“The Greatest Thing, Then, Is to Make the Nervous System Our Ally Instead of Our Enemy.”

— William James

“Miracles Do Not Happen in Contradiction to Nature, but Only in Contradiction to That Which Is Known to Us About Nature.”

— Saint Augustine

Launching New Paradigms of Psychophysiological Self-Regulation
The cover of the Summer Issue shows a graphic developed by Lynda Kirk, AAPB's new president, conveying the inspirational message of her inaugural remarks as president, at AAPB’s Jacksonville conference in March 2003.

This issue of *Biofeedback* has a number of special treats for readers. Randy Neblett is the editor for surface EMG topics, and has recruited two SEMG articles for this summer issue: an article discussing a new approach for removing cardiac artifact from SEMG recordings, and an introduction to the newly emergent field of aquatic biofeedback—using surface EMG with patients in the water!

Katherine Gibney and Erik Peper provide a thought provoking article on the “Medicine of Fun,” suggesting that biofeedback therapy does not have to be all serious work, and that playfulness has a critical role to play in therapy and healing. Jeff Leonards begins a new series of articles on Sports Psychophysiology, with a review of current approaches applying biofeedback and psychophysiology to sports. David Siever also begins a new series, with an introduction to the exciting use of audio-visual stimulation to entrain the brain therapeutically. AVS has been shown to be useful in a number of applications, ranging from: 1) more effective induction of hypnosis, to 2) assisting relaxation and sedation, to 3) improving attention in individuals with ADHD. This first article provides a history of the development of audio-visual stimulation and an overview of the relevant basic science.

Seb Striefel provides an article outlining some of the effects of the new federal privacy legislation (HIPAA) on clinical practice. Both patient confidentiality and record keeping are significantly affected by HIPAA. Eric Willmarth reviews a new book edited and written by a number of AAPB members, *The Handbook of Mind-Body Medicine for Primary Care*. Polina Cheng reports on the current uses of biofeedback in Hong Kong.

Finally, the News and Events section includes columns from AAPB’s new President, Lynda Kirk, the new President-Elect Steve Baskin, and AAPB’s Executive Director, Francine Butler. News and Events also provides a photo collage from AAPB’s March annual meeting in Jacksonville, Florida, and a summary of awards presented in Jacksonville.

Proposals and Abstracts are now invited for special issues on: *Complementary and Alternative Medicine* for Fall 2003, and *Case Studies in Clinical Psychophysiology* in Spring 2004. The editor also welcomes proposals for future special issues of the *Biofeedback Magazine*. 
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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.
• April 1 for Summer issue, published August 5.
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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.

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Confidentiality and Psychotherapy Notes

Sebastian “Seb” Striefel, PhD, Logan, UT

Abstract: Confidentiality and trust are considered to be critical components of psychotherapy, for without them clients may withhold information that is critical to successful treatment. The US Supreme Court has acknowledged the importance of privileged communication (confidentiality in a legal proceeding) and made a decision that binds all federal courts in both civil and legal cases to confer privilege communication status to information shared by a client with his or her licensed psychotherapist in confidence during counseling. More recently, HIPAA has recognized the importance of confidentiality for psychotherapy notes within certain guidelines. Psychotherapy notes can be protected if certain rules are followed, such as keeping them in a separate file. Practitioners may well want to advocate for more stringent state laws to deal with the deficits in HIPAA for protecting client confidentiality. When more stringent, state law supersedes HIPAA.

Introduction

In 1996 the US Supreme Court in Jaffee v. Redmond ascribed the importance of privileged communication to the communication that occurs between a licensed mental health therapist and his or her patient when that communication occurs in confidence as a part of a counseling (or psychotherapy) session (Kitchener, 2000). In that ruling the Supreme Court recognized that confidentiality and trust are essential to the relationship that a licensed therapist has with a patient. The decision acknowledged that privacy is essential for psychotherapy to be effective, essential for the patient to trust the relationship, and important to society as well (Kitchener, 2000).

In practical terms, the decision prevented the information given by a police officer (Mary Lu Redmond) to her therapist (a licensed social worker) in confidence from being disclosed in a lawsuit (privileged communication) brought against her by the family of a man she shot and killed in the line of performing her police duties. The decision is binding only in federal courts, but the court ruled that the privilege is not subject to a decision by individual judges on a case-by-case basis, rather it is binding in all federal civil and criminal cases (Corey, Corey, & Callanan, 1998). Each state court can still decide whether to ignore or accept the decision in cases they preside over (Kitchener, 2000).

As such, practitioners still need to take care to inform clients about the limits of confidentiality, and exercise caution when receiving a subpoena for their psychotherapy notes or testimony. There is always a concern whether a specific court will grant the psychotherapy notes privileged communication status in a particular situation (DeBell & Jones, 1997).

Health Information Portability and Accountability Act (HIPAA)

HIPAA defines Protected Health Information (PHI) as anything that includes information that could identify a patient (e.g., name, address, phone number, social security number, insurance number, etc.) (45 CFR 164.502). Such information is to be protected by practitioners and is considered to be confidential. Non-identifying information is not protected. The new HIPAA regulations provide a new avenue for protecting psychotherapy notes.

HIPAA established a new floor of protection for PHI. The regulations provide some helpful provisions for protecting confidentiality, psychotherapy notes being one of those provisions. However, some argue that the core protection of privacy is missing because informed consent from the client is not required before sharing PHI for treatment, payment, or other health operations (all defined in the regulations). Many professionals who commented on the original proposed regulations argued that requiring written informed consent in these areas would be difficult to get and too costly (Basler, 2003). The US Department of Health and Human Services (HHS) agreed that requiring informed consent before proceeding in treatment could negatively impact access, quality, and timeliness of services so they changed the regulations (45 CFR Parts 160-164). For example, pharmacists could not fill a prescription until the client came in and gave his or her consent; hospitals could not prepare for admitting a client for a procedure based on a physician’s referral unless the patient came in and signed a consent form first (perhaps they have never heard of a fax machine or e-mail signatures); and emergency room personnel were concerned that even getting consent as soon as reasonably practical after an emergency would be an administrative burden. So, the regulations were changed.

Mandatory consent for treatment, payment, and health operations was replaced by voluntary consent at the provider’s option, allowing them to obtain consent so as not to disrupt treatment that they deem needed (45 CFR Parts 160-164), thus largely ignoring the client’s right to confidentiality and
the right to be involved in making decisions about their own health.

Each of the arguments given for changing the regulations to not mandate informed consent seems to be a convenience issue for practitioners who resist making changes in the way they do things. This really brings into question the ethics of practitioners. Clearly, practitioners need to be able to deal with emergency treatment issues in a timely manner, but not mandating informed consent before treatment in non-emergency situations sets the stage for infringing more and more on patients’ rights to autonomy.

It seems that some practitioners are more than willing to compromise client confidentiality when it makes their job easier and more convenient. Ethics codes generally make clear that clients have a right to expect confidentiality unless the client is a danger to self or others, an emergency exists, breaching confidentiality is required by law, or the client signs a release of information form. Clients have always had a right to be informed about what the limits of confidentiality are, e.g., if and what kind of information is to be shared for treatment, payment or other purposes.

According to Richard Sobel, a senior research associate of the psychiatry and law programs at the Harvard Medical School, HIPAA makes it easier for practitioners and Managed Care Organizations (MCOs) to do a broad disclosure rather than to get informed consent. You yourself may have received a disclosure statement from your health insurance provider or doctor in the mail recently. Would you want to receive treatment without any further input? Hopefully, practitioners will strive to the highest level of ethical functioning by aspiring to involve patients by getting informed consent whenever possible before initiating treatment, billing or other health operations.

HIPAA legally allows professionals to discuss a patient’s condition or treatment at nursing stations, over the phone, with another provider, or with a family member without taking any precautions to prevent the information from being overheard by others (45 CFR Parts 160-164). Such behavior may be legally acceptable, but is it ethically acceptable?

It is important for practitioners to remember that just because something is not prohibited by law (i.e., is allowed legally), does not make it ethical. AAPB’s old and new (AAPB, 1995, in press) ethical codes expect biofeedback practitioners to inform clients about the limits of confidentiality, to do all they can to protect confidential information, and to obtain informed consent as an ongoing part of assessment and treatment. The American Psychological Association’s (2003) code of ethics has similar expectations for psychologists (APA, 2003). Aspire to the highest level of ethical functioning.

Psychotherapy and Psychotherapy Notes

Protecting confidentiality becomes especially important when dealing with very sensitive information as often happens in psychotherapy. As already mentioned, trust and confidentiality are essential to effective psychotherapy. Clients may well not be frank and may not completely disclose all of the information needed by the therapist if they believe the information will not be kept confidential (Corey et al., 1998). Supreme Court Justice, John Paul Stevens in Jaffee v. Redmond said, “effective psychotherapy depends upon an atmosphere of confidence and trust in which the patient is willing to make frank and compete disclosure of facts, emotions, memories, and fears” (Corey et al., 1998, p. 157).

HIPAA requires the specific authorization of the client (via a signed release) for the use and disclosure of psychotherapy notes for treatment, payment, and other health operations (45 CFR 164, 508 (a) (2)). This sounds simple, but it isn’t. Several conditions must be met in order for this requirement to apply. The first is the definition of psychotherapy notes. Psychotherapy notes are defined as, “notes recorded in any medium by a mental health professional documenting or analyzing the contents of a conversation during a private counseling session” (Halloway, 2003b, p. 22). Psychotherapy notes may well contain sensitive information and impressions that are not appropriate for placement in the medical record or general client file. For special consideration, and for a signed authorization for release by the client to apply to psychotherapy notes, they must be kept in a file separate from the rest of the client’s record. If not kept separate, the information may well be accessed without specific authorization by the client.

In addition, certain information is not considered to be part of the psychotherapy notes and does not require a separate patient authorization for release. That information includes:

1. Medical prescriptions and monitoring;
2. Counseling session start and stop times;
3. Modalities and frequency of treatment;
4. Results of clinical tests (testing information); and
5. Any summary of diagnosis, functional status, treatment plan, symptoms, and prognosis or progress (Halloway, 2003b).

