to disconnect and reconnect each of the three leads.

We have also introduced our new Pro-SB Dual Interface device; you are now able to use one ProComp+ and run the BioGraph and CardioPro software programs, simultaneously. This gives you the ability to get real-time EEG and HRV data in one recording session.

For those unfamiliar with CardioPro™, it is a specialized physiological monitoring and biofeedback application for the cardiovascular and respiratory systems. It can perform real-time feedback on respiratory sinus arrhythmia (RSA) and heart rate variability (HRV) from an electrocardiography (EKG) or blood volume pulse (BVP) sensor. The system can also monitor other key physiological functions, such as respiration, temperature and skin conductance, for the most complete view on your client’s physiology.

With a simple graphic user interface and comprehensive reporting features, CardioPro lets you easily flow through the steps of recording, reviewing, and analyzing data. CardioPro is powerful enough for research applications, yet remains flexible for clinical work.

I believe it is also important to mention that our products, most notably ProComp+, are used with numerous 3rd party software and hardware peripherals, which offer a wide variety of innovations. Some of these include: BioResearch’s BioIntegrator software, EEG Spectrum’s NeuroCybernetics software, Neurofed.com’s software, BioComp’s HEG and sEMG+ by Clinical Resources.

Telemedicine

Some of the more advanced applications in biofeedback monitoring include the area of telemedicine. One of the first to apply remote biofeedback monitoring was Dr. Ray Folen of Tripler army base. He used a ProComp+/BioGraph in Hawaii to treat military personnel in the Orient, by using 2 telephone lines and specialized software and hardware which allowed him to control the client’s PC running BioGraph and to provide visual and auditory feedback. With the advent of the Internet combined with some clever Java programming, clients no longer have to leave their homes to visit their clinician; all they have to do is connect their electrodes, turn on their PC and connect to a web site. For example, Dr. Howard Glazer uses our MyoTrac 3 and Televital’s Internet service, to assess and treat his patients with...
pelvic floor disorders anywhere on the Globe. No longer do his patients have to bear the expense and inconvenience of traveling to and residing in New York.

**Other Advances in Technology**

Another area that appears to offer a powerful enhancement for biofeedback is the technology of Virtual Reality. By monitoring one’s physiological responses to the virtual scene, the program can stop or change the characteristics of the environment when ‘VR travelers’ encounter stressors which overcome their abilities to cope.

Eye Tap, the brainchild of Dr. Steven Mann, incorporates a wearable PC with a video camera ‘inside’ the wearer’s eyeglasses. He couples this ‘broad band application’ (he is on line on the web in real time) with 8 channels of physiological signals from ProComp+™, so that he, and anyone tuned in, knows, for example, which painting in the gallery makes his heart race.

Amusement? Perhaps, but one clinically relevant application is for agoraphobics and use biofeedback-coupled desensitization techniques, while a clinician monitors progress over the web. Another potential application would be for authorities to evaluate pedophiles’ physiological responses to children in their environment!

WearComp is an example of a practical realization of Humanistic Intelligence (HI). The apparatus consists of a battery-powered, wireless, wearable, internet-connected computer system with miniature eyeglass-mounted screen. The apparatus travels with the user, either superimposing a computer screen on top of the real world, or representing the real world as a video image. (See Figure 1).

Using biofeedback technology provides a greater synergy between the user and the EyeTap wearable computer system. The fact that the WearComp/EyeTap apparatus is worn underneath clothing facilitates direct contact with the body, and thus encourages further new forms of intelligent signal processing.

**Simpler Technologies**

As leading-edge developers of biofeedback equipment, not only does Thought Technology have to lead the trend towards sophisticated and clinical systems for professionals, but also the trend towards simpler, cheaper PC-based devices for home use. It is interesting that we are moving back into the area from which we started in 1974 with our GSR1 and subsequently our GSR2™ home trainers (of which there are more than 400,000 in use).

Our easy-to-use, single-channel and battery-operated SEMG training device, U-Control, allows clients to practice pelvic floor contraction exercises in the comfort of their own home. Daily practice with SEMG feedback enhances their recovery time. The U-Control is the predominant home training device in the U.S.A., Germany, the U.K., and over 60 countries.

**Quality Assurance**

At the last AAPB convention, I discovered that many of our AAPB friends were surprised to learn that the company that Hal Myers and I founded in 1975 currently has 44 employees. We decided at our inception that Thought Technology would design products that conform to current medical and quality standards (removed words). As such, since 1998, we have achieved ISO 9001, ISO 13485 and European CE certification, which assists us in maintaining the highest level of quality and design innovations, which are responsive to user input, thus ensuring clinical relevance.

I believe it is important to note that when you consider your purchase of equipment that you ask yourself the following questions:

1. Is the device clearly labeled as a medical device and does it comply with FDA 510(k) pre-market notification rules? If not, am I open to liability claims from a disgruntled patient who claims that I treated him with an “educational device.”
2. Is the device manufactured by a company or by a few individuals? What are the long-term prospects for service and support?
3. Is there good technical support? Try calling technical support before your purchase to see what type of response you get.
4. Is there a 30-day return privilege?
5. What is the reputation of the company? Speak to users. If you don’t know any, ask for references.
6. Does the company offer training in its equipment and clinical applications?

**Worldwide Education for Practitioners**

To change medical practice in the world is a tall task, but education is the only method, combined with hands-on training and research. Dr. Erik Peper, is the author of Biofeedback for Repetitive Strain Injury and Healthy Computing; a most timely subject since computer related disorders have surpassed lower back pain as the major reason for missing work. Not only is physiological monitoring useful to evaluate ergonomic position it is also a valuable tool for analyzing and feeding back autonomic function to evaluate overall systemic

**Figure 1. The WearComp Apparatus**
1-day and 2-day workshops are approved by able using the BioGraph system. All of the day workshop for beginners to feel comfort- insights they could not get otherwise. use this powerful tool to give them clinical technology, teaching participants how to incorporate Biofeedback as an invaluable day workshop format. Their clinical skills their course curriculum into a two or four clinicians from disparate fields, who can fit Mental Health. Spine Society, the International Society for Back and Pelvic Pain, the North American Interdisciplinary World Congress on Low Nurses and Associates (SUNA), the 4th ciations including: the Society of Urological and ISMA. Also collaborating are a number by the international groups of the AAPB 2nd 2002. The BFE is now co-sponsored in Amsterdam from February 26-March 6 years! Next year it is at the Free University in Amsterdam from February 26-March 2nd 2002. The BFE is now co-sponsored by the international groups of the AAPB and ISMA. Also collaborating are a number of international research societies and associations including: the Society of Urological Nurses and Associates (SUNA), the 4th Interdisciplinary World Congress on Low Back and Pelvic Pain, the North American Spine Society, the International Society for Heart Research and the World Assembly for Mental Health.

These workshops are taught by talented clinicians from disparate fields, who can fit their course curriculum into a two or four day workshop format. Their clinical skills incorporate Biofeedback as an invaluable technology, teaching participants how to use this powerful tool to give them clinical insights they could not get otherwise.

Thought Technology also provides a 1-day workshop for beginners to feel comfort- able using the BioGraph system. All of the 1-day and 2-day workshops are approved by the Biofeedback Certification Institute of America (BCIA), for Category A accredited, continuing education for BCIA re-certification. The future of Biofeedback in medicine is assured each time a clinician is trained to use biofeedback as an integral part of their practice. In addition to investing in education and training, our company was proud to be congratulated recently by the Association of Applied Psychophysiology and Biofeedback (AAPB) and the Biofeedback Foundation of Europe (BFE) for an equipment grant of US $100,000 for excellence in clinical teaching and applied research in their fields. The company is particularly proud to see its devices being used in research.

**Emerging Applications**

Despite exciting claims made for biofeed- back, The FDA still limits the use of biofeedback devices for relaxation, muscle education and incontinence including stress, urge and mixed. Even when an application, like incontinence, is approved for the use of biofeedback, it still needs to get reimbursement to be widely accepted. For this reason, the recent decision by the Health Care Financing Administration (HCFA) was of great importance. A HCFA panel stated that a review of scientific evidence and testimony from expert witnesses and professional organizations convinced them to implement Medicare coverage of biofeedback for patients who do not benefit from pelvic muscle exercises (PME) alone.

Barbara Woolner, RN, CRNA, CCCN, John Perry, and several others had a major hand in getting sEMG covered by HCFA successfully. The HCFA panel noted that most of the studies examined by them were inconclusive or flawed, leading them to the conclusion that there was insufficient evidence that biofeedback is an effective treat- ment for stress, urge, or post-prostatectomy incontinence. HCFA’s comment underlines the need for clinical studies to provide more conclusive evidence, not only for inconti- nence, but for many other conditions not currently approved for use for biofeedback and reimbursement.

Breakthroughs in applications come when clinicians in twenty-four branches of Medicine use our instruments for some of the most interesting applications of psychophysiology. Attending their courses is uplifting and enlightening; but satisfying their clinical and research needs means continuous software and hardware development.

Each leader teaches various subjects based on their personal experience. By developing their own screens, reports and protocols, the clinician becomes familiar with the intricacies of this powerful clinical tool. As a last word on training, we also organize our own equipment workshops. The goal of these 2-day workshops is not only to make clinicians feel comfortable using our BioGraph system, but also to facilitate its use within their practice.

I coined a phrase: “Even a Stradivarius needs a Menuhin”. (In ‘jock talk’, “Even a Louisville Slugger needs a Mark McGuire”). Thought Technology is proud to provide superb instruments to the growing number of health professionals, but our instruments are mute without their talented hands. We are equally proud of the growing network of highly competent professionals partner- ing with our company to develop new applications and protocols based on this instrumentation.

![Figure 2. Touring after the BFE 2000 meeting in Eilat: Lawrence Klein with family — Dr. Janet Shinder, Talia 12 and Ariella 7.](image)
New Developments Leading EEG Biofeedback into the New Millennium

Thomas F. Collura, PhD, P.E., BrainMaster Technologies, Inc.
Oakwood Village, OH

Abstract: The field of EEG biofeedback (“neurofeedback”) is experiencing unprecedented transformation and growth, spurred on by a host of factors. These include software and technological developments, as well as clinically motivated improvements in protocols and usage patterns. Key elements are identified and described in this report, which details the changes that are currently driving the industry toward the next generation and beyond.

Based upon a host of technical and clinical developments, EEG biofeedback (also known as “neurofeedback”) is experiencing an unprecedented transformation and growth, leading to new uses and applications, both within the clinic, and in home and business environments. Based upon new discoveries and approaches that were formed in the 1990’s (the Decade of the Brain), the next decade of EEG biofeedback promises to be revolutionary, providing benefits to an ever-growing population of clinicians, educators, and trainees. The key developments that are facilitating this transformation are:

New Software and Signal Processing Algorithms

New software and signal processing algorithms that exploit the latest PC hardware and software. These include new digital filtering, analysis, and quantitative assessment (QEEG) methods, plus graphics and sound such as detailed and informative game and technical displays, and sound feedback incorporating the MIDI (musical instrument device interface) technology, bringing multimedia capabilities to even the lowest-cost EEG systems. In addition, neurofeedback is now possible on any PC, including the ones on office and school desktops, where other applications are being used while neurofeedback training is being done.

New Electronic Technology

New electronic technology, and electrodes providing simple, robust connections to a wide range of EEG electrode locations. Using new types of amplifiers, headbands, caps, and electrode attachment and electrolyte methods, including both dry and liquid-based electrodes, it is now easier than ever to connect a trainee to an EEG device and get good training results, without the need for a trained EEG technician. Some of the key attributes of this new technology are as follows:

New Amplifiers

By using very high-input-impedance amplifiers with superior common-mode rejection, it is possible to achieve good EEG signals with electrode connections that are of much poorer quality than previously possible. Thus, whereas electrode impedances of 10KOhms or less per pair were required with earlier technology, it is now possible to use electrodes with impedances of 50K or more. This makes it possible to record without ever connecting a trainee to an EEG device and get good training results, without the need for a trained EEG technician. Some of the key attributes of this new technology are as follows:

New Electrodes

The latest electrodes can use liquid electrolytes that are designed to conduct the tiny currents from the scalp to the electrodes with a minimum of impedance, and for extended periods of time. Thus, electrodes may be used that are wetted or merely dampened with the solution, which then comes into contact with the skin. These solutions can even work through moderate amounts of hair, so that there is less necessity to clear or cut hair, to find the surface of the scalp.

New Protocols

New electrode configurations use cloth or Velcro headbands in conjunction with plastic assemblies that hold the electrodes securely enough, without having to glue or otherwise secure the electrode to the skin. Some new electrodes are “dry” and use materials that contain the electrolyte embedded in a plastic, rubber, or other matrix. This makes it possible to use new configurations that include baseball hats, retaining caps, and other devices in place of conventional “medical” electrodes. In the future with further improvements, we can envision systems where the user simply puts on the hat on, shimmies the electrodes into place, and good EEG connections are readily made.

New Chemistry

New protocols enhance brain functioning for improvement of attention, concentration, focus, mood, and inner balance. These protocols are based on new clinical and research studies that show the value of training protocols that go well beyond the simple “alpha” and “beta” training of the last two decades. New methods selectively

continued on Page 27
FEATURE ARTICLE

Heart Rhythm Coherence – An Emerging Area of Biofeedback

Rollin McCraty, PhD†, HeartMath Research Center, Institute of HeartMath, Boulder Creek, CA

Abstract: The analysis of heart rate variability (HRV), or heart rhythms, provides a reliable measure of autonomic nervous system dynamics that is particularly sensitive to changes in psychophysiological state. Whereas common methods of HRV analysis typically quantify the amount of variability in a given recording, additional information can be gained by heart rhythm pattern analysis. Research has shown that sustained positive emotions lead to a highly efficient and regenerative functional mode associated with increased coherence in heart rhythm patterns and greater synchronization and harmony among physiological systems. A new development in biofeedback technology is the recent introduction of heart rhythm feedback trainers, which monitor heart rhythm patterns and help people develop skills to maintain states of increased physiological coherence. The use of pulse wave sensors makes this technology extremely versatile, time-efficient, and easy to use in a wide variety of settings. Heart rhythm feedback trainers are currently utilized in medical, mental health, corporate, and academic settings to improve clinical, psychological, and performance outcomes. This technology holds promise as a powerful and practical tool for the enhancement of health and human potential.

Heart Rate Variability and Its Significance

Heart rate variability (HRV) is a measure of the naturally occurring beat-to-beat changes in heart rate. The analysis of HRV, or heart rhythms, is a powerful, noninvasive measure of neurocardiac function that reflects heart-brain interactions and autonomic nervous system dynamics (Task Force of the European Society, 1996; McCraty et al., 1995; McCraty & Singer, in press). HRV can be derived either from the ECG (using electrodes placed on the chest) or from pulse wave recordings (using a plethysmographic optical sensor placed at the fingertip or earlobe). ECG recordings have the advantage of producing fewer movement-related artifacts. However, pulse wave recording devices also provide data suitable for most biofeedback applications, and, as they require no electrode hook-up, are more easily adaptable for use in a much wider variety of settings (e.g., workplaces, schools, etc.). Of the two main types of pulse sensors available (fingertip and earlobe), the earlobe sensor is slightly less prone to yield artifacts produced by a person’s movement.