The APA argues that testing information and the theme of psychotherapy should be protected because they include the gist of sensitive information (Halloway, 2003b). APA suggests that such information not be released without a signed release by the patient (Halloway, 2003b).

It should be recognized that practitioners should not automatically keep two records on every client, one for psychotherapy and one for other information (Halloway, 2003b). A separate psychotherapy note record should be kept only if sensitive information is included in the record. If sensitive information arises during treatment, a practitioner can then create a separate file for psychotherapy notes from that date on and then the HIPAA protections apply. Managed Care Organizations (MCOs) are barred from making payment contingent on a patient authorizing access to psychotherapy notes (Halloway, 2003a).

Minimally Necessary

Another HIPAA provision bars MCOs from requesting information beyond what is “minimally necessary” for payment and other administrative tasks (Halloway, 2003a). MCOs cannot request the complete record. Unfortunately, the law did not define what “minimally necessary” means. As such, practitioners and MCOs are likely to define it differently. So HIPAA does not prevent too much information from going
Abstract: Electrocardiographic (ECG) artifact is commonly observed in EMG recorded from the torso and is a potentially serious measurement problem, especially when muscle activity is low. This artifact may result in over-estimation of absolute EMG levels, and in the identification of right/left muscle asymmetry levels where none exist. A novel method of removing ECG artifact is described in this article. An evaluation, the results of which are presented herein, indicates that (1) the new method is effective in removing ECG artifact from surface-recorded EMG and (2) the presence of ECG artifact results in a significant overestimation of mean resting EMG levels.

It is well known that the heart produces a strong electrical signal that may contaminate surface-recorded EMG. The waveforms introduced into an EMG record by cardiac activity are known as electrocardiographic (ECG) artifact. This source of noise is a concern whenever EMG is recorded from muscles in the torso of the body. An example of ECG artifact is illustrated in Figure 1. This figure shows a 3-second sample of EMG obtained from the upper left- and right-trapezius muscles and left- and right forearm extensor muscles of a 40-year-old man during seated rest. The corresponding ECG is also shown. ECG artifact is clearly evident in the left trapezius muscle (panel A). To a lesser extent, it is also evident in the right trapezius muscle (panel B). However, it should be noted that the artifact is not always observed in right trapezius EMG. In contrast to the trapezius muscles, ECG artifact is not evident in the forearm EMG records (panels C and D). It is typically not observed in EMG recorded from the forearms unless a wrist-to-wrist configuration is used (Cram, Kasman, & Holtz, 1998).

The magnitude of the ECG artifact may be quite large relative to that of the EMG signal, especially when muscle activity is low (as during biofeedback training), and therefore poses a potentially serious measurement problem. If ignored, ECG artifact may result in a significant overestimation of EMG activity levels. Further, the asymmetry in the magnitude of the artifact recorded from homologous sites on the left and right sides of the body may yield an apparent asymmetry in observed EMG levels when none actually exists.

Limitations of the Currently Available Methods for Eliminating or Reducing ECG Artifact

Currently, methods for eliminating or reducing ECG artifact are largely limited to high-pass filtering and “gating” (Schweitzer, Fitzgerald, Bowden, & Lynne-Davies, 1979). Both methods have serious drawbacks. Filtering the EMG signal to pass frequencies >80 Hz will substantially reduce, if not largely eliminate, ECG artifact. However, as a significant amount of the EMG signal (power) resides at frequencies below 80 Hz, high-pass filtering will attenuate the signal and, hence, result in a loss of information. The second strategy – gating – involves excluding ECG-contaminated epochs of EMG from further processing and analysis. Hence, it results in a loss of data.
The loss of data will be greater at higher heart rates and, at high heart rates there may not be enough data to analyze or yield reliable estimates of EMG activity levels. In light of the drawbacks of filtering and gating, it is difficult to know what to do about ECG artifact. Not infrequently, the artifact is simply ignored. The sense of resignation regarding this problem is reflected in Cram et al. (1998, p. 67), an introductory book on surface electromyography, in which the authors note that many practitioners accept the ECG artifact as a fact of life and merely educate the patient about this phenomenon. However, it may no longer be necessary to accept ECG artifact as a fact of life. A satisfactory solution to the ECG-artifact problem now seems possible. Recently, we have explored a novel method of removing ECG artifact from EMG that does not appear to suffer from the drawbacks of currently available techniques. The method is an adaptation of a technique developed in the context of respiratory research (Bloch, 1983). In this article we will describe the method and present some data which demonstrates its effectiveness.

**Description of the New Technique**

The method was first proposed by Bloch (1983) as a means of eliminating ECG artifact from diaphragm EMG. It essentially involves electronically extracting epochs of EMG data that contain an ECG artifact (see Figure 2); aligning those epochs on a readily identifiable feature of the artifact, such as the R-wave peak; and ensemble-averaging the epochs. The result is a waveform that reveals the average shape of the ECG artifact in the EMG record. Values of the ensemble average will be approximately 0 when ECG contamination is absent and nonzero when ECG contamination is present.

![Figure 1. A 3-second sample of left (A) and right (B) upper trapezius EMG, left (C) and right (D) forearm extensor EMG, and ECG (E) obtained from a 40-year-old man during seated rest. EMG signals were filtered, passing frequencies between 10 and 300 Hz, and sampled at 1 kHz. ECG was filtered, passing frequencies between DC and 500 Hz. ECG artifact (indicated by arrows) is evident in the left and right upper trapezius EMG but is more prominent in the left upper trapezius muscle. No ECG artifact is present in the forearm EMG.](image)

![Figure 2. Epochs of upper left trapezius EMG and the associated ensemble-averaged waveform. Each epoch consists of 751 data points containing an ECG artifact: 250 points preceding the ECG R-wave peak and 500 points after the R-wave peak. Each epoch is aligned on the R-wave peak. Ensemble-averaging proceeds by averaging data points at time 1 across all of the available epochs (i.e., epochs = 1 to N; N = number of ECG artifacts in the measurement interval) and then repeating the averaging process for each of the remaining data points in the epoch (i.e., time = 2 to 751). In this example, the result is an ensemble-averaged waveform with a length of 751 points that represents the average influence of the ECG activity on EMG activity. The expectation is that values in the ensemble-average will approximate 0 except when ECG activity is influencing the EMG.](image)
In the final step a subtraction template, which represents the artifact (i.e., the nonzero portion of the ensemble-averaged waveform), is aligned with each artifact in the EMG record and subtracted from it, yielding an artifact-free data series. Figure 3 shows a sample of contaminated left-trapezius EMG with the associated ensemble-averaged waveform (with the subtraction template marked) and the corrected EMG.

**Adaptation of the Method to Surface-Recorded EMG**

Variations of this basic method have been employed successfully in respiratory research to remove ECG artifact from diaphragm EMG obtained with esophageal wire electrodes in humans (Levine, Gillen, Weiser, Gillen, & Kwatny, 1986) and hook electrodes in anesthetized dogs (Bartolo, Dzwonczyk, Roberts, & Goldman, 1996). We have recently adapted the technique to surface-recorded EMG (Spalding, Kerick, Hatfield, Schleifer, & Cram, 2001). Our method differs from that employed in the respiratory research in two ways. First, we recorded the ECG with a standard configuration of chest electrodes and used it to unambiguously identify R-wave peaks in the EMG records. R-wave peaks were used to align epochs of contaminated EMG for ensemble-averaging and to align the subtraction template with individual artifacts in the EMG record. ECG was not recorded in the previous respiratory studies. In these studies contaminated EMG epochs were identified and aligned via a cross-correlation procedure. This procedure is probably adequate when applied to diaphragm EMG obtained with wire electrodes during expiration. Diaphragm EMG is quiescent during expiration and ECG artifacts can be identified unambiguously. However, the cross-correlation procedure may not be reliable when applied to surface-recorded EMG, especially if muscle activity levels are relatively high or episodes of high activity are evident. As we were interested in assessing trapezius EMG during psychological stress in computer work (Schleifer, Spalding, Hatfield, Kerick, & Cram, 2001), we expected to observe relatively high EMG activity levels during the periods in which participants were typing on the computer keyboard. Secondly, the subtraction procedure was simplified. In the previous studies the subtraction template was adjusted via regression to account for variation in the observed ECG artifacts introduced by respiration-related movements of the wire electrodes. As surface electrodes are less vulnerable than esophageal wire electrodes to such movement artifact, this adjustment was deemed unnecessary.

**Evaluation of the Ensemble-Average-Based Subtraction Method**

In order to determine if our method was effective in removing ECG artifact from surface-recorded EMG we compared contaminated-, gated-, and corrected-EMG on mean activity level (mV rms). Left upper trapezius EMG and ECG data were acquired from 21 women (n = 17) and men, aged 18 to 49 years (M = 28.3, SD = 9.1), during 5 minutes of rest while seated and with hands in the lap. Both signals were sampled at 1 kHz. The EMG data were dual-pass filtered, passing frequencies of 20-300 Hz. The data were dual-pass filtered because the initial (forward) filtering introduces a phase shift or a displacement of the series in time. This time displacement is highly undesirable in our application. Hence, the data were filtered again, backwards, to correct the phase shift. The filtered data constituted the contaminated series. These data were further processed to create the gated and corrected series. As indicated above, gating involves excluding from further analysis those epochs of EMG data that are contaminated by ECG artifact (Schweitzer et al., 1979). Previous investigators (Levine et al., 1986; Schweitzer et al., 1979) excluded epochs of a constant length (i.e., 380 ms). However, we determined the
“gate” length empirically for each participant individually as the interval between the onset and offset of the nonzero portion of the ensemble average. Gated series were included in the analysis in order to estimate the mean level of the true, uncontaminated muscle activity. Although the true mean activity level cannot be known, it seems reasonable to estimate it using the gated series. As the participants were in a stable posture and state (i.e., relaxed and behaviorally inactive) throughout the recording period, it is reasonable to expect that their EMG activity was stable and, as such, the true activity level in the contaminated epochs (which cannot be known definitively) should be similar to that in the artifact-free epochs. Hence, excluding contaminated epochs of EMG should not bias the estimate of the true mean activity level. Finally, the corrected series were constructed by removing the ECG artifact using the ensemble-average-based subtraction technique. We expected that, if the ensemble-average method was effective, the mean of the corrected EMG series would be similar to that of the gated data and, further, that both means would be lower than that of the contaminated series. The results supported this expectation.

Comparison of Mean EMG Activity Levels for Corrected, Gated, and Contaminated Series

Mean EMG activity levels of the corrected, gated, and contaminated series are shown in Figure 4. Consistent with our expectations, mean activity levels of the corrected and gated EMG series were similar (identical, in fact) and both means were significantly lower than that of the contaminated series. These results indicate that the ensemble-average-based subtraction technique effectively removed ECG artifact from left-trapezius EMG and yielded an estimate of mean activity equivalent to that of the true uncontaminated EMG activity level.

Discussion

The influence of ECG artifact on measures of EMG activity may depend on the magnitude of the ECG signal relative to that of the EMG signal (i.e., the signal-to-noise or ECG-to-EMG ratio) (Bartolo et al., 1996). Our results indicate that, when the ECG-to-EMG power ratio is high (as it typically will be in biofeedback applications), ECG artifact will be a significant measurement problem and should not be ignored. In our study ECG contamination resulted in overestimating mean left-trapezius EMG activity levels by 2.2 \( \mu \text{V rms} \). As mean resting levels of trapezius EMG activity range from 2 - 5 mV, this error is quite large. As a percentage of the estimated true mean level (i.e., 3.2 mV rms), the magnitude of overestimation was 69%.

Advantages of the Method

Our method is procedurally more complicated than filtering or gating. The reader may, therefore, question the utility of the technique. The primary advantage of the method is that it eliminates ECG artifact while preserving the continuity of the data series (i.e., no data are lost) and retains information in the lower frequencies of the EMG spectrum. In contrast, gating results in a loss of data as well as produces discontinuities in the data series. The loss of data may be substantial. Assuming a constant gate length of 380 ms as employed by Schweitzer et al. (1979), a heart rate of 60 bpm would result in a data loss of 38%. At a heart rate of 80 bpm, more than half (51%) of data will be lost; at 100 bpm, the loss of data reaches 63%. Hence, even for heart rates that are commonly observed at rest, gating results in a substantial loss of data. It would seem that such losses would seriously compromise the reliability of measures of activity levels. Additionally, at high heart rates, there may be an insufficient amount of data to analyze.

In contrast, high-pass filtering (e.g., passing frequencies \( \geq 80 \) Hz) does not result in a loss of data or produce discontinuities in the data series. However, it does significantly attenuate the signal and results in a loss of information contained in the EMG spectrum below the cutoff frequency. Further, at low muscle activity levels such as in biofeedback applications, high-pass filtering may result in a disproportionately large loss of information, as the relative amount of power in lower frequencies is greater at lower levels of muscle activity. With the ensemble-average-based technique there are no restrictions on filter settings. The clinician or investigator is free to set the high-pass filter cutoff frequency at or near the lower boundary of the EMG spectrum (e.g., 10 - 20 Hz). Hence, the ensemble-average-based technique should enable more of the EMG signal to be preserved. The amount of signal preserved will, of course, depend on how low the high-pass filter cutoff frequency is actually set.

It is worth noting that the ensemble-average-based technique is applicable to surface-recorded EMG obtained from any muscles of the torso and with any high-pass filter cutoff frequency settings between 1 Hz and 80 Hz. The shape and magnitude of ECG artifact will vary, depending upon the muscle being measured and the filter settings. However, this is not a concern because the technique does not require any assumptions about the shape or magnitude of the artifact. The only requirements are that artifacts be reliably identified and aligned for averaging and subtraction, and that the signal amplification is set such that the analog-to-digital converter does not saturate. Additionally, a high-pass filter with a cutoff frequency of at least 1 Hz should be employed in order to ensure that the EMG series is centered about a mean of 0. Otherwise, the method should adequately model the shape of the artifact. Although only one component of the ECG waveform (i.e., the QRS complex) was observed in our trapezius data, it is possible that, in other circumstances, additional components (e.g., P- or T-waves) could be observed. The ensemble-average-based technique should easily accommodate multiple components.
Application of the Ensemble-Average-Based Method in Clinical Biofeedback

In our study the ensemble-average-based technique was applied off-line. To be of use in clinical biofeedback it must be applied on-line and in real-time. Unfortunately, software for removing ECG artifact on-line (or off-line) is not available commercially. However, it seems quite possible to adapt the method for on-line, real-time applications. Given the strong interest in muscles of the torso (e.g., trapezius muscles), the ubiquitousness of ECG artifact, and the drawbacks of filtering and gating; it would seem that there is a large need for such software.

Future Research

Further research is needed in at least three areas. First, it is known that there are large individual differences in resting heart rate. The effect of such individual differences on measures of EMG activity, in both the time- and frequency-domains (e.g., mean level in mV rms versus mean frequency, respectively), is not known and merits investigation. Secondly, is there a threshold for the ratio of ECG power-to-EMG power beyond which the effect of ECG contamination is negligible? For example, if EMG activity is high relative to the ECG signal, can ECG artifact be ignored? The answer may depend on whether a time- or a frequency-domain measure is being considered. Lastly, it is unclear if individual differences in resting heart rate have a detrimental effect (via ECG artifact) on skill acquisition in EMG biofeedback training and/or treatment outcomes (e.g., pain ratings). Further research in these areas will likely clarify the extent and nature of the measurement problem that ECG artifact poses and its impact on biofeedback therapy and applied psychophysiology.

References


Future Research

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Confidentiality and Psychotherapy Notes

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to MCOs, but it does provide grounds for a practitioner to refuse to give some information (Halloway, 2003a). The courts and HHS will ultimately provide guidance on how to define “minimally necessary” (Halloway, 2003a).

Interestingly, New Jersey’s psychology licensing law specifies that MCOs can request only: administrative and diagnostic information, the status of the patient, reasons for continuing treatment (limited to assessment of the patient’s level of functioning and distress), and a prognosis (Halloway, 2003a). How well the law will work remains to be seen. It should be remembered that anytime a state law is more stringent than the requirements in HIPAA, state law supersedes HIPAA. It could be useful for practitioners to correct the problems inherent in HIPAA by getting more stringent state laws passed. Perhaps the New Jersey law could be used as a starting point.

References


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Footnotes

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Surface EMG and the Evolution of Aquatic Biofeedback
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Abstract: The union of aquatic therapy and surface EMG was derived out of necessity in order to help validate the effects of aquatic therapy exercise and to qualify its outcomes. The technique of aquatic biofeedback has undergone several changes in its evolution. Initially, waterproofing the electrode was done with a bioclusive barrier that was expensive and difficult to apply. Now, with the advent of a latex extremity sock that covers the electrode, application of the technique is much easier and less time consuming. The aquatic biofeedback technique is currently being used in the treatment of orthopedic and neurologic conditions, such as cerebral vascular accidents (CVAs), anterior cruciate ligament repairs, patellofemoral pain syndrome (PFPS) and spinal cord injuries.

Introduction to Aquatic Biofeedback

Biofeedback and surface electromyography (SEMG) have a well-established relationship with the fields of physical and occupational therapy. The land-based use of biofeedback in the treatment of various upper and lower extremity conditions is well documented and has proven to be an important adjunct to established treatment methods.

Aquatic therapy has been around for centuries. From the community baths of Rome to the healing pools of Bad Ragaz, aquatic rehabilitation has been practiced in one form or another by utilizing the physical properties of water to relieve pain and to strengthen weakened muscles.

Extending land-based biofeedback procedures to the aquatic environment, however, has developed a new twist to both aquatic therapy and biofeedback. A tangential hybrid of sorts, created out of necessity, it is a marriage of the two rehabilitative entities that offers patients the best of both worlds. The aquatic environment provides buoyancy to unload the joints and decrease pain while SEMG biofeedback contributes quantitative measurement and direction for both patient and therapist. Aquatic biofeedback now gives us the ability to quantify the exercises performed in the pool and gives us analytical data to direct our rehabilitative efforts in a more specific and purposeful direction.

Techniques of Aquatic Biofeedback

The aquatic SEMG treatment model is the same as in land-based biofeedback, but it has been adapted and modified to conform to the aquatic environment (specifically, drawing on hydrodynamic principles). The same skin preparation is followed prior to the application of the sensors. The only difference is that once the set-up is complete, a waterproof covering (referred to as a sock) is placed over the site, and the extremity can be immersed. Exercises are carried out, and training is facilitated and practiced, until the desired effect is achieved. Then the sock and sensors are removed and physical therapy can continue either in the pool or on land.

The whole process is quite easy. The desired muscle is selected and the site is prepared with an alcohol swab to remove dirt and oils (Figure 1). After placing the electrodes over the appropriate muscle site, the wires from the inside of the waterproof sock are hooked up, the whole sock is pulled up over the extremity (Figure 2), and the air is pumped out to form an airtight barrier (Figure 3). The corresponding (outer) electrode wires are plugged into the EMG unit, and after the correct parameters are programmed into the EMG unit, the biofeed-
Exercises are performed to either facilitate or inhibit activation of specific muscle groups. The SEMG biofeedback signal assists with the treatment and enhances the aquatic treatment regimen. Box I shows an instrumentation system currently available for aquatic use and contact information for the relevant manufacturer.

Safety Issues
When I first suggested using EMG in the aquatic environment, clinicians would look horrified at the thought of me taking such an expensive and sensitive piece of equipment into the pool. The risk management people literally scrambled to find me, in order to remind me of the legal ramifications of mixing water, electricity and patients. Fortunately, the emergence of powerful, battery-powered, hand-held EMG units has eliminated the need for a wall plug. Using three “AA” batteries in an aquatic setting significantly reduces the chance of electrocution to zero. Patients are never at risk of harm from the unit or the technique. The information gathered at a particular session is saved on the hand-held unit and then downloaded later to a computer for further analysis. The only real concern comes from dunking the EMG unit in the pool, and this is eliminated by placing the unit in a waterproof box during the session. A friend of mine who has supported and believed in the aquatic biofeedback technique was once asked (many years ago) about the possibility of using EMG in the water. He replied that it was possible … but only once! His opinion of EMG in the water has changed. A lot of people’s opinions about EMG in the water have changed.