Heart Rhythm Pattern Analysis

Typically, instruments used for recording HRV analyze the signal by means of time domain or frequency domain (spectral) analysis, both of which quantify the amount of variability in heart rate that exists in a given recording. A new approach to HRV monitoring and feedback, which I will describe briefly here, is the analysis of heart rhythm patterns. Heart rhythm pattern analysis, which analyzes the varying shape of the HRV waveform, shows promise to be an especially useful tool in psychophysiological research and biofeedback applications. This type of analysis can be particularly valuable in applications that aim to illuminate the physiological correlates of different mental and emotional states, assess the extensive interactions among the mental, emotional, and physiological systems in arousal-induced pathology, or examine psychophysiological responses to different interventions. There are a number of approaches that can be applied to HRV pattern analysis, which provide varying degrees of insight into the autonomic and physiological dynamics underlying the generation of the heart rhythm. In addition to quantifying how much variability exists, power spectral analysis can also be used to characterize certain aspects of the heart rhythm pattern. For example, spectral analysis is a useful approach for quantifying shifts in autonomic balance, vascular resonance, and entrainment, although it is not very useful in identifying more complex patterns. Nonlinear and geometric methods can be used for more complex pattern analysis; however, a detailed discussion of these methods is beyond the scope of this article.

HRV and Emotional States

Recent research conducted at the Institute of HeartMath (IHM) has demonstrated that HRV dynamics are particularly sensitive to changes in emotional state, and that positive and negative emotions can be readily distinguished by changes in heart rhythm patterns. Specifically, during the experience of negative emotions such as anger, frustration, or anxiety, heart rhythms become more erratic or disordered, indicating less synchronization in the reciprocal action that ensues between the parasympathetic and sympathetic branches of the autonomic nervous system. In contrast, sustained positive emotions, such as appreciation, love, or compassion, are associated with a highly ordered or coherent pattern in the heart rhythms, reflecting greater synchronization between the two branches of the autonomic nervous system (McCraty et al., 1995; Tiller, McCraty & Atkinson, 1996).
Our research on HRV and emotion has identified a distinct mode of physiological functioning that is frequently associated with the experience of sustained positive emotion. We call this mode *physiological coherence* (McCraty & Atkinson, in press). “Coherence” is used here as an umbrella term to describe a physiological mode that encompasses a range of distinct but related phenomena, including synchronization, entrainment, and resonance, all of which emerge from the harmonious interactions of the body’s subsystems. Correlates of physiological coherence include a smooth, sine wave-like pattern in the heart rhythms (heart rhythm coherence), a shift in autonomic balance toward increased parasympathetic activity, increased heart-brain synchronization (alpha rhythms become more synchronized to the ECG), increased vascular resonance, and entrainment among diverse physiological oscillatory systems (*i.e.*, heart rhythm patterns, respiratory, craniosacral, and blood pressure rhythms) (McCraty & Atkinson, in press; Tiller, McCraty & Atkinson, 1996).

### Heart Rhythm Feedback Trainers

A promising new development in the field of HRV instrumentation is the recent introduction of heart rhythm feedback training devices. Heart rhythm feedback training is a powerful tool to help people learn to self-generate states of increased physiological coherence at will, thereby reducing stress and improving health, emotional well-being, and performance. Technologies are currently available which enable physiological coherence to be objectively monitored and quantified. These heart rhythm feedback trainers also help individuals develop emotional self-regulation skills that increase the capacity to sustain coherent states and their associated benefits. Using a fingertip or earlobe plethysmographic sensor to detect the pulse wave, these interactive hardware/software systems plot changes in heart rate on a beat-to-beat basis. Heart rhythm feedback trainers can be used in conjunction with breathing techniques or positive emotion refocusing techniques that guide people in intentionally generating sustained positive emotional states and coherent heart rhythm patterns (Childre & Martin, 1999). As people practice the coherence-building techniques, they can readily see and experience the changes in their heart rhythm patterns, which generally become less irregular, smoother, and more sine wave-like as they enter the coherent mode. This process enables individuals to easily develop an association between a shift to a more healthful and beneficial physiological mode and the positive internal feeling experience that induces such a shift. These programs also analyze the heart rhythm patterns and calculate a coherence ratio for each session. The coherence level is fed back to the user as an accumulated score or success in playing on-screen games designed to reinforce coherence-building skills. The software generally includes a multi-user database to store results and track clients’ progress.

Because this technology uses a pulse wave monitor and involves no electrode hook-up, it is extremely versatile, time-efficient, and easy to use in a wide variety of settings. Heart rhythm coherence feedback training has been successfully used by mental health professionals, physicians, educators, and corporate executives to decrease stress, anxiety, depression, and fatigue, treat children with ADHD and asthma, improve academic, work, and sports performance, lower blood pressure, and facilitate health improvements in numerous clinical disorders (Lehrer, Smetankin & Potapova, 2000; Luskin, Reitz Newell, Quinn, & Haskell, in press. 2000; McCraty, 2001; McCraty, Atkinson & Lipsenthal, in preparation; McCraty et al., 1999a; McCraty et al., in preparation; McCraty et al., 1999b).

Many health professionals have found heart rhythm monitoring and feedback to be an effective tool to support and facilitate a wide variety of therapies, both conventional and complementary. For example, this technology is increasingly being used by neurofeedback practitioners to calm clients and stabilize the nervous system before sessions. This preparation often allows for a shorter and more effective session. Many clinicians have found heart rhythm feedback to be an effective addition to treatment programs for chronic conditions that are associated with or exacerbated by emotional stress, including fibromyalgia, chronic fatigue, hypertension, asthma, environmental sensitivity, sleep disorders, dia-

![HeartMath’s Freeze-Framer™ heart rhythm feedback trainer.](image)
beates, and cardiac arrhythmias, among many others. Practitioners also use heart rhythm feedback devices to monitor the real-time psychophysiological effects of various therapeutic interventions that affect autonomic nervous system dynamics.

Because of the sensitivity of HRV patterns to changes in psychophysiological state, many psychologists utilize heart rhythm monitoring effectively as a “camera on the emotions.” Continuous monitoring of clients’ HRV throughout a therapy session is easily accomplished and can give both therapist and clients immediate insight into clients’ emotional responses, often enabling a more efficient and effective session. This technology often proves helpful in identifying subconscious feelings, reactions, and emotional triggers that operate at a level below an individual’s conscious awareness but are nevertheless reflected in physiological patterns and processes. The sensitivity of heart rhythm monitoring to psychological variables is clearly illustrated by the account of one psychologist who uses this technology with clients with multiple personality disorder. This clinician finds that he is able to reliably distinguish between the different personalities his clients manifest on the basis of distinct changes in their heart rhythm patterns.

The Promise of Heart Rhythm Feedback

In summary, heart rhythm feedback is a versatile technology that has broad-based applications in clinical, workplace, and academic settings for the enhancement of health and human performance. In the future, we foresee that heart rhythm feedback training will be increasingly incorporated in programs for the prevention and treatment of cardiovascular diseases and arousal-induced pathologies. We also expect that its use will increase in education, as more schools incorporate programs that seek to educate students in emotional awareness and emotion regulation skills.

Furthermore, we anticipate that future developments in research, heart rhythm monitoring technologies, and pattern analysis methods will enable an even more refined electrophysiological discrimination of emotion than is currently possible. This may help therapists guide clients in developing greater awareness and understanding of their emotional responses, both conscious and subconscious, and ultimately to achieve greater control over their emotional well-being and health.

References


Address all correspondence to Dr. Rollin McCraty, HeartMath Research Center, Institute of HeartMath, 14700 West Park Ave., Boulder Creek, CA 95006. Phone: 831-338-8500, Fax: 831-338-1182, Email: rollin@heartmath.org
Abstract: Telemedicine is a technological innovation that allows for direct, real-time interaction between healthcare providers and their patients. Real-time physiological monitoring over the Internet offers a unique solution for overcoming the barriers of distance and time, while improving continuity of healthcare.

In the rapidly changing world of healthcare and information technology, telemedicine plays a vital role in building a bridge between healthcare providers and patients. It involves the use of telecommunication tools such as phones, video cameras, digital imagery, computers, and the Internet to allow for direct, real-time interaction between healthcare providers and their patients.

Telemedicine offers a high-tech solution to the universal problem of access to healthcare. Geographical isolation doesn't have to be an insurmountable obstacle to receiving the basic needs of timely and quality medical care. The ultimate goal of telemedicine is to provide the best of available health care to anyone, anytime, anywhere. This technology can create an effective “virtual” global health village that makes optimal health care for all a real possibility.

The growth in telemedicine applications has given rise to the development of a host of new technologies that can greatly improve healthcare. Technologies range from continuous blood pressure devices, up-to-date Internet relay of cardiac data from a patient’s home to the physicians’ offices, medical data that can be stored-and-forwarded when real-time information is not required, and elaborate T-shirts woven with built-in sensors that continuously monitor and record over 30 physiological signs of health.

Telepresence surgery permits experts to effectively guide the surgeons who are actually performing the operation in a remote location. Telerobotics takes this a step further by allowing surgeons to remotely operate on patients using strategically placed video cameras and telerobotic arms that mimic every subtlety of movement made by the surgeon at the geographic location, which is accurately reflected by the robotic arms at the patient’s end.

Current technology supports the real-time streaming and remote viewing of raw and interpreted vital sign data over the Internet. Physiological signals are typically transmitted over a 56K dial-up modem with less than a second delay.

A female patient with bilateral frontal/temporal surface EMG placements interacts through the Internet with a therapist 1,000 miles away.

The computer shows the same patient’s current surface EMG and an inset box shows the therapist.
Numerous standard biofeedback devices have already been modified to be web compatible and the technology currently supports a variety of physiological monitoring modalities including electromyography (EMG), heart rate (HR), heart rate variability (HRV), peripheral skin temperature, sweat gland activity, and respiration patterns. Even specific programs such as the Glazer-Perry protocol used for the assessment and treatment of urinary incontinence are available through the web. The portable biofeedback unit plugs into the serial or USB port of the client’s computer. The software is completely browser-driven, so biofeedback clinicians can literally view their client’s real-time physiological data from anywhere in the world to create a virtual clinic.

At this time, clinicians and their clients sign on through the website using their personally created, secure login ID and passwords. The browser-based software signals a clinician when their clients are on-line and streaming live data. By clicking the “live” button, clinicians immediately view their client’s physiology from a distance, along with the use of real-time communication tools such as videoconferencing, built-in instant messaging, or with plain old telephone service (POTS). Video conferencing fully taps the capabilities of telemedicine by making the nonverbal components of communication available to therapists and clients.

While auditory and visual cues guide the patient through the entire procedure, clinicians have complete remote control to advance through each segment of the protocol, and adjust the gain for optimal display. After conducting a real-time remote session, healthcare providers immediately view an auto-generated graphical and statistical summary report, which includes data fields for entering client information, clinical notes, and treatment recommendations. This report can be printed locally and remotely to the client-end. All sessions are securely timed, dated and stored, and can be retrieved, exchanged and analyzed with ease anytime, anywhere.

Telemedicine is a medium that will open new doors for healthcare providers. It offers a unique solution for overcoming the barriers of distance and time while improving continuity of healthcare.

i Direct all inquiries to Yair Lurie, MS, 1326 Piper Drive, Milpitas, CA 95035, Phone – 408-262-2665 or by Email: info@televital.com

ii TeleVital is collaborating with several device manufacturers, and has recently web-enabled Thought Technology’s Myotrac3 and Procomp+, and J&J Engineering’s C-2 I330 biofeedback devices to give their customers more versatile treatment options.
The Future of Biofeedback

R. Adam Crane
American BioTec Corp., Ossining, New York

"Try to develop models which are not arbitrary and man-made but organic and natural. The difference is in the intention. Arbitrary man-made models have as their intention manipulation and control. Natural, organic models have as their intention resonance and reverence."

– Margaret Mead

Abstract: Biofeedback is a technology of self-knowledge and as such will become ubiquitous both in healthcare and performance enhancement applications. 'Consciousness Processing' technology and services will become one of the most robust industries on earth with both commercial and non-profit manifestations. As quantum physics unfolds technologies of self-knowledge will become even more important.

Introduction

Shall I seize this opportunity to promote our business or say what I feel and risk driving potential clients into the arms of the competition (most of whom are my friends)? So, my friends, open your arms because here comes my spin on our future.

Near Term

Biofeedback Equipment Survivors are developing telemedicine, virtual reality (VR), increasing capabilities, decreasing size and cost, etc. Internet applications will grow in terms of training and diagnostics. VR Feedback will deliver some of the most effective self-regulation learning systems ever developed. Flight simulators and VR training of special forces in dangerous combat skills illustrate this concept. Computers are necessary in order to maximize clinical effectiveness. However, the market will grow for portable, battery-operated instruments reminiscent of Walkmans, and Palm Pilots. However, I want to invest my 2,000 words discussing the somewhat unseen possibilities of the future.

Although estimated biofeedback billings range in the hundreds of millions of dollars, manufacturing is one of the smallest niche industries in Healthcare. The future of biofeedback depends on where the culture is headed. I love George Carlin's humor, but the entire culture is not 'circling the drain.' Segments of the status quo are 'circling the drain' - probably a good thing. That makes me an optimistic apocolypticist.

I do not think the terms biofeedback or applied psychophysiology adequately describe this technology. There are 'paradigm shifts' under way in many sciences and we are a scientific melting pot. I prefer to think of biofeedback as a Technology of Self-knowledge. If that is true, then biofeedback has a huge and complex future.

The unfolding of that future depends on investment. Investment depends on the importance our culture places on self-regulation and the nurturing of consciousness. Improving consciousness is destined to become a huge 'industry' with powerful organizations taking both commercial and nonprofit forms. Elmer Green's Mind Body Principle implies that enhancing consciousness improves health and vice versa. But how long will it take biofeedback to attract adequate capital to make it a mature industry?

Long Term Changes

'The gift of prophesy is but the flowery trapping of the Tao and the beginning of folly.'

– Lao Tzu

Changes are happening on many fronts including clinical equipment, personal equipment, sensors, and training. Clinical software has come a long way, but must evolve in order to catch up to the hardware's capabilities. We provide exceptional flexibility by combining Windows and DOS, but that will not do much longer. Manufacturers are fighting the 'Windows Wars' as Microsoft keeps changing the rules forcing purchase of its new products. We’re looking into Open Source but costs are daunting. Programmers must develop more intuitive software and improve flexibility so that practitioners can easily tailor reports to payors, referrals, client learning etc. Clinicians and researchers must be freed creatively. We know how to improve software systems considerably. However we, like others, stalk investment while stretching capital. Equipment developers will continue influencing research by providing better tools.

Four amplifier Neurofeedback/QEEGs will emerge just as four channel EP systems became common in neurology. A significant advance is the integration of normative data-bases into the software so that clinicians will have a better understanding of when signals are abnormal.

Artfulness Will Attract Funding

Both clinical and emerging life/performance enhancement technology are already ahead of the current state of the art. Early movie technology provides an example. It took years before artists, writers, directors, even actors emerged who knew how to use movie technology in a way which delivered compelling stories. Several computerized biofeedback systems have unexploited capabilities. We await practitioner/artists to more fully employ existing potential. The engineers and developers in this field, dancing to the beat of daily operations and business, long to contribute more to this artistry.
Like other immature industries, funding awaits mass acceptance, mass acceptance awaits improved artfulness, and improved artfulness awaits funding. We grow slowly until ‘killer applications’ hit. Then we move to more creative and economically rewarding levels. Our field screams for more creativity. Learning strategies must be so good that they work well without biofeedback. Then biofeedback makes them work better. The wagon worked. Then we added engines. Instruments are limited without mighty ‘mind stuff’ behind them. Instruments by themselves are like spoons without food. Granted, gifted practitioners can make something beautiful with a piece of wood and a hammer. Master carpenters can make something. Such ‘art’ makes food. Instruments by themselves are like spoons without food. Granted, gifted practitioners can make something beautiful with a piece of wood and a penknife. But they more often choose to use the $80,000+ worth of tools in their pickups.

“Young shall see visions. Your old will dream dreams.”  – Old Testament

Playing prophet, I believe our field will give birth to astounding developments. The line between clinical biofeedback equipment and a popular technology of self-knowledge blurs. Personal instruments will become as ubiquitous as bathroom scales and mirrors. If science fiction writers are correct, then beautiful instrumentation will be worn like clothing and jewelry. I co-founded QTran, which invented the Mood Stone - a beautiful, functional temperature trainer. After selling millions of dollars worth of them (they were expensive and durable - $150 in 1975) we were wiped out when costume jewelry manufacturers flooded the market with useless junk. $500,000,000 + worth of them were sold before the ‘fad’ was killed off. We attempted to raise money for heart rate watches in 1978. Others succeeded in developing a substantial business. But these kinds of personal instruments are trivial compared to what will emerge.

We will develop fashionable and effective instrumentation. Algorithms already emerging will increase awareness of healthy or unhealthy influences in terms of stress, psychoneuroimmunology, brainwaves, heart function, blood pressure, pulmonary function etc. We can be warned if something we are eating or breathing is toxic, blood alcohol levels are too high, or we are too drowsy, etc..

All detectable radiation can be fed back. Signals of relatively infinite subtlety can be fed back. If the ayurvedic ‘chakras’ reflect actuality (probably reasonable third dimensional models of fourth dimensional phenomena) then why can’t ‘subtle energy’ information be fed back?

As room temperature superconductors emerge, walls will be turned into sensors monitoring any living thing close by creating hundreds of applications (dialing 911 if you become unconscious) and privacy worries.

Over 50% of communication is nonverbal. Personal instrumentation can augment the communication between us in a more subtle way than even telephones, since telephones amplify words that are basically thoughts (abstractions) and instruments amplify primal signals radiating from the psychophysiology. Lying could become more difficult and less fashionable.

**The Mission**

Awakening human beings to signals that were there all along - implies a biofeedback ‘endpoint’ mission – enhanced awakening, with an applicable understanding of how the mind/body linkage works. Paradoxically, biofeedback leads to increased sensitivity (intelligence, from the Latin *Intelligere* - to see between threads finely woven) and less need for the instruments themselves. The mission becomes how to improve moment-to-moment quality of consciousness.

“The intention with which you approach the problem is more important than knowing what to do about it.”  – Krishnamurti

If it is true that there are no practical limits on the improvement of consciousness, this technology will be a moving feast for hundreds of years. We are all interconnected.

When we can monitor subtle energies interplaying interpersonally - changing world-views will change politics. Acts of kindness and anger spread outward like circles. Biofeedback amplifies those ‘circles’, increasing sensitivity to them - decreasing dependence on biofeedback itself. Our focus will intensify on rediscovering, understanding and teaching ‘deep space’ (meditation?) consciousness clarification. Arguably, biofeedback’s greatest mission is increasing understanding of meditation. Problems with the word meditation continue even as the ‘real thing’ catches a second wind as an efficient way to enhance sensitivity and ‘EQ’ intelligence.

**Research Must Evolve**

An ancient hunter was probably amusing himself twanging a bowstring. (S)he invented the forerunner of the guitar (probably three strings) and from that the piano evolved. Biofeedback instruments are like quality musical instruments. Everything depends on the artistry of the player. Our research lags our artists. Quantum physics, nonlinear dynamics, neuroscience, neophilosophy are leading to research transformation. The maxim ‘If it can’t be counted it doesn’t count’ will change to ‘That which counts most cannot be counted’. Relatively few are aware of the psychological seachange. Even fewer are aware of biofeedback’s power to serve ‘the new sciences.’ Neurofeedback is an oasis where the new sciences converge and integrate. The intermarriages are robust and fecund. Something old is dying. Something new is being born.

In the 20’s the scientific establishment knew that the entire universe was the Milky Way Galaxy. Then Hubble proved there are other galaxies-100 billion and counting. Now, that’s a paradigm shift!

Niche markets will breed diversity. Even greater differences will emerge in the way similar tools are used. A saw cuts wood or bone. Carpenters should not amputate even if they do charge less than surgeons.

**Drug War Victory?**

Better research will reveal biofeedback’s power to potentiate drugs. Under enlightened medical supervision practitioners will achieve results with drug/biofeedback combinations that will astonish skeptics and motivate politicians. Inspiring applications to neuroimmune disorders will unfold. Animal studies are inadequate to meet our research challenges, increasing pressure to invent better research strategies. Voters will have to lead, but as Healthcare costs escalate pharmaceutical companies must realize that making less drugs work better is in

continued on Page 33
Abstract: There are many exciting EEG Biofeedback technologies and applications in our future. But the effective use of these innovations will require tools which are capable of extracting new and revealing EEG relationships from the complex underlying multichannel EEG dynamics. The successful application of this emerging technological edifice will depend on the construction of an equally innovative EEG database foundation which will involve genetic and other physiological data, multimodal analysis, and simple intuitive dynamic displays. This will allow practitioners to map database analyses into optimized feedback protocols, exquisitely attuned to the individual needs of each patient.

For more than twelve years, Lexicor has adhered to the principle that physiological data is like a rich mineral vein that can be mined. However, without a sufficient infrastructure to collect and process large amounts of physiological data, in this case multichannel EEG, this ore deposit will remain largely untapped. Lexicor has devoted the past decade to building such a data collection and analysis infrastructure and is excited about moving to the next phase – the efficient acquisition of large amounts of data, the discovery of new relationships in the data using powerful signal processing techniques, and the provision of new clinical services based upon this analysis.

To carry the analogy further, even ore that seems to be low grade or played out can be further refined using sophisticated signal processing techniques to increase the value and yield. There’s gold in them there hills! So far, this refining process has involved the use of normative and other types of EEG databases but Lexicor feels that this is only the tip of the iceberg. We are at the beginning of a revolution in the fields of Neurotherapy and Brainmapping, which will ultimately provide a rational basis for the meaningful fusion of these two important Neurophysiological disciplines.

Extracting data using various kinds of sophisticated signal processing and mathematics is, however, only the first step. In order to transform this data into a form appropriate for use by health care professionals, a qualitative translation is required. This translation will involve the transformation of dry numerical data into exciting dynamical displays and representations that convey the underlying patterns in an immediately accessible and intuitive format. To this end, Lexicor is working on providing a dynamic hyperlinked capability to our DataLex service which will provide Neurotherapists and other health care professionals the ability to massage or explore data in their patient reports using simple but powerful on-line capabilities.

Tools of Translation
Evolving neurodiagnostic tools such as PET, SPECT, and fMRI technologies have also exerted an influence on the evolution of EEG neurodiagnostics, in that it has become obvious that EEG data needs to be acquired and processed in such a manner so as to facilitate comparisons with the other forms of neurodiagnostics using what are often referred to as Multimodal Imaging and Registration techniques. In particular, new EEG topographic brain mapping techniques and data processing algorithms have been developed which generate accurate representations of three dimensional EEG activity within the brain which can be related to anatomical structures.

Lexicor first entered the brainmapping and Neurotherapy markets with the introduction of the NeuroSearch-24 brain mapping system. Taking complex QEEG information and translating the data into a language for the health care professional focused on brain disorders, Lexicor created a system that delivered useful biological data that was accurate, clinically relevant, and economically viable.

Providing a sophisticated device for col-
lecting, analyzing, displaying QEEG data, the NeuroSearch-24 empowered clinicians with a tool that provided more accurate diagnostic features while facilitating a better understanding of brain disorders. But Lexicor recognizes that this is only a foundation that must be continually built upon to realize the potential and promise of this technology.

The NeuroSearch-24 EEG brain mapper and NRS2D Neurotherapy units are therefore only part of the Lexicor's data translation vision. Lexicor introduced DataLex (meaning: the language of data) to its portfolio of services to handle QEEG data acquisition and transmission, while providing data analysis using online QEEG databases. DataLex removes many of the onerous tasks associated with QEEG data translation while offering an economic means to access some of the industry's current leading comparative databases. Lexicor is now devoting considerable resources towards the development of automatic artifactual, neural net driven pattern recognition and the collection of larger data sets, all in the service of creating more robust and accurate data bases and services.

**Developing Diagnostics-GEEG**

If biological data provides measurable clues to the rules and structures of individuals' health and well being, perceptive insight into the interaction of data may yield improvements in understanding. Lexicor believes that to realize the true impact of biological data translation, it is imperative to understand the relationship and correlation between a choice set of physiological features.

Ultimately, the role of genetics will impact the diagnosis of many diseases, including the diagnosis of brain disorders. Lexicor believes QEEG data may provide a suitable partner to genetics in the overall process of brain disorder understanding and management and prediction of optimal therapeutic interventions. Lexicor will be referring to this new union of genetics and QEEG by the acronym GEEG.

As a leader in QEEG data collection and analysis, Lexicor is pursuing the development of a series of GEEG databases that will provide insight into a range of brain disorders. This project is expected to last several years, create a number of ever-improving quality databases, and deliver exceptional tools which advance our understanding of the relationship between QEEG, other physiological parameters, and genetics.

**The Future**

So what does the future hold? When we gaze into our company's crystal ball, we see images that are almost overwhelming in their promise and diversity. Even more amazing is that much of what is seen can, and will, be accomplished using technology that already exists today. Here are just a few of the visions that Lexicor sees as important for future development and plans to play a significant role in bringing to fruition.

The fusion of Neurotherapy and Brain mapping will continue, until an automated and seamless path exists for clinicians to translate the information acquired during the brain-mapping phase to effective and optimized Neurotherapy protocols.

New three-dimensional EEG databases will be developed using LORETA (Low Resolution Electromagnetic Tomographic Analysis), which are cross validated with other neuroimaging techniques.

Real-time neurofeedback methods will also evolve to incorporate LORETA and other three dimensional EEG imaging techniques. Patients will be able to focus on specific anatomical structures and/or complex communication pathways to effect profound physiological changes.

Physiological databases will be created from data acquired during the presentation of various complex forms of cognitive stimuli, as well as subject responses, to augment the current eyes open and closed databases in wide use today.

These multimodal physiological databases will also be integrated with genetic information where appropriate, to provide clinicians with new perspectives on the relationship of genotype and phenotype and the relative influences of components related to nature and nurture.

In summary, biofeedback instrumentation of the future will facilitate the attainment of more general and adaptive physiological objectives than is currently possible using today’s one-size-fits-all protocols. With advances in electrode hookup technologies, the benefits of multichannel (8,16,24,32, etc.) EEG feedback paradigms will be more easily realized and the knowledge gained from recent findings in neuroimaging and physiological models, more effectively applied. The distinction between topographic EEG brainmapping and biofeedback technology will begin to blur. EEG brainmapping hardware will shrink in size, and prices will drop significantly. And EEG feedback protocols based on global EEG dynamics will more rapidly lead to the achievement of clinical goals than current protocols implemented using EEG biofeedback instruments which derive information from spatio-temporally under sampled brains.