Applications
I have used aquatic biofeedback with orthopedic and neurologic patients alike - specifically with cerebral vascular accidents (CVA’s), anterior cruciate ligament (ACL) reconstructions, rotator cuff tears/reconstructions, cerebral palsy (CP) and spinal cord injuries. I have also published articles testing the validity of aquatic biofeedback, outlining its uses, and calling upon its measurements to investigate the mechanisms by which progress is achieved in certain conditions (Fuller, Awbrey, 1999; see also Stowell, Fuller, & Fulk (2001).

Recently, I co-published a case study that utilized aquatic biofeedback to validate the progress made by a 20 year old spinal cord injured patient one year post-injury (Stowell, Fuller, & Fulk, 2001). Our patient had an incomplete C6 spinal cord lesion from an automobile accident. He was seen for four months of land and aquatic based physical therapy that included ambulation training in the pool at various water depths (to manipulate the effects of weight bearing by utilizing buoyancy) as well as on land. Aquatic biofeedback was used to train the abdominals, gluteals, quadriceps and hamstring muscles during aquatic exercise and to record the muscle activity of those particular muscles (on land and in the pool) throughout the 4-month treatment program. The effects of gravity on land can inhibit the patient’s ability to successfully stand or even walk. In the water, patients with a muscle test grade of “Trace” or “Poor” can hold themselves upright or even walk. This is possible by utilizing the hydrodynamic principle of buoyancy to support and assist the patient. Walking was mimicked in deep water (7 ft. depth), where the effects of gravity are almost completely eliminated, and also in the shallow water (4 ft. depth), where the graduated loading of the lower extremities could facilitate potential neural adaptations of the locomotor circuitry at the spinal cord level (Wernig & Muller, 1992; Wernig, Muller, Nannasy, & Cagol, 1995). Pre- and post-testing consisted of ambulation assessment, manual muscle testing and surface EMG testing on land and in the water. At the conclusion of the 4-month treatment intervention, the patient was able to ambulate five times farther than initially noted. The EMG readings showed significant improvement on land and in the pool, of all muscles tested. The final manual muscle tests showed a decrease from the initial test readings. Significant progress was made with the patient’s functional ability and mobility in spite of the plateau he had reached with manual muscle tests (one of the major discharge “gold standards” in spinal cord rehabilitation).

The emerging theory of facilitating the Central Pattern Generator with body weight supported treadmill gait training has shown great promise in the realm of spinal cord rehabilitation. This treatment technique utilizes a harness to suspend the patient upright and a treadmill to allow stationary ambulation. The Central Pattern Generator theory suggests that assisted walking may provide sensory stimulation, which generates an adaptation to the normal neural pathway. This would occur at the spinal cord level (more reflexive than a higher level function).

Utilizing the buoyant property of water in lieu of the harness system was easy enough to manipulate. By employing aquatic biofeedback to record the improvement and to assist with muscle training, valuable information was compiled that helped

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**Box I.**

AquaSense™ Aquatic EMG Systems
Manufactured by
Thought Technology Ltd.
2180 Belgrave Ave
Montreal, Quebec, Canada
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Tel: (800) 361-3651
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Aquatic biofeedback has helped quantify treatment in an area that has had its share of skeptics and more that its share of tall tales and half-truths. A common misnomer in aquatic therapy has been that you can't treat specifics in the pool, only generalities. A familiar comment verbalized by some skeptics is that the benefits of water are mostly subjective and that there is little documented, quantitative research to back up the glowing affirmations voiced by patients. This was true several years ago. However, with the release of NASA generated research (through the Freedom of Information Act) and the rapidly growing field of aquatic rehabilitation, more aquatic related research has been published now than ever before. Several published studies have dealt with aquatic biofeedback and rehabilitation (Nuber, Jobe, Moynes, & Atonelli, 1986; see also Becker, Erlanson, Hemmesch, & Redfield, 1996; Kelly, Roskin, Kirkendall, & Speer, 2000; Fuller, 2001). The main goal of these studies has been two-fold: 1) to develop quantitative measurement methods for aquatic exercise, and 2) to observe muscle function as the muscles are utilized during aquatic therapy. This allows us the ability to focus on the effect that water has on the particular exercise, thereby allowing the manipulation of the signal to better enhance the exercise routine. Each study utilized aquatic biofeedback to validate a training method or to substantiate a theory, leading to a better treatment model for the rehabilitation of our patient population.

**Conclusion**

Theory drives research. Research models treatment. Treatment begets knowledge, and knowledge creates the opportunity for theory … and so the cycle is perpetuated.

SEMG aquatic biofeedback has been tried, tested and now fine-tuned, giving therapists a new tool to help quantify progress in their aquatic therapy treatments. It has come a long way from an abstract idea to its present state. With continued research bringing about new treatments and creating new ideas, the sky (or the water) appears to be the limit!

**References**


Exercise or Play?
Medicine of Fun
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Abstract: Patients often equate biofeedback training homework to mandatory activities, which are often viewed as one more thing to do. Changing the perception from that of work to fun can encourage laughter and joy and help overcome a chronic pain pattern — all necessary for healing. This paper encourages therapists to explore utilizing childhood activities and paradoxical movement to help patients release tension patterns and improve range of motion. A strong emphasis is placed on linking diaphragmatic breathing to movement.

When I went home I showed my granddaughter how to be a tree swaying in the wind, she looked at me and said, “Grandma, I learned that in kindergarten!”

‘Betty’ laughed heartily as she relayed this story. Her delight in being able to sway her arms like the limbs of a tree starkly contrasted with her demeanor only a month prior. Betty was referred for biofeedback training after a series of 9 surgeries — wrists, fingers, elbows and shoulders. She arrived at her first session in tears with acute, chronic pain accompanied by frequent, incapacitating spasms in her shoulders and arms. She was unable to abduct her arms more than a few inches without triggering more painful spasms. Her protective bracing and rapid thoracic breathing exacerbated her pain and contributed to limited range of motion of her arms. Unable to work for over a year, she was coping not only with pain, but also with weight gain, poor self-esteem and depression.

Biofeedback training began with what we feel is the foundation of health: effortless, diaphragmatic breathing (Peper, 1990). Each thoracic breath added to Betty’s chronic shoulder pain. Convincing Betty to drop her painful bracing pattern and to allow her arms to hang freely from her shoulders as she breathed diaphragmatically was the first major step in regaining mobility. She discovered in that first session that she could use her breathing to achieve control over muscle spasms. During the first week, she practiced her breathing assiduously at home and had fewer spasms. Betty was able to move better during her physical therapy sessions. Each time she felt the onset of muscle spasms she would stop all activity for a moment and ‘go into my trance’ to prevent a recurrence. For the first time in many months she was feeling optimistic.

Subsequent sessions built upon the foundation of diaphragmatic breathing: boosting Betty’s confidence, increasing range of motion (ROM), and bringing back some fun in life. Activities included many childhood games: tossing a ball, swaying like a tree in the wind, pretending to conduct an orchestra, bouncing on gym balls, playing “Simon Says” (following the movements of the therapist), and dancing. Laughter and childlike joy became a common occurrence. She looked forward to receiving the sparkly star stickers she was given after successful sessions. With each activity Betty gained more confidence, gradually increased ROM, and began losing weight. Although she had some days where the pain was strong and...
spasms threatened, Betty reframed the pain as occurring as a result of healing and expanding her ROM—she was no longer a victim of the pain. In addition, her family was proud of her, she was doing more fun activities, and she felt confident that she would return to work.

Betty’s story is similar to many other clients whom we have seen. The challenge presented to biofeedback therapists is to help the patient better cope with pain, increase ROM, regain function and, often the most important, to reclaim a joie de vivre. Increasing function includes using the minimum amount of effort necessary for the task, allowing unnecessary muscles to remain relaxed (no dysponesis!), and quickly releasing muscle tension when the muscle is no longer required for the activity (work/rest). The challenge is to perform the task without concurrent evocation of components of the alarm reaction, which tend to be evoked when “we try to do it perfectly,” or “it has to work,” or “If I do not do it correctly, I will be judged.” For example, when people learn how to implement micro-breaks (1 – 2 second rest periods) at the computer, they often sit quietly believing that they are relaxed. However, they may continue a bracing pattern. Alternatively, tossing a small ball rather than resting at the keyboard will generally evoke laughter, encourage generalization of skills, and covertly induce more relaxation. Interestingly, therapists in their desire to help patients to get well commonly assign structured exercises as homework that evoke striving for performance and often boredom—this striving to perform the structured exercises may inhibit healing. Utilizing tools other than those found in the work setting helps the patient achieve a broader perspective of the healing/preventive concepts that are taught.

Obviously, clients are active participants in their own healing process. This implies that they practice exercises during the therapeutic session, at home and at work. Consequently, home practices are assigned to integrate the mastery of news skills into daily life. To help patients achieve increased health through physical activity three different approaches are often used: movement reeducation, youthful play, and pure exercise. How the patient performs the activity may be monitored with surface electromyography (SEMG) to identify muscles tightening that are not needed for the task and how the muscle relaxes when not needed for the task performance. This monitoring can be done with a portable biofeedback device or multi-channel system when walking or performing the exercises. Patients can even use a single channel SEMG at home.

When working to improve ROM and physical function, the following rules are recommended:

1. Maintain diaphragmatic breathing – rhythm or tempo may change but the breath must be generated from the diaphragm with emphasis on full exhalation. Use strain gauge feedback and/or SEMG feedback to monitor and train effortless breathing. Strain gauge feedback is used to teach a slower and diaphragmatic breathing pattern, while SEMG recorded from the scalene to trapezius is used to teach how to reduce shoulder and ancillary muscle tension during inhalation.
2. Perform activities or stretching/strengthening exercises that may trigger or aggravate pain during the exhalation phase of breathing.
3. Use the minimum amount of tension necessary for the task and let unnecessary muscles remain relaxed. Use SEMG feedback recorded from muscles not needed for the performance of the task to teach patients awareness of inappropriate muscle tension and to learn relaxation of those muscles.
4. Quickly release muscle tension when the task is accomplished. Use SEMG feedback to monitor and show that the muscles are completely relaxed. If rapid relaxation is not achieved, teach the subject to first relax before repeating the muscle activity.
5. Perform the exercises as if you have never performed them and do them with a childlike, beginner’s mind, and exploratory attitude (Kabat-Zinn, 1990).