Perhaps the most exciting advances may yet lie in the recognition and celebration of the individuality of each patient, and the development of biofeedback technology which can deliver “designer” biofeedback, exquisitely attuned to the uniqueness of each person’s genetics and physiological expression.
A living compendium of information on biofeedback devices
continued from Page 13

Association for Applied Psychophysiology and Biofeedback
Survey of Instrumentation and Software for Biofeedback/Applied Psychophysiology
Section 1: Biofeedback Devices "C. Stand alone Single/Dual parameter non-computer based systems"

<table>
<thead>
<tr>
<th>Name of manufacturer</th>
<th>Date updated</th>
<th>Power Source: Types of Biofeedback provided</th>
<th>Visual display output: Audio output:</th>
<th>Parameters recorded:</th>
<th>Are there isolated inputs for external equipment?</th>
<th>Number of channels of input:</th>
<th>Reliability of channel settings:</th>
<th>Scanning option:</th>
<th>Can this device use only the sensors provided by the manufacturer?</th>
<th>Skin preparation requirements for sensors?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-Feedback Systems, Inc.</td>
<td>battery AC power line</td>
<td>audio visual</td>
<td>digital analog meter</td>
<td>pulsed tone pitch</td>
<td>EEG EMG TEMP GSR</td>
<td>no</td>
<td>Number of channels of input: 1</td>
<td>Maximum sample rate per channel: 12, 14, 16, bits:</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Neuropathways EEG Imaging</td>
<td>battery AC power line</td>
<td>audio visual computer monitor</td>
<td>all digital real time EEG feedback</td>
<td>EMG feedback</td>
<td>EEG EMG feedback</td>
<td>all digital real time EEG feedback</td>
<td>Number of channels of input: n/a</td>
<td>Maximum sample rate per channel: n/a</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Thought Technology (MyoTrac)</td>
<td>battery visual</td>
<td>bar graph</td>
<td>EMG</td>
<td></td>
<td></td>
<td></td>
<td>Number of channels of input: n/a</td>
<td>Maximum sample rate per channel: n/a</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

Survey of Instrumentation and Software for Biofeedback/Applied Psychophysiology
Section 2: Software not supplied with original equipment

<table>
<thead>
<tr>
<th>Name of manufacturer:</th>
<th>Name of software:</th>
<th>Intended Use:</th>
<th>What does this software do that the unit does not do?</th>
<th>Screens:</th>
<th>Training Protocol:</th>
<th>HRV/RSA Protocols:</th>
<th>Printable:</th>
<th>Devices Supported:</th>
<th>Suppliers of software:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thought Technology Ltd.</td>
<td>BiographX</td>
<td>animations; screens and protocols</td>
<td>offers additional screens and protocols not included in the original system</td>
<td>default</td>
<td>no</td>
<td>n/a</td>
<td>PC Windows 98 and higher</td>
<td>Thought Technology and various distributors worldwide</td>
<td></td>
</tr>
<tr>
<td>Brain Train</td>
<td>Captain's Log</td>
<td>cognitive training</td>
<td>(as supplied by unit) trains basic cognitive skills, attention, memory, auditory processing, phonemic awareness, tracking, reasoning, visual scanning</td>
<td>yes</td>
<td>yes</td>
<td>results</td>
<td>Brain Train</td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Biotech Corporation</td>
<td>UniComp Windows</td>
<td>data storage: biofeedback reports statistics</td>
<td></td>
<td>default</td>
<td>yes</td>
<td>new version under development</td>
<td>notes</td>
<td>American Biotech Corporation</td>
<td></td>
</tr>
<tr>
<td>American Biotech Corporation</td>
<td>CAPSCAN Windows</td>
<td>data storage: biofeedback reports statistics</td>
<td></td>
<td>default</td>
<td>yes</td>
<td>yes when integrated with UniComp 1330</td>
<td>notes</td>
<td>American Biotech Corporation</td>
<td></td>
</tr>
<tr>
<td>American Biotech Corporation</td>
<td>CAPSCAN C30</td>
<td>data storage: biofeedback reports statistics</td>
<td></td>
<td>default</td>
<td>yes</td>
<td>yes when integrated with UniComp 1330</td>
<td>notes</td>
<td>American Biotech Corporation</td>
<td></td>
</tr>
</tbody>
</table>
### Biofeedback

| Method of transmitting the signal from the sensors to the device: | Built in quality checks for: | Computer Requirements: | Warranty period (years): | Usual turn around time for repairs: | “Availability of technical (software, hardware) advice, support”: | Which computer operating systems are supported by the system? | How is the biofeedback device interfaced with the computer? | What kind of data can be stored in the computer? | Can the data be accessed by standard programs? | How long has this device been on the market? | Does the device have FDA approval? | “If yes, what is it labeled for”? | Suppliers of this unit: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| wires | Loose sensors: no | Impedance: no | Battery: yes | Other: dummy subjects for EMG/EDR temp self check feature | n/a | 1 | 2 days | during | n/a | n/a | n/a | n/a | 10 years | yes | biofeedback | BFS Inc., ETI |
| wires | Loose sensors: yes | Impedance: yes | Battery: yes | Other: all in one unit | 3 years | 2 days | during | diskette | CD | Build all from scratch | alone unit | raw | yes | 5 years | no | Neuro-pathways EEG Imaging Inc. |
| n/a | Loose sensors: n/a | Impedance: n/a | Battery: n/a | Other: n/a | 1 year | n/a | during | n/a | n/a | n/a | n/a | 25 years | Bio-Temp Products, Inc. |
| wires | Loose sensors: no | Impedance: no | Battery: no | Other: n/a | 1 year | 2 weeks | during | factory reconfiguration | n/a | n/a | n/a | n/a | 15 years | yes | class 2 | Thought Technology and worldwide distribution |

---

**The Future of Biofeedback**

continued from Page 23

their long term interests. Entrepreneurs will combine electromedicine with pharmacueticals, decreasing costs profitably.

**THE BODIES ARE ALIVE WITH THE SOUND OF MUSIC.**

Pop star musicians will hold concerts in which they produce music and visual displays by manipulation of their physiology. We have experimented with simple conversion of physiological signals to musically corrected sound. Amazing how like jazz it sounds. We speculate that jazz derives much of its power from intuitive sensing of psychophysiology and integrating same with emotions and thematic material (We sold an early neurofeedback device to Stan Getz). This has been done in crude form but lacked the technology and artistry to be glorious. When the technology is ready the artists will appear.

“What if the quality of consciousness of the ‘observer’ significantly influences which one of all those potentials within any given moment collapses, and which manifests? Schrodinger believed consciousness is a special case, a kind of singularity, regarding the wave/particle laws. Biofeedback, the technology of self-knowledge, is dedicated to improvement of consciousness quality. What if consciousness is assisting in ongoing manifestation of the Universe? Walking the talk is not always easy, but what alternative exists?

**Integration of Disciplines**

The ancient Greeks considered psychology the greatest of all sciences because it dealt with the health of the mind. Healthy minds are required to keep other sciences ‘running true’. As science becomes more aware of the implications inherent in integration of disciplines (wholeness) a new appreciation for what has been called spiritual, mystical, or metaphysical is emerging.

“The most beautiful and profound emotion we can experience is the sensation of the mystical. It is the power of all true science.”

– Einstein

Bohm and other scientists consider the mystical to be the fountainhead of creativity. Hawking said, “The truth about the boundaries of our universe is that there are no boundaries.” If that makes science more challenging, wonderful, then, to paraphrase Betty Davis, “Science ain't for sissies.”

“Given sufficient development of advanced technology it is indistinguishable from magic.”

– Arthur C. Clarke

---
Nanny Christie is a Licensed Professional Counselor, certified by the Biofeedback Certification Institute of America and holds a Certificate of Professional Studies in Clinical Psychophysiology. She has over 20 years combined experience as a biofeedback practitioner and counselor in psychiatric facilities, pain rehabilitation and private practice.

Amy Coleman is a senior at Chapman University’s Washington state campus. She resides in Bremerton, Washington with her husband and two children. This is her first research project with Dr. Richard Sherman. She looks forward to doing more research in biofeedback with him and their colleagues. She is currently doing research on short term memory processes and the validity of psychometric devices.

Thomas F. Collura, PhD., PE, is founder and President of BrainMaster Technologies, Inc., Oakwood Village, Ohio, where he conducts research and development of EEG neurofeedback systems for clinical and home use. He received an AB in Philosophy of Science and an Sc.B. in Biology from Brown University, Providence, Rhode Island (1973), and an MS and PhD in Biomedical Engineering from Case Western Reserve University, Cleveland, Ohio (1978). He is a registered professional engineer in Ohio and Illinois, and is a Board Certified Neurotherapist.

R. Adam Crane is a BCIA Senior Fellow, BCIA-EEG certified, President of American BioTec, Director of BioMonitoring International, and Founder of Health Training Seminars which offers BCIA Certification Training. He is co-author of MindFitness Training: Neurofeedback and The Process. Adam and the organizations he has founded or co-founded have served the biofeedback and applied psychophysiology community since 1971. He has recently formed the non-profit International MindFitness Foundation that is dedicated to psychophysiological research and education with a particular emphasis on life and performance enhancement.

Stuart Donaldson, a psychologist in private practice in Calgary, Alberta, received his PhD in 1989 at the University of Calgary. He is the director of a multidisciplinary pain treatment and rehabilitation center (Myosymmetries, Calgary). A pioneer in the field of sEMG and chronic pain, his more recent work has involved the integration of sEMG, QEEG, psychological status, and chronic pain. He has published extensively on biofeedback, chronic pain, and fibromyalgia.

David Joffe is a founder of Lexicor Medical Technology as well as a number of other biomedical companies. David has always had an abiding interest in consciousness and the means of connecting objective and subjective experience. To this end, he has focused his attention on the development of various mathematical transforms to decompose complex multichannel brain wave states, for both offline analysis and real-time feedback. He is currently involved in the unification of genetic and QEEG information for diagnostic and treatment purposes.

Lawrence Klein is senior Vice President for Sales and Marketing and cofounder of Thought Technology Ltd. Klein is co-author with Major Nory Laderoute of Mind Over Muscle, a biofeedback-aided, applied sports psychology training program. He has been an active member of the Association for Applied Psychophysiology and Biofeedback for 27 years. Klein has a BA in Psychology, is married to Dr. Janet Shinder, and has two lovely daughters, Talia and Ariella.

Rollin McCraty, PhD, is Director of Research of the HeartMath Research Center at the Institute of HeartMath in Boulder Creek, California. His research interests include the physiology of emotion, with a focus on the mechanisms by which heart-based positive emotions influence cognitive processes, behavior, and health. Findings from this research have been applied to the development of tools and technology to optimize individual and organizational health, performance, spiritual well-being, and quality of life.

Olafur S. Palsson, PsyD, is a clinical psychologist. He is a research associate in the Department of Medicine at the University of North Carolina at Chapel Hill, as well as the CEO of Mindspire, LLC, a mind-body technology development company.

Alan T. Pope, PhD, is a clinical psychologist and a researcher at NASA Langley Research Center.

Richard A. Sherman, PhD, received his doctorate in psychobiology from New York University in 1973 and has accrued over thirty years of experience teaching and performing research and clinical work in behavioral medicine and related fields. Dr. Sherman’s areas of interest spanning over thirty years of research and clinical work in psychophysiology include elucidating mechanisms and treatments for phantom limb pain, determining the effectiveness of pulsed electromagnetic fields for treatment of migraine headaches, and describing temporal relationships between changes in muscle tension and pain. He has held numerous positions within AAPB including chair of many committees and two terms on the board.

Irene J. Sleight, MS, BCIA, received her master’s degree from the California School of Professional Psychology in Clinical Psychophysiology and Biofeedback. She is nationally certified by the Biofeedback Certification Institute of America (BCIA) as a biofeedback practitioner, and is a Board Member of the Biofeedback Society of California (BSC). She has interned at the UCI Medical Center on a Prenatal Outcome study researching the psychosocial and physiological effects of stress on an unborn child. As part of the pain management team at Charter API Behavioral Health, she has educated pain patients in conjunction with biofeedback treatment, and has treated patients with stress-related disorders at the Cybernetix Medical Institute. She has most recently assisted TeleVital Inc. in the launch of VitalWeb, a browser-based open architecture software engine that supports real-time streaming and continued next page
About the Authors
continued from Page 34
remote viewing of raw and interpreted vital sign data along with audio and visual communication.

Sebastian “Seb” Striegel, PhD, is a Professor in the Department of Psychology at Utah State University. There he teaches graduate level courses in ethics and professional conduct, clinical applications of biofeedback, clinical applications of relaxation training and behavior therapy. He is also the Director of the Division of Services at the Center for Persons with Disabilities at Utah State University. In that role he manages a variety of programs, including an outpatient clinic, a biofeedback lab and an early intervention program. He is a past president of AAPB and regularly writes this column and conducts workshops on ethics, standards, and professional conduct.

BOOK REVIEW


I must start out by confessing to be an ardent fan of David Simons and I. Jon Russell. So my expectations of this book were high, expecting well organized, highly researched materials with supporting documentation. I also expect to be reading this book for years to come. All of these expectations were met.

This is not a book that can be read in one sitting. There is so much information on biochemistry, neurophysiology, muscle activity, and muscle patterns that reading it requires concentration, more than a basic knowledge of physiology, and several days.

The book is divided into nine chapters, the first eight by Mense and Simons, and the last by I. John Russell. Each chapter is self-contained (that is, you can read it by itself without having to reference other chapters). Chapter 1 starts generally exploring background and basic principles of muscle pain. Chapters 2 to 8 are devoted to a specific aspect of muscle pain. For example there is a chapter on neuropathic pain, one on central pain and centrally modified pain. Each chapter explores the current research on the topic at hand with an adequate use of figures and diagrams. The information is presented in a well-organized and sequential manner. As an added touch at the end of most chapters there is a section on medications and their effects on muscles and pain. I. Jon Russell writes chapter 9 conducting an extensive review of the research and epidemiology regarding fibromyalgia. All theories are covered as well as current research.

This book is a must read for any one conducting forensic and disability evaluations, for anyone conducting sEMG biofeedback or working with the pain populace. It clearly identifies the neurophysiological basis of muscle pain (as it is understood today). It will make an excellent companion in court or as a rational for the insurance companies providing the physiological reason for what you did (and why it took so long). It will be difficult reading for the novice practitioner or for someone without a neurophysiology background.

Of course this text does not go into biofeedback for these conditions so has limited use for treatment.

I recommend purchasing this text and using it as the neurophysiological basis for any sEMG work and as the justification for doing relaxation training.

CLASSIFIED ADS

Equipment for Sale
Bio Integrator – biofeedback unit. New condition, never used. 2 EEG, 2 EMG; 1 SCL, 1 HR/BVP, 2 Temp. Box of leads/gels – 1 monitor. $3500 or best offer. For more info, call 781-344-8878.

Retired—Selling remainder of J&J equipment: M-57 dual channel EMG; T-68 dual channel Thermal/EDG. Three Portable EMGs: one M-59a and two M-56A. All work. Original cost $3000, will sell all for $950. Duane Kolilis, PhD, 503-796-9396.

Neurosearch 24—caps, electrodes, gels, etc. Please call Mary Loescher, 505-255-9200 or 505-299-9477.

It has been my privilege to serve AAPB as president for the past twelve months. I am grateful for the experiences of the past year, most of all the opportunities to meet and dialogue with so many talented and fascinating individuals who make their life’s work in biofeedback and applied psychophysiology. In the next year AAPB will benefit from the capable guidance of incoming president Paul Lehrer, PhD. I will now overview for AAPB members some of the most important activities within the organization in the past year.

This has been a year of AAPB expanding educational opportunities. We believe that the foundation for growth in applied psychophysiology lies in high quality training, and more consistency in the skills and knowledge shared by practitioners nationwide. In the past year, AAPB has begun marketing a basic home study program to prepare individuals for BCIA certification. Doil Montgomery and Andrew Crider are currently managing a group of authors who are updating this home study program. AAPB also offered an expanded series of workshops, under Steve Baskin’s guidance, at the annual meeting in Raleigh and in locations including Denver, Washington DC, and Chicago. Andrew Crider has also developed an AAPB model curriculum for graduate programs in applied psychophysiology. Fred Shaffer will now serve as our education chair and will continue to expand our workshop offerings and educational programs.

This has also been a year of expanded support for students. Board member Christine Hovanitz has gathered information for educational and work opportunities for our students. Christine and Paul Lehrer have also led fund-raising efforts, strongly supported by our Board, for more scholarships for the annual meeting.

AAPB has also aggressively worked this past year at building a stronger worldwide community of biofeedback and neurofeedback professionals. AAPB collaborated extensively with SNR, the Society for Neuronal Regulation this year, in several advocacy projects. AAPB also extended member rates at our annual meeting to SNR members. AAPB was a co-sponsor for the Amsterdam conference of the Biofeedback Foundation of Europe. Our September 2002 workshops will be jointly sponsored with ISARP, the International Society for the Advancement of Respiratory Psychophysiology. Finally our Board created a new correspondence membership, with a fee of only $50.00, for individuals outside North America, who wish to be members with no voting rights and online only access to publications. Paul Lehrer has aided us in interacting with our international colleagues, and we hope to increase their participation in AAPB.