Movement and exercise can be taught as pure physical exercise, movement reeducation, youthful play, and pure exercise. Physical exercise is necessary for strength and endurance and at the same time, improves our mood (Thayer, 1996). However, many exercises are considered a burden and are often taught without a sense of lightness and fun, which results in the patient thinking in terms that are powerless and helpless (depressive)—“I have to do them.” Helping your patients to understand that exercise is simply a part of every day life, that it encourages healing and improves health, and that they can “cheat” at it, may help them to reframe their attitudes toward it and accomplish their healing goals.

Pure Physical Exercise—Enjoyment through Strength and Flexibility

The major challenge of structured exercises is that the person is very serious and strives too hard to attain the goal. In the process of striving, the body is often held rigid: Breath is shallow and halted and shoulders are slightly braced. Structured exercises are very helpful for improving ROM and strength. Maintaining a daily chart is an excellent tool to show improvement (e.g., more repetitions, more weight, increased flexibility). When using pure exercise, remember that injured patients often have a sense of urgency – they want to get well quickly and, if work stress was a factor in developing pain, they often rush when they need to meet a deadline. As much as possible make the exercise fun. Help the patient understand that he can be quick while not rushed. For example, monitor SEMG from an upper trapezius muscle using a portable electromyograph. Begin by walking slowly. Add a ramp or step to ensure that there is no bracing when climbing (a common occurrence). Walk around the room, down the hall, around the block. Maintain relaxed shoulders, an even swing of the arms, and diaphragmatic breathing. Walk more quickly while emphasizing relaxation with speed rather than rushing. Go faster and faster. Up the stairs. Down the stairs. Walk backward. Skip. Hop. Laugh.
Movement Reeducation – Be ‘Oppositional’ And Do It Differently

Movement reeducation, such as Feldenkrais, Alexander Technique or Hannah Somatics, involves conscious awareness of movement (Hanna, 1988; Murphy, 1993). Many daily patterns of movement become imbedded in our consciousness and, over the years, may include a pain trigger. A common trigger is lifting the shoulders when reaching for the keyboard or mouse. Patients suffering from thoracic outlet syndrome (TOS) often have such patterns. A keyboard can often inadvertently cue the patient to trigger this dysphonetic, and frequently painful, pattern. Have the patient do movement reeducation exercises in which they are guided through practices in which they have no expectancy and the movements are novel. The focus is on awareness without triggering any fight/flight or startle responses.

Ask the patient to explore performing many functional activities with the opposite hand, such as brushing her hair or teeth, eating, blowing her hair dry, or doing household chores, such as vacuuming. (Try this for yourself, as well!). Be aware of how much shoulder muscle tension is needed to raise the arms for combing or blow-drying the hair. Explore how little effort is required to hold a fork or knife (you might want to do this in the privacy of your own home!). Do movements differently such as, practicing alternating hands when leading with the vacuum or when sweeping, changing routes when driving/walking to work or the store, getting out of bed differently. Or, break up habitual conditioned reflex patterns such as eye, head and hand coordination. For example, when doing a movement, slowly rotate your head from left to right and simultaneously shift your eyes in the opposite direction (e.g., turn your head fully to the right while shifting your eyes fully to the left, and then reverse) or before reaching forward, drop your elbows to your sides then, bend your elbows and touch your shoulders with your thumbs then, reach forward. Often, when we change our patterns we increase our flexibility, inhibit bracing and reduce discomfort.

Youthful Playing – Pavlovian Practice

Remember the story of Pavlov in the hospital? Many, including his family, thought he was slipping into death when he quietly lay in his hospital bed and gently played with a bowl of water and dirt. Yet, the next morning he awoke and ate a hearty breakfast. Soon he was out of the hospital. Pavlov knew that evoking the playful joy of childhood would help to encourage mental and physical healing (Peper, Gibney, & Holt, 2002). Having patients play can encourage laughter and joie de vivre, which helps in physical healing. Often being involved in childhood games or actually playing these games with children removes one from worries and concerns—both past and future—and allows one to be simply in the present. Just being present is associated with playfulness, timelessness, passive attention, creativity and humor. A state in which one’s preconceived mental images and expectancies—the personal, familial, cultural, and healthcare provider’s hypnotic suggestions—are by-passed and for that moment, the present and the future are yet undefined. This is often the opposite of the patient’s expectancy. Namely, the past experiences and the diagnosis create a fixed mental image that expects pain and limitation. Explore some of the following practices as strategies to increase movement and flexibility without effort and to increase joy. Use

Free Your Neck and Shoulders*

— Push away from the keyboard and sit at the edge of the chair with your knees bent at right angles and your feet shoulder-width apart and flat on the floor. Do the following movements slowly. Do NOT push yourself if you feel discomfort. Be gentle with yourself.
— Look to the right and gently turn your head and body as far as you can go to the right. When you have gone as far as you can comfortably go, look at the furthest spot on the wall and remember that spot. Gently rotate your head back to center. Close your eyes and relax.
— Reach up with your left hand; pass it over the top of your head and hold on to your right ear. Then, gently bend to the left lowering your elbow towards the floor. Slowly straighten up. Repeat for a few times feeling as if you are a sapling flexing in the breeze. Observe what your body is doing as it bends and comes back up to center. Notice the movements in your ribs, back and neck. Then, drop your arm to your lap and relax. Make sure you continue to breathe diaphragmatically throughout the exercise.
— Reach up with your right hand and pass it over the top of your head and hold on to your left ear. Repeat as above except bending to the right.
— Reach up with your left hand and pass it over the top of your head and hold on to your right ear. Then, look to the left with your eyes and rotate your head to the left as if you are looking behind you. Return to center and repeat the movement a few times. Then, drop your arm to your lap and relax for a few breaths.
— Again, reach over your head with your left hand and hold onto your right ear. Repeat the same rotating motion of your head to the left except that your eyes look to the right. Repeat this a few times then, drop your arm to your lap and relax for a few breaths.
— Reach up with your right hand and pass it over the top of your head and hold on to your left ear. Then, look to the right with your eyes and rotate your head to the right as if you are looking behind you. Return to center and repeat a few times. Then, drop your arm to your lap and relax for a few breaths.
— Again, reach over your head with your right hand and hold onto your left ear. Repeat the same rotating motion of your head to the right except that your eyes look to the left. Repeat this a few times then, drop your arm to your lap and relax for a few breaths.
— Now, look to the right and gently turn your head and body as far as you can go. When you can not go any further, look at that point on the wall. Did you rotate further than at the beginning of the exercise?
— Gently rotate your head back to center, close your eyes, relax and notice the feeling in your neck, shoulders and back.

*This practice was adapted from a demonstration by Sharon Keane and developed by Ilana Rubenfeld (2000).
your creativity and explore your own permutations of the practices. Observe how your mood improves and your energy increases when you play a childhood game instead of an equivalent exercise. For example, instead of dropping your hands to your lap or stretching at the computer terminal during a micro- or meso-break, go over to your coworker and play "pattycake." This is the game in which you and your partner face each other and then clap your hands and then touch each other's palms. Do this in all variations of the game.

For increased ROM in the shoulders explore some of the following (remember the basics: diaphragmatic breathing, minimum effort, rapid release):

Ball Toss: a hand-sized ball that is easily squeezed is best for this exercise. Monitor respiration patterns, and SEMG forearm extensors and/or flexors, and upper trapezi muscles. Sit quietly in a chair and focus on a relaxed breathing rhythm. Toss the ball in the air with your right hand and catch it with your left hand. As soon as you catch the ball, drop both hands to your lap. Toss the ball back only when you achieve relaxation—both with the empty hand and the hand holding the ball. Watch for over-effort in the upper trapezi. Begin slowly and increase the pace as you train yourself to quickly release unnecessary muscle tension. Go faster and faster (just about every variation). When working with a patient, call out different degrees of pressure (e.g., 50%, 10%, 80%, etc.). The same rules apply as with the ball toss.

Ball Hand to Hand: Close your eyes and hand the ball back and forth. Go faster and faster and add ball squeezes prior to passing the ball.

Gym Ball Bounces: Sit on a gym ball and find your balance. Begin bouncing slowly up and down. Reach up and lower your left then, right hand. Abduct your arms forward then, laterally. Turn on the radio and bounce to music.

Simon Says: This can be done standing, sitting in a chair or on a gym ball. When on a gym ball, bounce during the game. Have your patient do a mirror image of your movements: reaching up, down, left, right, forward or backward. Touch your head, nose, knees or belly. Have fun and go more quickly.

Summary: An Attitude of Fun

In summary, it is not what you do; it is the attitude by which you do it that affects health. From this perspective, flexibility and movement are enhanced, discomfort decreased and health increased when exercises are performed with joy and experienced as fun. Inducing laughter promotes healing and disrupts the automatic negative hypnotic suggestion/self-images of what is expected. The patient begins to live in the present moment and thereby decreases the anticipatory bracing and dysponetic activity stirred-up by striving. By decreasing striving and concern for results, patients may allow themselves to perform the practices with a passive attentive attitude that may facilitate healing. For that moment the patient gets the painful past and a future fraught with promises of continued pain and inactivity. Instead, the moment is lived in a joyful present—one in which the pain cycle is interrupted and which can provide hope and a glimpse into a healthy future.