This has also been continued and aggressive advocacy by AAPB for biofeedback. An article critical of neurofeedback was published in the Behavior Therapist, the newsmagazine of the Association for the Advancement of Behavior Therapy. AAPB and SNR collaborated on a response, and a group headed by Theodore LaVaque and D. Corydon Hammond wrote a persuasive response for publication in the Behavior Therapist. A researcher named William Mullaly widely distributed claims, through the Reuters Health press service, based on a single unpublished study, that biofeedback is too expensive and ineffective for headache. A team including Frank Andrasik, Angele McGrady, John Perry, Steve Baskin, and myself drafted a response published in the Winter 2001 Biofeedback Newsmagazine. Fortunately Reuters also distributed a new release, summarizing the evidence supporting biofeedback for headache. Rob Kall, Seb Striefel, and Joel Lubar are organizing an outreach to CHADD, to promote neurofeedback as a treatment option. Finally, John Perry has continued to work aggressively and tirelessly on a variety of advocacy efforts, including a new series of issues that arose with HCFA and incontinence care this year.

This has also been a year of expanded teamwork and collaboration for AAPB. Our President Elect Paul Lehrer worked extensively with our membership chair Eliza Bigham, to reach out creatively to new populations of potential members, including students. AAPB worked with the Illinois Chapter in putting on workshops and an evening scientific program in Chicago in November 2001. As mentioned above, we are working with SNR on a series of collaborative projects. The most important collaboration this year was a joint AAPB/SNR Task Force on Methodology and continued on Page 2A
FROM THE EXECUTIVE DIRECTOR'S DESK

Francine Butler, PhD

It has barely been a month since our meeting in Las Vegas. And yet time has flown. We are already well into the planning for the 2003 meeting in Jacksonville, FL, March 27-30. Chair, Rich Sherman, has a stellar list of speakers lined up. Make your plans now to be there. The Call for Papers will be posted on the AAPB web site within the next few weeks. Watch for it.

On one of our evenings at the meeting we would like to have an “AAPB Cabaret”—an event totally dependent on talented AAPB members. So if you sing, dance, play an instrument or have another talent to share, please let us hear from you.

Along with the elation we celebrated upon the conclusion of a successful meeting, we also experienced sadness when we learned of the deaths of two of our revered members. Both Neal Miller and Eugenia Carmagnani passed away in March. Neal Miller was an elegant researcher who paved the way for so much of the fundamental work in Biofeedback. And left us a legacy—Be bold in what you try and cautious in what you claim. He was a wonderful and charming human being—it was he on the dance floor at the AAPB meetings when many of the younger members were resting on the sidelines.

I met the Carmagnani’s almost 25 years ago when they came to the US on a trip and phoned the BSA (Biofeedback Society, our former name). We were still housed at the University of Colorado Medical School and I happened to be in the office on a Saturday morning. A gentle lady—she and I remained friends over the years. She was a great force in helping to develop the AAPB International section.

This month we launch the availability of the on-line version of our journal Applied Psychophysiology and Biofeedback. You can gain access via the AAPB web site. (Just click on the link at www.aapb.org). Remember as an AAPB member you also have on-line access to the Journal of Behavioral Medicine. Also check out presentations at the AAPB annual meeting by clicking on the Digiscript Virtual Library icon. Be sure to use all of these AAPB benefits.

AAPB Year in Review

continued from Page 1A

Empirically Supported Treatments. Ted LaVaque and D. Corydon Hammond headed this task force, and produced a final report approved by both organizations' Boards. The Report establishes a continuum of efficacy ratings, each with very clear criteria. The Report will be published in our journal and SNR’s journal.

This has also been a year for new publication projects. We have added a monthly electronic update to our members, keeping them posted on AAPB activities and relevant breaking news. AAPB has adopted a new logo and developed a new membership brochure. In addition AAPB has contracted for several new publications: Carolyn Yucha and Christopher Gilbert will produce a new Clinical Efficacy booklet. Sebastian Striefel will author both a new book on Standards and Guidelines for Clinical Practice, and a new Ethics book. Ted LaVaque and I have also agreed to oversee a new set of White Papers on Biofeedback and Neurofeedback Applications. D. Corydon Hammond will assist on the neurofeedback applications. The White Papers will utilize the new efficacy ratings developed by our Task Force on Methodology.

While we continue our efforts to expand the world of biofeedback, and increase our impact on health care, AAPB itself has suffered the same problems as many other associations in our country who are seeing a decreasing membership and lower income. AAPB experienced a financial loss in 2001, which the Board is dealing with. We have cut expenses in many areas, and are focusing efforts on increasing income. We ask your help in the way that can be most beneficial—urge a colleague to join AAPB. Our strength is in our numbers, and a bigger stronger organization can more effectively advance our mission.

There was much more activity that I can’t cover here. However, I want to thank our officers, our Board members, our committee members, and other volunteers, as well as the AAPB staff who have worked so hard this year on all of the routine tasks that need to be done year after year, as well as on so many special projects. Thank you!

We Encourage Submissions

Send chapter meeting announcements, section and division meeting reports, and any non-commercial information regarding meetings, presentations or publications which may be of interest to AAPB members. Articles should generally not exceed 750 words. Remember to send information on dated events well in advance (we may be able to publicize your event more than once if you get your calendar to us early enough).

Send Word (.doc) or text files by e-mail to the News and Events Editor: Ted LaVaque, PhD tlavaque@ghonline.com by March 15 for the Summer Issue.

2A Biofeedback Spring 2002
FROM THE PRESIDENT

Paul Lehrer, PhD

The good feelings of our last AAPB meeting are starting to fade into fond memories, and we are beginning to plan our next activities. Among the many things we are hoping to emphasize in AAPB are:

**More involvement of students and new professionals, and activities that may be of particular help to them.** To this end, we have started a “bank” of job and educational opportunities, which hopefully will grow to a full-fledged “job market”. Anyone with a job to offer, an educational program in applied psychophysiology, or a seeker of such opportunities — think of coming to our next meeting, and making yourself known to us!

**More involvement of regional, specialization, and international groups.** We would like regional, special interest and international groups (and their members) to have a greater presence within AAPB. To advance our science, practice, and training, as well as the general legitimacy of our field, we need to have greater “presence” —- this means more unity in the field, and more involvement of all for the common good. In recent years there has been a tendency to a bit of entropy in our field. This is a time to work together. I personally would like to reach out to specialty groups and regional groups whose interests overlap with those of AAPB, to explore ways that we can join hands and work more effectively together. I will write in more detail about these possibilities in future columns.

**Support innovation.** The theme of our next meeting will be “Beyond the Boundaries of Biofeedback”. Although most AAPB members are involved specifically in biofeedback, there is tremendous national interest in other methods of self-regulation. Indeed our society was one of the first to disseminate good scientific research on various Eastern and Western meditative practices. I have encouraged a group of AAPB members to organize a special interest group in this area. If you are interested in joining this bandwagon, let me know! This activity will in no way detract from AAPB’s interest in supporting and encouraging the practice specifically of biofeedback. However many of these other techniques differ from biofeedback more in details of procedure than in over-all goals and methods. We can and should learn from each other and support each other’s work.

As many of you know, my personal involvement in biofeedback is as a researcher as well as a clinician. The remainder of this column will be devoted to some research issues that should, directly or indirectly, affect most of us.

A common topic of discussion among AAPB members has been the need to bring research findings to various third party payers and government regulators, to help legitimize our field. This, of course, brings us face to face with the sad problem that published research in our field lags quite far behind clinical innovation. Part of what AAPB’s mission therefore should be to facilitate both production and dissemination of good research in applied psychophysiology. Some current events may present both some hindrances and opportunities regarding this endeavor.

I have just returned from a meeting of the Federation of Behavioral, Psychological, and Cognitive Sciences (of which AAPB is a member organization), devoted to regulation of human research. One theme of the meeting was a bill that soon will be introduced to Congress that would place new regulations on all human research. If enacted, the bill could increase your difficulty of collecting data from your own and your colleagues’ clinical practices, unless your protocol is approved by a duly constituted Institutional Review Board (e.g., at a hospital or university), and unless each participant specifically can sign a written informed consent form. This may particularly be a problem for many AAPB clinical researchers who collect their observations and data from their own records, from patients who are not specifically enrolled in a research project. We all know that our field sorely needs more good research, and that much if it will come from ongoing clinical work, because funds for large-scale controlled studies are often hard to come by, particularly without the kind of industry support that characterizes pharmaceutical research, and generally allows generous payments to study participants and clinicians alike. This is exactly the type of research that may be stifled by unwise additional research regulation.

Hopefully, some of my concern may eventually be found unwarranted. Everyone agrees that protection of the safety, dignity, and rights of participants should be the paramount consideration for all researchers (as well as everyone else involved in the research enterprise); and the exact provisions of the bill are not yet public. However I suggest that all interested AAPB members keep their eye on the Congressional Register.

Consider this: Sometimes the process of obtaining informed consent can itself be problematic, and may be harmful. In my own work, I remember the plight of a very interested but minimally literate patient at an inner-city asthma clinic. She could have benefited from the free biofeedback treatment and medical care we were offering, but was daunted by the 7-page informed consent form required by our local Institutional Review Board (supposedly written on an eighth grade level, but, after doctoring by various legal minds, made somewhat more complicated). For several weeks in a row she returned to the clinic and again asked to take home a copy of the informed consent form, so her daughter could read it and explain it to her. I explained the procedure word for word each time, but the fear and magic associated with a written contract were too overwhelming. Eventually her daughter also gave up on the task. She
humiliatingly disappeared. I suspect that other people may similarly have been turned off by a two-page informed consent form required for us to administer a 10-item true-false screening questionnaire!

What about cross-cultural issues in informed consent? What happens when we do research abroad, where people do not think of written contracts the same way that we do? As I understand it, business deals in China are made more on the basis of mutual trust and personal experience and obligation, than on the basis of a written contract. I wonder what Chinese research participants might think of a 10-page contract thrust upon them by a foreign stranger, written to fulfill legal requirements of American contract law, to permit attachment of EEG and EKG electrodes? How much of an insult might we be delivering? (Well, perhaps we can pass it off humorously as one of the many incomprehensible ways that we Westerners relate to each other.) According to current US regulations governing human research, foreign institutions involved in collaborative research must constitute Institutional Review Boards fashioned according to American standards, and require written informed consent for all procedures. I would love to be a fly on the wall during deliberations of one of these groups!

The particular issue that should concern us is the possibility that we may put a research participant at risk. This may occur in our research where participation would involve deprivation from effective medical treatment. However, most of us do research where such treatment is routinely provided to participants, or where it may not be available. In such cases the risks of biofeedback usually are quite minimal, certainly when compared with the risks of taking an untested drug or undergoing a surgical procedure. Most Institutional Review Boards, on the other hand, are constituted in order to protect people from more traditional biomedical research, where the risks may be quite real. Protecting people from our minimal-risk procedures requires a different perspective from protecting them from procedures that involve real risk!

I suggest that we seriously consider several suggestions coming from the Federation meeting.

Let's keep an eye on regulation of applied psychophysiology research in our own back yards. Is an applied psychophysiologist, or even a behavioral scientist, on the Institutional Review Board, who understands the procedures and risks (or lack thereof) of participating in our kind of research?

If anyone sees proposed state or federal regulations about human research that may affect us, let the AAPB office know about it. This concerns us vitally!

Let's keep a collection of our own personal “horror stories” of over-regulation of research in our field, as well as special stories illustrating how current regulations have protected research participants, or where new regulations may indeed be needed for this purpose. Send them to me, for now. I will keep a compendium.

Foreign members: let us know about your own experiences with human research, and how research participants are best protected in your countries. Do American-type regulations work for you, or are special other procedures used, or appear more desirable?

In Memory: Pioneer Researcher, Educator, Neal Miller

Neal Miller, a former president of AAPB, and a pioneer in the field of biofeedback, passed away March 23 at the age of 92. His pioneering research, extraordinary educational activities, and unflagging advocacy were of great benefit to society, and an inspiration to his colleagues and successors.

“Neal was an extraordinary scientist whose work has forever changed the way man considers the capability and potential of man. We in the field of biofeedback owe him a great debt of gratitude,” says AAPB member Rob Kall. Rob remembers a favorite quote from Miller this way, “Be modest in what you claim, bold in what you do.”

It may seem like common sense now that fear is a learned response, or that people can be taught to control autonomic functions such as blood pressure and heart rate, but it was radical and shocking when Dr. Miller began advancing these concepts in the late 1950’s. His peers were aghast and he even had trouble getting laboratory assistants to work on his experiments. However, many of those same peers now consider him at least the equal of his more famous contemporary, B.F. Skinner.

Unlike Skinner, who dealt with the psychological and social aspects of behavior, Miller and his colleagues experimented with the physiological aspects, training rats to control their heart rate and brain waves. Without today’s sophisticated measuring equipment, they were breaking new ground on a variety of frontiers, and radically advancing our understanding of human behavior.

Neal Miller was far more than a researcher, however. After attending the Universities of Washington, Stanford and Yale, he went to Vienna to study psychoanalysis with an emphasis on Freud. He taught for years at Yale and Rockefeller University, and was a past-president of the American Psychological Association.

He was also very interested in the practical aspects of his work and spreading the benefits to the maximum number of people. During his term as President of AAPB (then the Biofeedback Society of America), Dr. Miller promoted the idea of standardized clinical data collection, which could be pooled into a better understanding of efficacy, and used as leverage in reimbursement decisions.

Neal E. Miller, PhD, is survived by his wife, Jean Shepler of Hamden, Conn.; a son, Dr. York Miller of Denver; Colo., and a daughter, Sara Miller Mauch of Ypsilanti, Mich.
White House Panel Issues Recommendations on Complementary and Alternative Medicine

Michael P. Thompson
AAPB Director of Communications

The White House Commission on Complementary and Alternative Medicine Policy has issued final recommendations regarding Complementary and Alternative Medicine (CAM) in the United States. Created by President Clinton in March, 2000, the commission was charged with making recommendations in four areas: (a) the education and training of health care practitioners in complementary and alternative medicine; (b) coordinated research to increase knowledge about complementary and alternative medicine practices and products; (c) the provision to health care professionals of reliable and useful information about complementary and alternative medicine that can be made readily accessible and understandable to the general public; and (d) guidance for appropriate access to and delivery of complementary and alternative medicine.

In its final report, the Commission made 29 specific recommendations regarding CAM policy in the United States, including research, legislation, regulation, promotion, and reimbursement.