References

Footnotes
i Dysponesis involves misplaced muscle activity activities or efforts that are usually covert and, which do not add functionally to the movement. From: “Dys” meaning bad, faulty or wrong, and “ponos” meaning effort, work or energy (Whatmore and Kohli, 1974)

ii A meso-break is a 10 to 90 second break that consists of a change in work position, movement or a structured activity such as stretching that automatically relaxes those muscles that were previously activated while performing a task.
Abstract This article is the first in a three-part series on the use of biofeedback (BFB) in helping athletes reach their optimal competitive potential. The author’s extensive literature review suggests that however compelling the outcomes, research in this area has been surprisingly quite limited. Perhaps chiefly responsible for the lack of growth in this field, a field considered otherwise fraught with potential, has been inconsistent methodology, which at times has bordered on little more than untested assumptions. Happily, studies today seem increasingly rigorous, the findings more empirically robust, leaving little doubt that research in this field can pass scientific muster. The author is thereby optimistic that this new field, which he refers to as sport psychophysiology (SPP), could eventually achieve recognition as distinct yet complementary to the myriad other established disciplines making up the sports sciences. Such an achievement would certainly augur well for a new generation of applied and research-oriented BFB enthusiasts. In short, this three-part series will review the trends, problems, and ultimately the potential for SPP as an applied science in its own right.

"Cyclists are computer slaves; we hover over precise calculations of cadence, efficiency, force, and wattage. I was constantly sitting on a stationary bike with electrodes all over my body, looking for different positions on the bike that might gain mere seconds…”

– Lance Armstrong (Armstrong, 2000, p. 63.)

Since time immemorial, combatants and contestants alike have endeavored to optimize their performance, be it in battle or simply in a competitive sports arena. Rather than being content with who is intrinsically the better contestant, people have long thirsted to discover new techniques to increase one’s odds of winning. While in earlier times technological improvements may have been limited to weaponry, contemporary sports technology addresses both objective and subjective variables. Objective technology encompasses entities external to the competitor, such as the design of better shoes, lighter bats, more versatile skis, faster bicycles, wider tennis racquets, and the like. Innovations in this area enable the same athlete to perform differently depending upon the equipment used (May, 2000). In contrast are subjective variables that focus more on psychological factors (images, self-statements, beliefs, etc) as well as physiological events (sleep, breathing, muscle tone, and related autonomic states). Over the years, the reality in the sports world has become one where “it is no longer a case of the athlete responding to the coach- it’s the coach responding to the physiological and psychological world of the athlete” (Braden, 1985, p. x).

As engineers have continued to push the envelope in terms of equipment design, researchers over the past few decades have reached new heights in recognizing the importance that psychophysiological states can have on competitive outcomes. Biofeedback (BFB) has figured prominently in this regard as studies have increasingly shown that subtle modifications in such variables as respiration, muscle tone, brain waves, and heart rate can have appreciable impact on performance, especially with elite athletes whose outcomes are often differentiated by milliseconds. There is no doubt that applied psychophysiology has contributed to the sports sciences (Collins, 1995). What is of concern is whether and to what extent research in sports psychophysiology (SPP) will continue to benefit elite athletes and their coaching staff?

Efficacy of Biofeedback in Sport

Myriad studies over the past 30 years have concluded that athletes are no different from other clinical populations in having the potential to benefit from feedback of physiological processes. In their now classic book, Biofeedback and Sports Sciences, Sandweiss and Wolf (1985) provide an excellent introduction to the topic as well as copious research supporting the use of BFB in athletic training. It is important to note, however, that subsequent to that publication, SPP research came under harsh scrutiny because of methodology that was often found wanting. While recent research has appeared more empirically robust, there remains a strong need for tighter methodological controls in order to enhance credibility not just in SPP, but BFB in general (see Yucha, 2002). Part III of this series will address some of the common inadequacies in SPP outcome research.

Most of the attention in SPP focuses on a non-distressed population- healthy athletes working towards improved functioning. A smaller, yet important body of research is specifically directed towards rehabilitation of the injured athlete. Whether it be with distressed or non-distressed subjects, all of the studies can be differentiated according to three distinct aims (Landers, 1985). The first, arousal reduction, is perhaps the most
heavily researched and is based on the premise that an athlete’s performance suffers when tension exceeds their capacity for optimal functioning. This rather dated concept is often referred to as the “inverted U hypothesis” (Yerkes & Dodson, 1908), which basically contends that optimal athletic performance is found somewhere in the midrange between calmness and tension. In other words, performance will improve with heightened arousal, but only up to a certain point, after which performance will actually begin to deteriorate as arousal continues to increase. Students of economics may recognize a similarity between this theory and the “law of diminishing returns.” While the inverted-U hypothesis has been challenged and/or refined over the years (Gould & Udry, 1994), suffice it to say that exceptional performance corresponds with an optimal level of pre-competition arousal (Spielberger, 1989). The goal is to find this level in each athlete, and then train them to reproduce it in competition. Hyperarousal suggests relaxation strategies, whereas hypoarousal necessitates interventions aimed at energizing or “psyching up” (Zaichkowsky & Takenaka, 1993). Pinel and Schultz (1978) used surface electromyography (sEMG) to demonstrate not only how high levels of pre-competitive muscle tension can disrupt athletic performance, but that BFB-assisted relaxation can ameliorate this same arousal. Blais and Vallerand (1986) also found BFB effective in reducing competitive arousal. In short, BFB in a variety of forms has been found empirically capable of transforming debilitating anxiety into constructive energy that can maximize performance across a wide variety of sports.

The second key area in SPP centers around optimizing autonomic control. This approach is also geared to healthy athletes whose performance is adversely affected by autonomic phenomena, such as HR, sweat, hand/foot temperature, respiration, and so on. The aim is to teach self-regulatory skills that enable the competitor to become aware of these physiological processes in order to manipulate them to his or her advantage. An example might be a biathlete who is required to shoot a target after skiing several kilometers at race-pace.

Because under those conditions heart rate (HR) is not just rapid but subjectively palpable, the athlete can learn where in either the respiration or HR cycle to initiate their shot in order to achieve maximal results. In such a situation, reduction of arousal is not important, because after shooting, the athlete must resume several kilometers of race-pace skiing. The competitor must therefore maintain existing levels of arousal while learning to use proprioceptive cues as signals for when to pull the trigger.

The third area of SPP research involves rehabilitative interventions with injured athletes. Much of the work in this area centers around physical therapy applications of electromyography (EMG). Chondromalacia, for example, can often result from muscle imbalances reinforced by repetitive cycling or running. Concomitant patellofemoral pain can actually be ameliorated through differential strengthening of vastus medialis and vastus lateralis, two muscles which can be neatly individuated and retrained through EMG. This approach was reported by Swanik, Lephart, Giraldo, Demont, & Fu (1999) in a study of female athletes with injuries to the anterior cruciate ligament (ACL). The authors determined that sEMG made it possible to differentially strengthen quadriceps and hamstrings to restore functional stability of the knee as well as protect it from subsequent ligamentous injury. A somewhat different rehabilitative application involved sEMG being used to encourage hamstring relaxation in order to measure anterior tibial displacement in ACL-deficient patients, an otherwise difficult procedure (Feller, Hoser, & Webster, 2000). Other BFB modalities have also shown utility in sports medicine, e.g., Zaichkowsky and Fuchs (1988), who discuss applications of HR, blood flow, and respiration feedback to limit, for example, the cardiorespiratory impact of rehabilitative exercise.

To summarize, SPP approaches can be differentially adapted for use with both distressed and non-distressed athletes. The three major directions just identified in SPP have been uniquely incorporated into a five-step schema that shows promise in regulating HR, increasing flexibility and muscle strength, and/or reducing pain and fatigue (Blumenstein, Bar-Eli, M., & Tenenbaum, 1997).

**Current Issues**

Despite the potential for this field as suggested by the research cited above, several trends should be of some concern to BFB as a profession, and more specifically to SPP as a sub-discipline within the exercise sciences. The first observation in reviewing the literature is that notwithstanding the seeming importance of psychophysiological variables in athletic performance, the literature in this area is not nearly as prolific as one might guess. Zaichkowsky and Fuchs (1988), two of the more prolific researchers in this field, referred to the total number of SPP studies as “extremely limited.” While BFB in general, unlike research in countless other areas of psychology, may tend to be a rather esoteric topic by itself, studies that specifically focus on BFB applications in sport are decidedly more obscure. Such a literature search would yield only a handful of studies, even fewer when narrowing in on either a specific sport (e.g., BFB with cross country skiers) or a specific BFB modality (EMG in sport). To look at both a specific sport and a specific BFB modality (EMG with cross country skiers) may yield only a few studies at best, depending on the sport, sometimes none at all. In the preparation of this manuscript, a rather extensive literature search yielded less than 100 studies reporting on BFB applications of any kind in any sport between 1976 and 2001. Compare that 25 year period, for example, to the 2700 or so studies on relaxation alone that were counted between 1972 and 1997 (Friedman, Sedler, Myers, & Benson, 1997) or to the 7000 studies in the field of sport psychology that were published between 1971 and 1991 (Kunath, 1995). The inference here is that, for whatever reason, SPP may be a grossly under-researched area.

Perhaps even more striking is the paucity of SPP research published by the Association for Applied Psychophysiology and Biofeedback (AAPB), considered by many the official voice for BFB practitioners in the U.S. The present study found that over the ten years between March, 1991 through September, 2001, the *Journal of Applied Psychophysiology and Biofeedback*...
(formerly called Biofeedback and Self-Regulation) published only four articles that were in any way related to this topic (von Scheele & von Scheele, 1999; Cassisi, Sexton-Radek, Castrogiovanni, Chastain, & Robinson, 1993; Nixon, 1994; Geugniert, Cauchefer, & Gallego, 1994) with half of them appearing in just one issue. AAPB’s sister periodical, Biofeedback, over the same ten year period fared similarly, with only six articles addressing BFB in sport (Tremain, 1996; Kall, 1997; Wilson & Gunkeleman, 2001; Sime, Allen, & Fazzano, 2001; Chartier, 2001; Carlstedt, 2002). Again, three of those articles (60%) appeared in just one issue (Spring, 2001), an intriguing reflection of the lack of research in this important area.