While the Commission was very careful to advocate research and the use of proven therapies, two of the members, in an unusual move, issued a dissenting statement, saying that the Commission’s recommendations “do not appropriately acknowledge the limitations of unproven and unvalidated ‘CAM’ interventions or adequately address the minimization of risk.”

The dissenting members, Tieraona Low Dog, MD, and Joseph J. Fins, MD, FACP, labeled some of the recommendations as “boost-erism” and said the panel tended to lump together proven and unproven therapies, which might strain funding sources and water down the effects of conventional medical care without improving health.

James S. Gordon, MD, chair of the Commission, on the other hand, cited teaching breathing techniques and biofeedback to children with problems concentrating as a good example of how CAM could more cost-effectively help Americans become more healthy.

According to Dr. Gordon, the panel’s recommendations create “a road map for discovering ways that CAM approaches might enhance our health care in the years ahead, a guide to help the President, Congress and the American people take necessary steps to create a more effective, comprehensive, responsive and humane health care system.”

Several of the recommendations could impact professional associations, such as AAPB, certification programs such as BCIA, and whether individual practitioners are licensed or regulated by state or federal government bodies. See more information at: http://www.whccamp.hhs.gov/finalreport.html and http://www.cmbm.org/press/releases/WHC%20Report.htm

Maria Eugenia Carmagnani Fattovich, PhD
(April 19, 1942-March 23, 2002)

The 2002 AAPB meeting was marked by the conspicuous absence of Eugenia and Angelo Carmagnani. With great sorrow, we learned that the absence was due to the premature loss of Eugenia’s life.

Maria Eugenia, linguist, clinical psychologist, and psycho-physiologist, died recently in Milan, Italy, as a result of a lung tumor. She and her husband, neurologist Angelo Carmagnani, had their own clinical institute in Milan. The Carmagnani were among the European private practitioners who pioneered the use of neuro-feedback and QEEG in their clinical work. They were members and regular attendees of the Annual AAPB meetings for several years.

With a sharp mind and enthusiastic outlook, Eugenia became a driving force behind the International Section of AAPB. Last year, she stepped down as its first president, having accomplished much to consolidate this important part of the organization. Those who had the opportunity to get to know Eugenia and Angelo, enjoyed the kindness and vitality that they radiated as a couple and the wealth of clinical knowledge they were ready to share as clinicians. Our deepest sympathy goes to Angelo at this time of grief. We will miss Maria Eugenia, and remember fondly the landmarks of her presence at AAPB and contribution to the creation of the International Section.

Susana A. Galle, PhD, ND, CCN.
Gabriel E. Sella, MD, MPH, MSc, PhD,
Vice-President, International Section, AAPB
AAPB Award Winners

Several awards were presented at the recent Annual Meeting by 2001-2002 President Don Moss. Following are the comments made by Dr. Moss as he honored the recipients.

“This year we honor Dr. Theodore LaVaque as the recipient of the Sheila Adler Service Award for AAPB. I want to recognize Dr. LaVaque for his major contributions to AAPB as Associate Editor of Biofeedback, where his day-in, day-out efforts have made a difference, and as Co-Chair of the Task Force on Methodology and Empirically Supported Treatments, which is a joint effort of AAPB and SNR to develop a working consensus in an important and rapidly developing area. It is my pleasure to recognize his contributions to biofeedback by presenting the Sheila Adler Service to Dr. Theodore LaVaque.

“Our second recognition goes to Frank Andrasik as the recipient of the AAPB Distinguished Scientist Award for his outstanding research on biofeedback in treatment of headache, and biofeedback parametrics, and for his service as Editor of Applied Psychophysiology and Biofeedback during a difficult period. His exceptional commitment of time and effort on behalf of the journal constitutes a major contribution to biofeedback research. AAPB is proud to confer the Distinguished Scientist Award to Dr. Frank Andrasik.

“I turn to my close friend and colleague, Eric Willmarth who chaired this year’s Annual Meeting Committee. You did a wonderful job. This plaque can only symbolize my enduring thanks.

“The Presidential Recognition Award is presented to an individual who provides outstanding service to AAPB and to applied psychophysiology as recognized by the President. This year, the award goes to my new friend Jay Gunkelman, Past President of SNR, for his contributions to the development of closer collaboration between AAPB and SNR, and for his actions in supporting the joint AAPB/SNR Task Force on Empirically Supported Treatments, and for his role in supporting the joint AAPB/SNR response to the Behavior Therapist article critical of neurofeedback. To use Jay’s own word, he has worked tirelessly this year to bring about an atmosphere of “coopetition” between SNR and AAPB, and I believe the field of biofeedback and neurofeedback owes him a debt of gratitude. Another example of Jay’s selfless generosity is his gift at this meeting of $1,000 to the neurofeedback division. Let me acknowledge the acceptance of this application form and check—Jay is now our newest member of AAPB.

“The Ken Russ Advocacy Award is presented to an individual or group who represented AAPB or biofeedback in an advocacy position. For their tireless efforts to secure inclusion of neurofeedback and biofeedback in the Texas Brain Injury Bill, please welcome, Lynda...
Kirk and Sarah Harper. “The Jack Johnson Service Award is presented to an individual or individuals who provide services to states or chapters. AAPB is proud to recognize Valerie Braschel and Kenneth Loftland for their role in organizing the joint AAPB/Illinois Chapter program. “The New Volunteer Recognition Award goes to an individual for dedication and service to an AAPB committee. AAPB recognized Elizabeth Bigham for her creative and energetic actions as Chair of the AAPB Membership Committee. “The Group Recognition Award is presented to groups working together on a project beneficial to the field. The recipients of this award are Theodore LaVaque, Cory Hammond, Jay Gunkelman and John Perry for their role in initiating and leading the Task Force on Methodology and Empirically Supported Treatments. “I want to turn now, not to the past of AAPB but the future. Each year, AAPB hosts a number of students who attend this meeting and are supported by the AAPB Foundation student scholarship awards. This year’s awards went to the following students: Logan Justin Banks, Elizabeth Bigham, Joseph Ciavarella, Jessica Del Pozo, Elizabeth Durso, Brian Reidenberg, Linda Kranitz, Adam Lipps, Brent Mruz, Blake Schneider, Stephanie Steinman, Curtis Strokes, Kerry Towler, and Alicia Townsend. “One of the sad events at the end of the year is to see the term of good people on the Board come to an end. This year Bob Whitehouse concludes his service at this meeting. Also, Doil Montgomery completes his term as Past President. Thank you for your service.”

New Mind-Body-Spirit Interest Group

If you found the content of the last Circle of the Soul AAPB convention important and personally motivating then you may want to participate in a proposed new Mind-Body-Spirit Psychophysiology special interest group. At the conference several participants had conversations with Paul Lehrer about creating a way to continue including these types of speakers and programs in the AAPB meetings. The idea of a special interest group (SIG) was proposed with the possibility of becoming a section if member interest is sufficient. This SIG would focus on applied psychophysiology as the interface with the emergent areas of consciousness studies, complementary and alternative medicine (CAM) and frontier medicine. This would increase the depth of AAPB participation expanding our network of creative thinkers, teachers, researchers and explorers in topical areas including meditation, distant healing, prayer, hypnosis and imagery, intuition and dreams, healing with music, qi gong and much more. If you are interested in this vision the first thing to do is to just send an email to get on a contact list. If there is sufficient interest we will organize a breakfast meeting for the next AAPB meeting in Jacksonville, Florida in March 2003. Send an email to: Adam Burke, PhD at <mailto:aburke@sfsu.edu>aburke@sfsu.edu or call 415-338-1774. We look forward to working with AAPB to contribute to this critically important and profoundly interesting area of investigation and human potential.
2 Channel Neurofeedback Monitor

- Compatible with all Windows PCs
- Dual monitors w/ Windows 98/2K/XP
- 8 adjustable frequency bands
- Input impedance: 10 Gohms
- User programmable & built-in protocols
- Raw and filtered waveforms
- Statistical summaries and graphs
- Many graphic display modes
- BrainMirror™ spectral display
- Apple, Mac G3 & G4 compatible

- Flexible, versatile & easy to use
- For clinical and home trainee use
- View & control client’s display screen from remote computer
- Coherence training & display
- 128 MIDI sounds
- Variety of audio feedback
- Percent time over thresholds
- Third party software
- Change thresholds on the fly

**BrainMaster AT-1.1.9A includes:** 2E Module; 1.9A Software; 1 Year Affiliate Membership; 15 Month Parts and Labor Warranty; Limited Technical Support; 1 Year List Server Membership; Training Video and Manuals; 5 Gold Plated Electrodes; Battery Charger; Designer Carrying Bag; EEG Conductive Paste; EEG Prepping Gel; and 30-Day Free Trial of Animation Pro Software!

**Ask about our preferred clinician courtesy program**

**Available Options:** Swingle Sounds; Vibrotactile Interactor Cushion; Light & Sound Interface; Animation Pro Software; FlexTrode™ Electrode Headband System (no more paste, no more goo)!

**Coming in 2002! HEG option; Take home disk; Auto threshold adjustment; and more...**

*BrainMaster Technologies, Inc.*
24490 Broadway Ave
Oakwood Village, OH 44146

**Phone:** 440-232-6000  **Internet:** www.brainmaster.com
**Fax:** 440-232-7171  **Email:** sales@brainmaster.com

*Invest wisely in your practice — insist on flexibility, ease of use, and affordability!*
Visit AAPB’s Online Bookstore!

- Specials and bestsellers
- Classics and new works in the field
- Full listings with regular updates
- Get tapes of Annual Meeting Sessions
- Check back regularly for updates and additions

Visit www.aapb.org and click on the AAPB Bookstore link.

---

Distance Education In Behavioral Medicine

Want distance education courses in biofeedback, A&P, and biological basis of behavior? Want to see a wider variety of patients and add physiological components to your assessments and treatments? It’s all available through the Behavioral Medicine Research and Training Foundation. Onsite, hands-on training available also! Our courses are accepted by BCIA for certification.

**Our distance education courses include:**
1. Biofeedback intervention and assessment 50 CE hours.
2. Biological basis of behavior 45 CE hours.
3. Anatomy & physiology for behavioral clinicians 45 hrs.
4. Behavioral treatment of headache 16 hours
   The 45 & 50 CE hour courses cost $550.
   The 16 CE hour courses cost $200.

**Learn in your own home at your own pace:** Our lecture courses are in an audiovisual format provided on CD along with lots of readings. You will receive individualized attention from your instructor via audio e-mail or phone.

**Hands-on training:** Learn how to use biofeedback and psychophysiological recording devices effectively and properly at our site in Bainbridge Washington.

**For more information:** contact us at rshepherd@nwinternet.com or (360) 598-3853.

---

Equipment for Sale

**MINDSET 16 CHANNEL EEG INSTRUMENT**

This a 16 channel EEG instrument including a SCSI pc card and cable to allow for connection to a laptop. Included are older and newer versions of software.

Please note that instrument inputs older male tip electrodes but can use the newer female tip electrodes with male to female adapters. Of course you can use electro-caps or equivalents.

**Price - $1500**

**Contact:** Ruben Rosenblatt, PhD
732-290-0311
rubenrosenblatt@yahoo.com
**Offering**

Quality EEG Feedback at an Affordable Price

---

### 2 Channel Neurofeedback Monitor

- Flexible; versatile & easy to use.
- Compatible with all Windows PCs
- Dual Monitors w/ Windows 98, 2K, XP
- 8 Adjustable Frequency Bands
- Input Impedance: 10 Gohms
- User Programmable & Built In Protocols
- Raw and filtered waveforms
- Statistical summaries and graphs
- Many Graphic display Modes
- Brain Mirror™ Spectral Display
- Apple, MAC G3 & G4 compatible
- For clinical and home trainee use.
- View & Control client’s display
- Screen from remote computer!
- Coherence Training & Display
- 128 MIDI Sounds
- Variety of Audio Feedback
- Percent time over thresholds
- Third Party Software
- Change thresholds on the fly
- View & control clients display
- Screen from remote computer!

**BrainMaster AT-1.1.9A includes:**
- 2E module
- 1.9A software
- One year Affiliate Membership
- 15 Month parts and labor Warranty
- Limited Tech Support
- One year List Server Membership
- Training video and manuals
- 5 gold plated electrodes
- Battery Charger
- Designer carrying bag
- EEG conductive paste
- EEG Prepping Gel
- 30 day free trial of Animation Pro software Package

**Ask about our preferred clinician courtesy program**

**Optionally Available:**
- Swingle Sounds
- Vibrotactile Cushion
- Light & Sound Interface
- Animation Pro Software
- FlexTrode Electrode Headband System (no more paste, no more goo!)

**Coming in 2002!** HEG option; Take home disk, Auto threshold adjustment and more.....

**BrainMaster Technologies Inc.**
24490 Broadway Ave., Oakwood Village, Ohio 44146
Internet: www.brainmaster.com
Telephone: 440-232-6000
Email: sales@brainmaster.com
Fax Number: 440-232-7171

*Invest wisely in your practice – Insist on flexibility, ease of use, and affordability!*
The Neuropathways EEG Imaging® neurofeedback system provides the following features:

- The only patented Real Time Digital Feedback Display in One Thousandth of A Second
- Minimum of 250,000 Samples A Second in Real Time Not Secondary FFT Averaged Data
- Displays Primary Original EEG Waveforms
- Filters Out Any Specific Frequency for More Effective Feedback
- Visual Graphic Display and Auditory Reinforcement
- Recorded Minute by Minute Statistical Analysis in Real Time
- The Only Instrumentation Where All Artifact is Clamped or Removed From Data in Real Time
- Windows 98, Second Edition

Neuropathways EEG Imaging® features a desktop computer or a new lightweight notebook computer design. This seven pound system can go anywhere. No need to plug it in, just use the built in battery. It is ideal for use in a hospital or rehabilitation setting. It is an essential addition for the mobile professional.

Neuropathways EEG Imaging® provides individualized EEG neurofeedback education for professionals and graduate students. The individualized education focuses on neurophysiology, electrode placement for EEG neurofeedback and the recognition of EEG patterns and their subtleties. Margaret Ayers, president of Neuropathways EEG Imaging® was first to publish in EEG Neurofeedback for head trauma, stroke, coma, and absence seizures. For more information please visit the website at www.neuropathways.com or write to 427 North Canon Drive, Suite 209, Beverly Hills, California, 90210 or fax (310) 275-7894.
Who says size matters?

Introducing the mini C-2 general purpose monitor

A powerful, pocket sized version of the popular full size C2, with fast USB interface and five channels. Starting at just $1995, the C-2 is an affordable, multiple modality biofeedback system.

Includes: Mini C-2 GP, Windows software, leads*, USB cable, li battery, and manual
* contact us for lead configuration options.

All in one biofeedback system

**ProComp+/BioGraph 2.1**

Windows based multimedia biofeedback system. Simple to use and configure for any type of application.