Another possible trend, as reflected by what this author gleaned from the available research, is the possibility that professional interest in SPP might actually have declined somewhat over the past ten years. Although any effort to quantify this was beyond the scope of the present paper, fewer studies may have been published in recent years as compared to what seemed like burgeoning interest in the 1970s and 80s. This possibility seems deserving of further investigation, particularly in light of continuously favorable outcome studies. Also of interest (though not within the context of this paper) is that while biofeedback research in the sports sciences admittedly continues, much of the current work, unlike in the past, may be occurring outside North America.

A final anecdote is that BFB research involving traditional applications seems to be increasingly supplanted by research focusing on neurofeedback (NF: Wilson & Gunkeleman, 2001). In fact, the Spring 2001 edition of Biofeedback devoted an entire issue to “optimal functioning,” and although that issue did include several articles on BFB in motor skills development, each was geared exclusively around neurofeedback (NF), with almost no mention of EMG, HR, oxygen consumption (VO2), galvanic skin response (GSR), heart rate variability (HRV), and thermal feedback, historically the gold standards in clinical biofeedback.

If in fact these are bona fide trends, sever-

al questions emerge, some of which will be addressed in this review. Have traditional BFB modalities in sport outlived their usefulness? Does the paucity of empirical studies in this field suggest that BFB in general lacks utility in the sports sciences? Are traditional BFB approaches inherently flawed, or are we simply needing new more portable technology that will make traditional instrumentation less obtrusive and therefore of greater utility to athletes and coaches? Are there intrinsic methodological weaknesses to SPP research, and if so how can we in the profession encourage more empirical rigor so as to promote greater credibility to BFB’s role in sport? And, finally, we need to look at whether NF is actually becoming the preferred medium in SPP, or is this simply the prevailing Gestalt?

Summary

It should be clear from the above that BFB has considerable potential to benefit athletes, particularly on the elite level. Moreover, the current literature review suggests that only a small part of this promise has been realized thus far. In Part II of this series, we will explore traditional BFB modalities (sweat, respiration, muscle tone, heart rate, etc.) and how they have already been adapted with varying degrees of success to a broad range of sports. Attention will also be given to the importance of sound methodology as the sine qua non for establishing credibility in SPP research and practice. In a subsequent issue, Part III will examine future directions in this field by considering specific indices widely used in exercise physiology (cortisol, catecholamines, blood lactate, oxygen consumption, etc.) and their possible utility as BFB measures with athletes.

References


Continued on page 27
Abstract: Since the discovery of photic driving by Adrian and Matthews in 1934, much has been discovered about the benefits of brain wave entrainment (AVE) or audio visual entrainment (AVE) as it is commonly known today. Studies are now available on the effectiveness of AVE in promoting relaxation, hypnotic induction and restoring somatic homeostasis, plus improving cognition, and for treating ADD, PMS, SAD, migraine headache, chronic pain, anxiety, depression and hypertension.

History
Clinical reports of flicker stimulation appear as far back as the dawn of modern medicine. It was at the turn of the 20th century when Pierre Janet, at the Salpêtrière Hospital in France, reported that when he had his patients gaze into the flickering light produced from a spinning spoked wheel in front of a kerosene lantern, it lowered their depression, tension and hysteria (Pieron, 1982). Then, in 1934, Adrian and Matthews published their results showing that the alpha rhythm could be “driven” above and below the natural frequency with photic stimulation (Adrian & Matthews, 1934).

This discovery further propagated a host of small physiological outcome studies on the “flicker following response” by many well respected researchers (Bartley, 1934, 1937; Durup & Fessard, 1935; Jasper, 1936; Goldman, Segal, & Segalis, 1938; Jung, 1939; Toman, 1941). Finally in 1956, W. Gray Walter published the results on thousands of test subjects comparing flicker stimulation with the subjective emotional feelings it produced (Walter, 1956).

Meanwhile, William Kroger accomplished other important developments in photic stimulation. Kroger was a physician investigating why radar operators were going into trances in front of their radar sets and of course, leaving the ship or plane at great risk to the enemy. He concluded that the rhythmic “blip” of the radar was “pulling” the radar operators into a trance state. These findings compelled Kroger to team up with Sydney Schneider of the Schneider Instrument Company of Ohio to construct and market the first electronic clinical photic stimulator, called the “Brainwave Synchronizer.” It comprised an intense xenon strobe light complete with a rotating dial that could be set to the frequencies of the standard four brain wave rhythms. They found the Brainwave Synchronizer had powerful hypnotic qualities and soon published a study on hypnotic induction (Kroger & Schneider, 1959).

They also prompted other studies involving hypnotic induction in surgery and dentistry, and studies of general interest to the hypnosis profession (Sadove, 1963; Margolis, 1966; Lewerenz, 1963).

In 1981, Comptronic Devices Limited was incorporated, with a focus on designing TENS units and EMG feedback devices for dental (TMJ) applications. In 1984, I designed the “Digital Audio-Visual Integration Device” (DAVID1), used for hypnotic induction and to calm anxiety in performing arts students at the University of Alberta. The “light and sound” (L&S) market at this time was in its infancy and resided primarily within the new age sector. There was little “known” research to support L&S technology, and professionals by and large showed disinterest in L&S technology. Due in part to poor quality L&S products and a lack of research, about 40 L&S companies have come and gone, most of them during the 1980s and 1990s. However, since the time of Adrian and Matthews, a considerable number of studies have verified photic and auditory “driving” of the EEG. I have since re-named this phenomenon as “audio-visual entrainment” or AVE, as any given frequency of stimulation that is reflected in brain wave activity and observable on an EEG or QEEG can be entrained. Many more studies on photic or combined audio/photic stimulation exist than pure audio stimulation studies, however audio-only stimulation studies have confirmed audio entrainment (Chatrian, Petersen, & Lazarte, 1959) and its effect on calming maseter muscle tension (Manns, Miralles, & Adrian, 1981).

Physiology of Audio-Visual Entrainment
In order for entrainment to occur, a constant, repetitive stimuli of sufficient strength to “excite” the thalamus must be present. The thalamus then passes the stimuli onto the sensory-motor strip, the cortex in general and associated processing areas such as the visual and auditory cortices. Figure 1 shows the visual pathway with the retina of both eyes becoming excited and sending pulses down the optic nerve, through the optic chiasm, and into the lateral geniculate of both thalami. From here, the visual signals are passed onto the visual and cerebral cortices for further processing. Notice that there is very little delay from the onset of the flash to the response in the optic nerve, but a delay of approximately 100 msec occurs by the time the visual evoked potential (VEP) is elicited in the
visual cortex. This delay may be why entrainment occurs best at the natural alpha frequency — as 100 msec equates to 10 Hz.

Photic entrainment begins its process as a series of overlapping evoked potentials (Kinney, McKay, Mensche, & Luria, 1973). Kinney broke down a simple VEP into its various components (Figure 2) representing the passage of time for 4, 8, 12 and 20 Hz. As can be seen, much of the VEP occurs within 250 msec, correlating to four Hz. The various overlapping parts were then vector summed into the mathematical VEP and compared with the actual VEPs observed by EEG at the higher, entrained frequencies, shown in Figure 2.

When this mathematical model was compared with the actual observed EEG of the entrained stimuli (Figure 3), a high degree of predictability was observed, demonstrating that photic entrainment is indeed a vector summation of VEPs and not a novel neuronal process.

By definition, entrainment occurs when an EEG reflects the brain wave frequency duplicating that of the stimuli, be it audio, visual or tactile (Siever, 2002). Entrainment occurs best near one’s own natural alpha frequency (Toman, 1941; Kinney et al., 1973). LEDs and xenon strobe lights contain much harmonic content due to the “squareness” or rapid turn-on and turn-off transitions of the stimuli and these harmonics are reflected within the EEG. Figure 4 shows a strong and pure entrainment at 12 Hz. The harmonics (small wavelets) seen in the EEG are a reflection of the actual harmonics contained within the stimulus. Square wave stimulation is associated with an increased risk of seizure (Joyce & Siever, 2000; Ruuskanen-Uoti, 1994). The only way to produce entrainment without harmonics is via sine wave stimulation in which the stimuli turn on and turn off in slow, gentle transitions and do not contain harmonics. (Van der Tweel, 1965; Townsend, 1973; Regan, 1966; Siever, 2002).

AVE at 18.5 Hz has also been shown to produce dramatic increases in EEG amplitude at the vertex (Frederick, Lubar, Rasey, Brim, & Blackburn, 1999). The results of this study showed that:

a) eyes-closed 18.5 Hz. photic entrainment increased 18.5 Hz EEG activity by 49%.
b) eyes-open auditory entrainment produced increased 18.5 Hz EEG activity by 27%.
c) eyes-closed auditory entrainment produced increased 18.5 Hz EEG activity by 21%.
d) eyes-closed AVE produced increased 18.5 Hz. EEG activity by 38.3%.

The bulk of entrainment shows itself near the vertex and frontally (Siever, 2002). Figure 5 is a QEEG, or “brainmap” from the SKIL (Sterman-Kaiser Imaging Labs) database, in 1Hz bins showing the frequency distribution of AVE at 7.8 Hz. Notice the area within the circle at 8Hz showing maximal effects of AVE in central, frontal and parietal regions (at 10uv in this case) as referenced with the oval area on the legend. It is through these effects that AVE has proven effective in treating depression, anxiety and attentional disorders. A harmonic is also present at 16 Hz. (the circled image), which is typical of semi-sine wave (part sine/part square wave) stimulation.

Figure 1. The EEG Photic Stimulation Path

Figure 2. EEG Wavelet

Figure 3. EEG VEPs - Vector Addition (Theoretical) Model vs. Observed EEG
Body/Mind Effects of Audio-Visual Entrainment

We conceptualize AVE as achieving its effects through several mechanisms at once (Siever, 2000). These include:
1) dissociation / hypnotic induction,
2) increased neurotransmitters,
3) possible increased dendritic growth,
4) altered cerebral blood flow, and
5) normalized EEG activity.

Dissociation

Dissociation is described as a process in which feelings, memories and physical sensations are kept apart from other information with which they would normally be logically associated. In pathological terms, dissociation is a maladaptive disruption in integrated functioning typically associated with depersonalization, stress, identity, amnesia and depersonalization disorders (Brownbeck & Mason, 1999).