Includes: ProComp unit, BioGraph software
Add sensors: EMG-$350, Temp-$185, EEG, Skin, Heart Rate/BVP, Respiration sensors-$250 each

BMI Price: **$3500.00**

**BrainMaster 2E**

A low cost, 2 channel brainwave monitor. Useful in the clinic, for research, education and more.

Includes: BrainMaster 2E unit, 8 sensors, software, 10/20 EEG paste, skin prep gel, and manual

BMI Price: **$975.00**

Ask about our free training!
In the evolving field of healthcare, biofeedback, as a treatment and evaluation tool, is playing an increasingly more important role. Biofeedback is used by a diversity of health professionals to treat an ever-lengthening list of conditions. Health professionals such as psychiatrists, psychologists, nurses, physiatrists, physical and occupational therapists and physicians in various specialties have come to use biofeedback, either independently or as an adjunctive technique, with positive results.

BFE Reports... is an on-going series of interviews with leading clinicians and newsworthy articles in the field of biofeedback lending the insights and techniques they have acquired through their many years of practice.

BFE Reports... interviewed
Dr. Joel Lubar

Dr. Joel Lubar received his Ph.D. at the University of Chicago in a multidisciplinary program known as Biopsychology, which is a combination of psychology, physiology and medicine. His original work was in the area of the neural basis of emotional behavior and it involved a number of animal studies. Dr. Lubar was an assistant professor at the University of Rochester for four years and continued his work there, before going to the University of Tennessee. Dr. Lubar was a Faculty Science Fellow with the National Science Foundation for a year at UCLA medical school and also was a visiting professor at the School of Medicine of the University of Bergen in Norway. Those were post-doctoral experiences.

The Biofeedback Foundation of Europe was founded to promote a greater awareness of biofeedback among European health professionals, and, through training workshops, educate clinicians in the use of biofeedback techniques and technology. For more information on BFE workshops worldwide see our website.

BFE Reports... Neurofeedback

by Joel Lubar

“IT is very clear now that ADD is not only a neurologically based disorder, but also a very significant brain disorder.”

Dr. Joel Lubar

Could you describe your current work?

My current work is primarily the development of databases and training protocols for treating individuals with attention deficit hyperactivity disorders (ADHD) and associated co-morbidities. These include learning disabilities, oppositional and anxiety disorders and other problems that are commonly associated with ADD. I also spent a number of years in my career doing research and treatment of patients with seizure disorders and epilepsy.

When did you first become acquainted with EEG biofeedback?

Back in the 1960’s, at the very beginning, I was involved with some of the early work that was done with alpha conditioning, for relaxation, and with theta conditioning, which was then associated with visualization. I then did a study that replicated some of Sterman’s very early work with seizure disorders. We completed this research and published our first paper on neurofeedback with epileptics in 1975, about a year and a half after he published his study.

While I was working with epileptic patients, I noticed that, while they were training, they became much more attentive, alert and focused. This observation is what led me to try a similar paradigm for hyperkinetic children (Hyperkinesis, as a diagnostic, was really the forerunner of ADD). We did a double-blind crossover study, which we published in several different places in the late 1970’s. The study showed that this paradigm was not only very effective, but also produced changes that could be measured by independent observers in the children’s classroom. I guess it became a kind of model control study at that time, even though it was a small study. After that, because the study worked out so well, I continued working with these kinds of problems and I wrote a book with a pediatric neurologist, Dr. William Deering of the Gunderson Clinic, in 1981. The book was titled “Behavioral Approaches to Neurology”; it was published by Academic Press and it contained our early work on epilepsy, learning disabilities and hyperkinesis. Since that time, we’ve published more than 25 papers in the area of ADD and seizure disorders and we’ve probably published more on neurofeedback than anyone else has in the ADD area.

Could you explain to us how EEG biofeedback works?

The goal is to train the individual to normalize the abnormal EEG frequencies and, at the same time, to develop as much awareness as possible of what that normalized EEG state is like, i.e. how it feels.
In the case of attention deficit, the first thing we do is a database analysis. In other words, we look at the quantitative EEG (QEEG) of that individual and we compare it with a normative database to see what areas and what frequencies are outside of the normal range. Then we set up a training procedure or protocol based on those abnormalities.

Can you explain to us what ADD/ADHD is and how it manifests itself?

We have been doing a lot of database work. For example, we published, last year, in the Neuropsychology journal, a multi-center study with over 480 cases. We were monitoring the EEG signal at this one location, CZ, that’s right on the top of the head and taking one measure, the ratio of theta to beta, under different task conditions: baseline, reading, listening and drawing. We found that we could accurately separate ADD and ADHD patients from control individuals with better than 90% accuracy. We just had a second paper accepted in the same journal, a replication of that first study with another almost 400 cases, very carefully screened, so there was absolutely no question that the ADD subjects were ADD and the control subjects were not. We did the screening based on multiple criteria: Continuous performance measures, history, rating scales and psychometric measures. Again, we were able to tell the difference, with close to 90% accuracy, between the two groups.

What we are working on now is a series of studies that are going to involve both single and multiple locations to see if we can develop databases for ADD, obsessive compulsive disorder and oppositional-defiant disorders. We want to see if we can really pin down the EEG differences between them. I have already done one database study with 125 cases, using a 19-channel device, in which we could differentiate ADD from controls using a simple eyes closed task. In a previous study that was published in the Journal of Learning Disabilities in 1984, we were able to separate children with reading disabilities from controls with a very high accuracy level, looking at six different locations during eight different tasks.

It is very clear now that ADD is not only a neurologically based disorder, but also a very significant brain disorder. We know, with certainty, that it is not caused by bad parenting or a lack of opportunities. It is, first of all, strongly genetic in nature, definitely brain-based and very definitely neurological. ADD involves abnormalities in the structure of the brain that have been clearly identified in MRI (magnetic resonance imaging) studies. It also involves abnormalities in cerebral metabolism and in the electrical activity of the brain, as measured by EEG and evoked potentials. Some people, who are experts in the field, like Russell Barkley and others, have gone so far as to say it is an outright example of a damaged brain. They have actually come around 180 degrees from what they believed ten years ago, when they said it was a behavioral disorder and a motivational disorder, to say now that it is a structural, neurological and biochemical disorder. These findings make ADD eminently appropriate for neurofeedback intervention.

What other conditions can EEG biofeedback be helpful for?

Besides ADD and ADHD, extensive published data indicates that it can be very helpful for dealing with depression, anxiety, substance abuse, recovery from mild to moderate post-head injury and, in some cases, in rehabilitation after strokes or other kinds of cerebral injury of that type.

Would you say that EEG biofeedback is sufficient as a single therapeutic approach to treat ADD and ADHD?

Well, that's a very important point. We don't look at neurofeedback (another name for EEG biofeedback), as powerful as it is, as a totally stand-alone procedure. In our clinic, we've always looked at it as part of a multi-component treatment process, which may involve behavioral work, parenting information, working with the family and, when appropriate, medication. We do, though, build the entire procedure around the neurofeedback therapy. In a way, EEG biofeedback is like the centerpiece around which we build everything else. I am convinced that our success rate is so high, better than 90%, because we do our clinical work this way. I really think that if a clinician just uses neurofeedback mechanically, without any of these other supportive techniques, then the success rate is going to be considerably lower, especially if there is significant hyperactivity involved.

Are there benefits to using EEG biofeedback as compared to using other therapeutic approaches like medication?

Several. The main one being that medication, even when it works well, is essentially state dependent. When you take somebody off of medication, they tend to revert to their original state and behavior. We've done studies that have shown that, even after ten years, the neurofeedback changes endure and the behavior that patients have learned endure just as much and can even improve. EEG biofeedback has a definite permanence that we have not seen with any other therapy. It is much more effective than behavior modification approaches, for instance, because those techniques, in a
sense, make the parents "prison-
ers" of the child. Because parents
have to be there to administer
complex ritualistic schedules of
reinforcement, rewards and time
outs, some parents might end up
resenting the whole procedure and,
by extension, resenting the child
for doing that to them.
Neurofeedback frees them up con-
siderably because it puts the bur-
den of the learning on the children.
They are doing this for themselves!
And once they internalize what it is
like to change the EEG patterns, the
transfer to the real world is much
better than with such mechanical
procedures as token economies
and other approaches of that kind.

Are there any risks involved in
using EEG biofeedback? Are
there known secondary
effects?

One of the questions that I've been
asked many times about EEG
biofeedback is "If it is so powerful,
why doesn't it seem to have signifi-
cant negative side effects?" My
answer is simply: "Because it is a
learning experience!"
Neurofeedback is not
induced like drugs or
light-and-sound stimula-
tion; people are
learning to change
themselves so they
can learn to internalize
control. So the
process is gradually
acquired from within,
not imposed from out-
side.

This doesn't, however,
mean that a clinician
can never go wrong
using neurofeedback.
If one trains the wrong com-
bination of frequencies in the wrong
locations, particularly if one has
done a careful analysis, initial-
ly, then it is possible that some
negative side effects can occur.

There are two kinds of side effects:
The first is that the person may not
be helped at all and has invested a
lot of time and expense with no
result. In some cases, they may
actually experience such physiolo-
gical consequences as anxiety or
increased depression. These kinds
of effects, though, are fairly mild.
In our clinical experience, we have
never seen a case of significantly
severe negative effects of neuro-
feedback training, at least for ADD.
With epileptic conditions, of

Could you describe, for us,
your biofeedback protocol?

We have two protocols. If the sub-
ject is hyperactive, we train to
increase the EEG rhythm called the
sensorimotor rhythm (SMR) on a
location over the motor strip. At the
same time, we train to inhibit
(decrease) slow activity, anywhere
in the range from 3 to 9 or 10 Hz,
(that depends on the subject's age)
over the same area. What we
decide to do is based on the quan-
titative EEG (QEEG) analysis that
we perform before the treatment.

That's the approach we use, primarily, for the
hyperactive component. Then, we work with the
focusing of attention. For
that, we train to increase
higher frequency beta
activity in the range
between 15 and 20 Hz,
approximately. At the
same time, of course, we
continue to train to
decrease to slow activity
as before. If the subject is
of the inattentive type, in
other words, if they don't have
hyperactivity, then we use the para-
digm of increasing beta activity
and decreasing theta or slow alpha
activity without the SMR training
as the first step. With these types
of subjects, we use a location over
the midline of the cortex, locations
anywhere from FZ to PZ, depend-
ing on age.

And that's the entire protocol?

Well, then there are some individu-
als that have unusual patterns,
such as increased frontal beta
activity or increased temporal
theta. Some subjects are deficient
in producing alpha, particularly
high alpha, between 10 and 12 Hz.
Depending on the pattern, we work
heavily on building back what's
missing and on suppressing the
excessive abnormal activity. The
whole idea is to bring them back
to normal levels, based on the data-
base analysis.

What type of biofeedback
equipment do you use?

I started with the Autogenic sys-
tem, but now use the ProComp+TM/
BioGraph from Thought Technology
Ltd. The more I work with it the
more I appreciate the beauty of the
system. It is incredibly versatile
and it includes peripheral meas-
ures. It has a great variety of cus-
tomizable options and is well worth
the effort to learn and master.

Do you also use peripheral
measurements in your work?

We have, at various times, looked
at the electrodermal response
(EDR) because some individuals
with certain types of ADD, particu-
larly the hyperactive type, show a
pattern of low arousal. This is when
the EDR is too low and they are not
responsive to stimulation. If you
do a stress test on these subjects,
they show very little responsibility;
so we try to teach them to increase
their reactivity using EDR. On the
opposite side of the scale, there are
individuals that are sometimes
very aggressive, explosive and
impulsive. We will often find their
EDR to be too reactive and we try
to quiet it down. At other times,
we have combined neurofeedback
training with a form of autogenic
relaxation training. This involves
repeating a series of phrases hav-
ing to do with heaviness and
warmth in the limbs. Sometimes,
we combine relaxation with temperature training or EMG training. The fact is that in some of the early studies that we did, when we tried to use EMG alone or EMG and temperature alone, we could only produce temporary improvements. We had to use the EEG biofeedback in order to get the long-term effect! So we basically look at other modalities as supportive rather than primary in treating ADD.

As a clinician, what obstacles do you see to this treatment's greater acceptance?

Right now, there are two kinds of scientific studies: One type, is what we call "observational" or "clinical outcome" study. The other is the randomly assigned group outcome study, which is really favored by the scientific community. So far, there are approximately 75 studies on ADD, published in Peer Review Journals, which fall into the first category. There are relatively few studies of the second category, and that's where most of the criticism comes from. This kind of study involves a fairly large sample of individuals that are assigned to different treatment groups.

That type of detailed multi-center, large-scale study has not been done yet. If one was ever done and actually demonstrated that EEG biofeedback works best or better than other approaches, then there would be no argument against EEG biofeedback becoming mainstream treatment. Some small-scale studies, along those lines, have already been done and seem to indicate that neurofeedback is the best modality. But they were done with quite small groups, 10-15 subjects, and were not entirely convincing to the critics.

The other trend that will help neurofeedback become mainstream is that there are more and more people interested in introducing EEG biofeedback systems in the school setting. This makes a lot of sense because many people have observed the possible benefits of the treatment and are actively searching for an adjunct treatment or an alternative to drugs. I think that this will make the treatment more accessible to a lot of individuals who couldn't afford it on a pay-per-service basis.

Are there other issues that you think should be addressed to help EEG biofeedback on its way to better recognition?

The other thing of crucial importance is that there are over 1500 practitioners, in this country, who are using neurofeedback and that ADD is what they treat the most. In our own work, we have trained a large number of these individuals, over the years, to teach them how to do neurofeedback. Although it is fairly easy to announce oneself as a neurofeedback practitioner, the fact is that there are certification programs given by organizations such as the BCIA (Biofeedback Certification Institute of America). I am of the firm conviction that, at least for patient protection, we, at our clinic, emphasize that clinicians who do neurofeedback should either be licensed or certified health professionals or should work under the supervision of a certified health professional. If at all possible, they should try to get certified themselves. There is a quality control issue that is very important, just a few practitioners doing the wrong thing can destroy neurofeedback's reputation in a very short time!

Peer Reviewed Studies on Quantitative EEG Evaluation & Neurofeedback Treatment of Attention Deficit/Hyperactivity Disorders

Compiled by Joel F. Lubin, Ph.D.


cardiopro 2.0™
HEART RATE VARIABILITY BIOFEEDBACK SYSTEM
CARDIOPRO IS A SPECIALIZED PHYSIOLOGICAL monitoring and biofeedback application for the cardiovascular and respiratory systems. It can perform real-time feedback on respiratory sinus arrhythmia (RSA) and heart rate variability (HRV) from an electrocardiograph (EKG) or blood volume pulse (BVP) sensor. The system can also monitor other key physiological functions, such as respiration, temperature and skin conductance, for the most complete view on your client's physiology. With a simple graphic user interface and comprehensive reporting features, CardioPro lets you easily flow through the steps of recording, reviewing, and analyzing data. CardioPro is powerful enough for research applications, yet remains flexible for clinical work.
1 or 5 minute window for 2D and 3D spectrum display:
An option to select a one-minute sliding time window provides CardioPro with much faster and more significant reactions to physiological changes. Heart rate variability (HRV) feedback with the 2D or 3D spectrum graphs is now much more responsive.

Raw and IBI data export function:
With CardioPro 2.0, researchers can export all the data generated within the system with just a few clicks of the mouse. Whether you want to get access to the raw sensor data or the table of interbeat intervals (IBI), CardioPro can easily convert its data format to standard comma-separated text files.

Option to record and monitor skin conductance:
A new sensor type was added to the list of physiological modalities that can be monitored with CardioPro. Users can now record skin conductance (SC), along with temperature, blood volume pulse (BVP), respiration and electrocardiography (ECG).

Windows to the heart

Bar graphs for real-time feedback on the power of the low and high frequency (LF and HF) components of HRV:
Where the 2D and 3D FFT spectrum graphs show the overall power for each frequency component, CardioPro 2.0 offers a quick way to get a reading on the difference in power between LF and HF. Two bar graphs were added to the RSA display to show these values in normalized units.

Ability to use CardioPro with a blood volume pulse (BVP) sensor:
CardioPro is now able to compute HRV from an easy-to-use BVP sensor, which is strapped around the person’s fingertip. This makes client preparation a snap!
• Uses industry standard measurements and statistical calculations for normalized data, based on a 5-minute time window.

• Integrated artifact editor to easily add, split, and average inter-beat interval data. Color-coded data segmentation helps you review your editing at a glance. This powerful editor makes normalizing and compiling data for clinical evaluation or research quick and easy.

The IBI editor makes artifact correction a breeze. Color-coded data segmentation helps you review your editing at a glance.

• Client session database and data exporting functions for client file management and research applications. If you prefer to analyze your data in 3rd party applications such as Statistica or SPSS®, CardioPro’s simple export functions allow you to get access to raw signal data and IBI tables.

• Records high-quality EKG and BVP signals. CardioPro 2.0 is able to record both EKG and BVP signals at 256 samples per second. You can compute IBI tables, edit your data and generate HRV statistics from a signal recorded with an EKG or BVP sensor.
• Real-time computations for thoracic/abdominal ratio, breath-to-breath heart-rate changes (HR Max - HR Min), HRV from the standard deviation of the R to R interval (SDRR), phase calculation between respiration and heart rate (HR) waves and many more.

• Real-time spectral analysis of HRV with full color 2D & 3D frequency graphs and power bar graphs for HF and LF components of HRV, in normalized units.

Important points to keep in mind:

• CardioPro uses the reliable and world-renowned ProComp+ hardware, which is used with a number of biofeedback applications. This allows you to consolidate your physiological monitoring equipment between and within departments, reducing expenditure and expensive training.

• Developed in consultation with some of the leading experts in the field of heart rate variability and RSA. The most clinically responsive HRV/RSA software on the market, CardioPro 2.0 incorporates changes recommended by a wide range of first generation users.

• 32-bit Windows™ application, intuitive, easy to use and runs on most Windows™ platforms.

The 3D Waterfall frequency spectrum display shows shifts in peak frequencies of HRV in beautiful colors, whether recording or reviewing.

• Ability to simultaneously monitor multiple modalities, including 1 EKG, 1 BVP, 2 respiration, 1 temperature and 1 SC sensor. Give yourself and your client the full physiological picture.

• Includes a fully user-customizable respiration pace, with “in” time, “out” time and “hold” periods, for effective breathing training.

• Offers four modes of audio feedback for behavioral training: Train for abdominal breathing, breath-to-breath heart-rate changes, heart-rate and SDRR.

• Ability to perform HRV feedback from an EKG or a BVP sensor. CardioPro gives the user the choice between the ease of use of BVP and the precision of the EKG signal.

• One-click report printouts show HRV statistics and Tachogram views in an easy-to-read table format.

1. The published standards on HRV analysis specify that HRV frequency-domain computations should be performed on 3-minute epochs of RR data. This standard should be respected for case documentation and research purposes. The 3-minute time window should only be used for feedback purposes.

2. FFT = Fast Fourier Transform - frequency spectrum of the inter-beat intervals (IBI) in the 0.0033 - 0.1 Hz bandwidth for the 3-minute time window.

3. The power of a frequency band in normalized units expresses power of LF and HF as Power of the Band/(Total Power) x 100.

4. HRV research indicates that RR computations performed from the BVP signal are less precise than those done from the EKG signal. Because of this, although using BVP is adequate for feedback purposes, sessions recorded for generating HRV data for reports or research should be performed using the EKG sensor. HRV computed from BVP is a technically called Pulse Rate Variability (PRV).


6. SPSS is a trademark of SPSS Inc., Chicago, IL. STATISTICA is a trademark of StatSoft, Inc., Tulsa, OK.
Fast 2D and 3D Spectrum displays: An option for a 1-minute sliding time window provides fast software reactions to physiological change.

Ability to perform feedback with BVP or EKG: You can opt for the ease of use of a BVP sensor or the precision of an EKG sensor for your HRV feedback sessions.

New frequency-domain calculations: Two new bar graph displays show the real-time power of the HF and LF components of HRV in normalized units.

Skin conductance measure: With the ability to record from a skin conductance sensor, CardioPro 2.0 is a true multimodal physiological monitoring system.

Raw data export function: Now, you can easily convert CardioPro’s sensor data files to comma-separated text files for exporting to third party statistical analysis software.

Improved IBI Editor: You can now select any number of consecutive IBI values to perform the add function.

RSA amplitude measure: The peak-to-trough difference in heart rate, from breath to breath can now be displayed as a percentage of the mean heart rate.

RSA phase angle measure: The RSA phase is a measure of the lag or anticipation that occurs between the respiration and HR waveforms during RSA training.

Peak frequency display: A new real-time display of the FFT peak frequency has been added to the RSA display for easy tracking of HRV changes.

BVP amplitude: A measure of the relative deviation of the BVP signal at each beat has been added.

Screen Freeze: This new function allows clinicians to freeze the display screen during a session without interrupting the recording. The Freeze function preserves the time continuity that is required by HRV computations.

What leaders in the field say about CardioPro 2.0:

Rob Nolan, Ph.D.: “HRV is arguably the most important index of cardiovascular health which is influenced by cognitive-emotional functioning. CardioPro will be of interest to both the scientist and practitioner, as a user-friendly device to assess HRV.”

Richard Gevirtz, Ph.D.: “CardioPro enables the clinician to monitor aspects of the Autonomic Nervous System that have been overlooked for years in traditional biofeedback.”

Paul Lehrer, Ph.D.: “CardioPro is a very competently designed system that is useful for clinical biofeedback, teaching, and research. It gives a clean and useful display of heart rate and heart rate variability, allows respiration “prompts” for varying the inhalation/exhalation ratio and pre/post-exhalation pauses, and has an editing routine for managing artifact and arrhythmic heart beats. It meets all accepted standards for acquisition and analysis of heart rate variability data. It is friendly and has a good manual. It has an unbeatable replay capability. I use it frequently, and highly recommend it.”

Call for information on workshops 1-800-361-3651
NEW

FREE THREE E-LEARNING COURSES
- INTRODUCTION TO BIOFEEDBACK - INTRODUCTION TO NEUROFEEDBACK - INTRODUCTION TO MINDFITNESS TRAINING

THE BIOFEEDBACK BOOT CAMP
ON LINE TRAINING, EXCELLENT BCIA EXAM PREP

MINDFITNESS TRAINING: NEUROFEEDBACK AND THE PROCESS
BY ADAM CRANE AND RICHARD SOLTAH PH.D
Available through amazon.com and American Biotech Corporation

THE BOOK
AN AMAZING SITE www.mindfitness.com

KEEP UP! Ask for our FREE EMAIL NEWSLETTER
* Call for Details
CALL TOLL FREE (800) 424-6832 Tel:(914) 762-4646

HEALTH TRAINING SEMINARS
A division of American Biotech Corp.

The Highest Quality, Most Time and Cost Effective Training Available.

The 2002 BCIA Certification Training Series
This Didactic Education Program is Accredited by the Biofeedback Certification Institute of America.

THE 2002 BCIA EEG Certification Training Series
Accredited by the National Registry of Neurofeedback Providers. For practitioners and researchers working in the fields of addictive behaviors, ADD/ADHD, PTSD, Pain, Traumatic Brain Injury, Depression, Performance Enhancement, and others.

4-Day Comprehensive Professional Courses
Aug 16-19 Woodland Hills, CA Nov 13-18 Woodland Hills CA
Sept 6-9 Edmonton, AB Canada Dec 6-9 Woodland Hills, CA
Oct 4-7 Woodland Hills, CA

EEG Spectrum Institute is the internationally recognized leader in the field of Neurofeedback education and research.

We have educated more than 2000 health professionals since 1989. We are active in 28 countries.

Call us for more information on our professional education and affiliate network.

Professional Education for incorporating EEG Neurofeedback in your Clinical Practice

Save.
www.aapb-ins.com

ENHANCED PROFESSIONAL LIABILITY COVERAGE
- Premium Discounts
- Online Customer Service
- Group or Individual Coverage
- High Coverage Limits
- Peace of Mind

Apply online today for a free, no-obligation quote.

NPG's Risk Management Resource Center for Members of AAPB
www.aapb-ins.com 1.888.830.2272

Endorsed By: Coverage By: Administered By:
The Best Offer in Biofeedback
From the Best Name in Biofeedback

For years, the Stens Corporation has been the premier provider of biofeedback systems and training seminars. Now we're adding to that, by offering an incredibly attractive deal — just purchase the ProComp+/MultiTrace or Bio Integrator System from us and we'll add a free three-day application workshop of your choice — RSA, Chronic Pain & Headaches, Advanced EEG Training for ADHD, depression/anxiety, Alpha-Theta for addictions.

The ProComp+/MultiTrace or Bio Integrator System provides true multi-modality training with exciting graphics and sounds, including animation, mandalas, nature scenes, and games. The environment creates better feedback, which leads to more successful outcomes.

Looking for the best offer in biofeedback? Start with the best name. Stens.

Professional Biofeedback 5-Day Certificate Program

Chicago, IL
San Francisco, CA
NY/NU
San Francisco
St. Paul MN
Los Angeles, CA
Apr. 20-24, 2002
May 18-22, 2002
June 22-26, 2002
July 20-24, 2002
Aug. 17-21, 2002
Sept. 21-25, 2002

Professional 5-Day EEG Certificate Program

NY/NU
St. Paul, MN
June 27–July 1, 2002
Aug. 22 - 26, 2002

Free* 3 Day Workshops

EMG for Chronic Pain & Headaches
Heart Rate Variability/RSA
Advanced EEG for:
ADHD/ADD/Alpha-Theta
for addictions/depression/anxiety
Biofeedback in Pediatrics
(April, July)
(May)
(November)

CEU's, for APA, CNA, BBS

Stens Corp. is approved by the APA to offer CE's for psychologists and maintains responsibility for the program.
Third Annual LORETA and QEEG Conference:
Newest Technology for enhanced analysis
November 15-17, 2002 • Key West, Florida

Workshop 1: “Third Annual LORETA Conference”
Friday, November 15: Introduction to the new Standardized LORETA and the new enhanced EUREKA3 software and expanded normative database.
Presenters: Joel Lubar, Marco Congedo, Leslie Sherlin

Saturday, November 16: Demonstration of software use in detailed step by step and hands on sequence.
Presenters: Joel Lubar, Marco Congedo, Leslie Sherlin

Workshop 2: “QEEG and LORETA based neurofeedback protocol design”
Sunday, November 17:
Presenters: Joel Lubar and Bob Gurnee
*Bring your laptops and EEG Recordings

Sponsored by: Nova Tech EEG, Inc., AZ Biofeedback Society, and ADD Clinic/Scottsdale Neurofeedback Institute

Certificates of completion available; a total of 26 hours of BCIA-certified CEU possible
Workshop 1 $375 until Sept 25, 2002. $425 thereafter. Refunds less $50.00 until Sept 25, 2002
Workshop 2 $195 until Sept 25, 2002. $225 thereafter. All three days $525, or $575 after Sept 25, 2002.
For more information or to reserve your place call or fax the ADD Clinic/Scottsdale Neurofeedback Institute at:
Ph:(480) 424-7200 Fax:(480) 424-7800
For information about Nova Tech EEG or the EUREKA3 software email inquiries to NovaTechEEG@yahoo.com

Robert L. Gurnee, MSW, BCIA:EEG, QEEGT,
Director

Scottsdale Neurofeedback Institute (SNI)/ADD CLINIC
6900 E. Camelback Road Suite 260, Scottsdale, AZ 85251
(480) 424-7200 Fax (480) 424-7800
email: Bob@ADD-Clinic.com

SNI QEEG Mapping Service

• 48 HOUR TURNAROUND

• QEEG based clinical interventions and neurofeedback recommendations by Bob Gurnee accessing his research on:
  * Depression
  * Dyslexia
  * Obsessive Compulsive Disorder
  * Attention Deficit Hyperactivity Disorder
  * Asperger’s
  * Math Learning Disability
  * Anxiety
  * Auditory Processing Deficits

• Maps starting at $75.00

• Access to Q-Metrix medical EEG services

• Maps are printed or downloaded from the web

• Wide range of choices:
  * NxLink – E. Roy John Normative Database and Discriminants
  * Neuroguide (Thatcher) Eyes Open and Eyes Closed Databases
  * Nova Tech EEG LORETA/QEEG Analysis System and Normative Database
  * Neurep Eyes Open and Eyes Closed Database and QEEG Analysis System
  * Thatcher Discriminant Analysis: TBI & ADD

• Supervision and training

• Send EEG data electronically or Mail CD’s

Robert L. Gurnee, MSW, BCIA:EEG, QEEGT,
Director

Scottsdale Neurofeedback Institute (SNI)/ADD CLINIC
6900 E. Camelback Road Suite 260, Scottsdale, AZ 85251
(480) 424-7200 Fax (480) 424-7800
email: Bob@ADD-Clinic.com
Biofeedback and Behavioral Health Practitioners Guild

Affiliated with
Office and Professional Employees International Union
Local 153, AFL-CIO
265 West 14th Street, New York, NY 10011

It's what we are working toward:

Legislation
Insurance Reimbursement
Benefits

Finally! A Professional Guild
Join: As a State Society or as an Individual
Contact us for details:

Ajfeedback@aol.com
Bionet53@yahoo.com
Ccarroll1@optonline.net

1-888-999-5114