On the other hand, dissociation occurs when we meditate, exercise, read a good book, take in a movie or enjoy a sporting event, because we get drawn into the present moment and dissociate from all of our daily hassles, worries, anxieties and the resulting unhealthy mental chatter. Audio dissociation analgesia using white noise and/or has been shown to effectively increase pain threshold and pain tolerance during a dental procedure (Morosko & Simmons, 1966). Regardless of the activity, this type of dissociation reduces our weekly stress load, whether we are aware of it or not. In essence, when we focus on something, we dissociate from other things. The saying, “a change is as good as a rest,” has much more truth to it than initially meets the eye (Siever, 2000).

The first study on dissociation induced via entrainment involved hypnotic induction, and found that photic stimulation at alpha frequencies could easily put subjects into hypnotic trances (Kroger & Schneider, 1959; Lewerenz, 1963). Figure 6 shows the results of Kroger and Schneider’s study in which nearly 80% of the participants in the study were in a hypnotic trance within six minutes of photic entrainment.

Psychologists have been looking for ways to dissociate their clients as a part of fear and phobia treatment. Inducing dissociation using AVE delivered by the DAVID1 was found to be more effective than dot staring or stimulus deprivation (Leonard, Telch, & Harrington, 1999) as shown in Figure 7.

Furthermore, Leonard completed a second study with people who experience dissociative anxiety (Leonard, Telch & Harrington, 2000). People with dissociative anxiety feel a need to have a sense of control in their lives and become anxious or panicky when they dissociate, be it driving home, at the office, or in a clinical setting. The Acute Dissociation Inventory (ADI) is a 35-item self-report scale (Leonard, et.al., 1999). It assesses dissociative sensations (ADI-Dissoc) and subjective anxiety, or dissociative anxiety in response to dissociative provocation (ADI-Anx). Leonard and her colleagues clinically dissociated people who become anxious when dissociating, by using...
a DAVID Paradise Hemistep™ alpha session. As expected, the participants’ anxiety (ADI-Anx) had almost doubled by the end of the AVE session. The surprise, however, was that their heart rate actually decreased, contrary to normal anxiety reactions (Figure 8). With the ability to clinically dissociate these people, yet simultaneously calm them down somatically, AVE can be used as a desensitization tool for reducing dissociative anxiety.

A dissociative mindstate or hypnotic trance may be described in terms of an altered state of consciousness (ASC) in which the subject (or an independent observer of the subject) observes a qualitative shift in the normal pattern of mental functioning (Glicksohn, 1986-87). ASCs produced via overstimulation also occur when a person is bombarded with higher than normal levels of sensory input, usually in more than one sensory modality (Hear, 1971, Lipowsky, 1975, Goldberger, 1982).

Glicksohn studied photic entrainment and the ASCs produced. He monitored the EEGs of subjects during photic entrainment. They all described a wide variety of reactions to the stimulation with some reporting incredible imagery consisting of items they had seen before in their lives, intertwined with geometrical patterns while others reported no visual changes at all. At the end of the study, Glicksohn concluded that:

1) It is the increase in alpha activity created by photic driving, and not the natural alpha activity itself, that is conducive to an ASC.
2) The appearance of visual imagery is neither necessary nor all that is involved to indicate the experience of an ASC.
3) If a photic driving response is not elicited, the subject will not experience an ASC.

Glicksohn’s observations support the concept that in order for AVE to occur, the stimulating frequency must have a direct impact on brain wave frequency and be observable on an EEG.

**Dissociation and Restabilization**

Dissociating clients with trauma histories, during the course of treatment is important. The state of mind that a person has at any given moment is made up of the brainwave activity associated with apprehension, anxiety, physical tension (proprioceptive/afferent associations), destructive thoughts, and conditioned responses relating to the colors, smells, sounds, etc. Once the mind is clear, all of these tensions, conditioned responses (bracing habits), fearful thoughts and the effects of afferance (sensory information) subside, allowing the mind and brain to relax, become more malleable and open to new healthy thoughts, post-hypnotic suggestions, brainwave activity and so on. During AVE, the EMG and electro-dermal responses fall, finger temperature increases and breathing becomes smooth and diaphragmatic. These changes reflect a return to homeostasis or restabilization, hence the term *dissociation and restabilization* (DAR) (Siever, 2000).

Figure 9 shows a typical reduction in forearm EMG and Figure 10 shows a typical increase in finger temperature. Notice that restabilization begins after about six minutes of AVE, when the user begins dissociating. Figure 11 shows normalization of breathing and heart rate variability following exposure to AVE at 7.8 Hz.
Neurotransmitters

There is evidence that blood serum levels of serotonin, endorphine, and melatonin rise considerably following 10 Hz, white-light AVE (Shealy, 1989). Increases in endorphines reflect increased relaxation while increased norepinephrine along with a reduction in daytime levels of melatonin, indicate increased alertness (Figure 11).

Dendritic Growth

There is evidence that stimulating neurons with mild electrical stimulation promotes growth of dendrites and dendritic shaft synapses in the cells being stimulated (Beardsley, 1999; Lee, Schottler, Oliver, & Lynch, 1980). However, studies do not yet exist on the influence of AVE on dendritic growth, although it is suspected because many people with autism, palsy, stroke and aneurysm (Russell, 1996) have gained significant motor and cognitive function following a treatment program of AVE.

Cerebral Blood Flow

Cerebral blood flow (CBF) is essential for good mental health and function. SPECT and FMRI imaging of CBF show that hypoperfusion of CBF is associated with many forms of mental disorders. CBF increases dramatically during AVE (Fox & Raichle, 1985; Sappy-Marinier et al., 1992). Figure 18 shows an increase of 28% in cerebral blood flow within the striate cortex, a primary visual processing area within the occiput. As an interesting note, maximal CBF occurs at 7.8 Hz, the Schumann Resonance of the earth.

Following Fox & Raichle’s study came a whole head PET analysis of visual entrainment at 0, 1, 2, 4, 7, &14 Hz (Mentis, et. al., 1997). This study on 19 healthy, elderly (mean age=64 years) found that regional cerebral blood flow (rCBF) was activated differentially with the:

1) left anterior cingulate showing maximal increases in rCBF at 4 Hz.
2) right anterior cingulate showing decreases in rCBF with frequency.
3) left middle temporal gyrus showing increases in rCBF at 1 Hz.
4) striate cortex showing maximal rCBF at 7 Hz.
5) lateral and inferior visual association areas showing increases in rCBF with frequency.

While there may be benefits to increasing occipital CBF, there is even greater concern regarding conditions involving hypoperfusion of CBF in frontal regions. Frontal disorders include: anxiety, depression, attentional and behavior disorders, and impaired cognitive function (Amen, 1998). Figure 13 shows an increase in frontal CBF recorded on Hershel Toomin’s “Thinking Cap” (or “Hemoencephalogram”) using infra-red light to measure perfusion of CBF. Notice that CBF at FPZ increases by 15% in 10 minutes (Toomin, personal communication).

Figure 14 shows a fairly typical brain map in 1 Hz bins of a person with mild depression and anxiety as shown on the Skil database. Notice that alpha is slowed and approaching +2SD from the norm and that some beta frequencies (16-18 Hz) are high (>1SD) in central frontal areas.

Following an AVE session of 7.8 Hz., both alpha and beta activity are normalized as shown below in Figure 15.
Conclusion

In closing, AVE has the ability to quickly and effectively relax people out of high sympathetic activation and traumatic states of mind, bringing about a return to homeostasis. AVE may be used alongside hypnotic suggestions on tape/CD or live via a microphone. At the same time however, AVE exerts a powerful influence on brain/mind stabilization and normalization. At the end of an AVE session, the user may realize that he/she has never felt so relaxed for years — perhaps not since childhood.

Parts II of this article series will address several studies where AVE was the clinical intervention. Part III will address the application of AVE in treating attention deficit and cognitive disorders.

Footnote:
1. For more information, address all correspondence to: David Siever, Comptronic / Mind Alive, 9008-51 Avenue, Edmonton, Alberta, Canada T6E 5X4. Toll Free: 800-661-6463, Phone: 780-461-9551, Web: comptronic.com, Email: info@comptronic.com

References


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**Sport Psychophysiology: the Current Status of Biofeedback with Athletes (Part 1)**

continued from Page 20


No one has attended meetings of the Association of Applied Psychophysiology and Biofeedback or who has followed recent writing in the field of neurofeedback, biofeedback or complimentary complementary-medicine can look at this wonderful handbook without being amazed and pleased at the list of contributing authors who participated in this project. Don Moss and his fellow editors have brought together a group representing hundreds of years of practical clinical experience and have done so without sacrificing the readability and utility required of any effort entitled Handbook. You will find a full-course meal contained in the 545 pages of this book and I believe anyone with a hunger to learn about behavioral medicine in primary care will have their craving satisfied.

The appetizer that quickly engages you in the need for this book is provided in the Foreword, written by Terrence C. Davies, MD (Chair of Family and Community Medicine Eastern Virginia Medical School) and Frank V. deGruy, MD (Chair of Family Medicine, University of Colorado School of Medicine). After developing the historical context of primary care and its crucial role in today’s society, they note that mind-body problems hold a “central place” within primary care. The authors also clearly challenge the separation of “mental” vs. “physical” health and stress the need for integration in any effective primary care program. I would advise readers who generally skip a book’s Foreword not to do so in this case.

The main course of this book is divided into four Parts including Part I: Models and Concepts for Mind-Body Medicine, Part II: Basic Clinical Tools, Part III: Applications to Common Disorders, and Part IV: Education for Mind-Body Medicine. Don Moss, director of West Michigan Behavioral Health Services and past president of AAPB, begins Part 1 with an overview of Mind-Body Medicine and Clinical Psychophysiology and does this in the context of Evidence-Based Medicine. He provides working definitions of each of these terms and conveys the insight of a seasoned clinician making conceptual models blend nicely into practical clinical usefulness. Ian Wickramasekera, who has contributed for many years in both biofeedback and hypnosis research, has two chapters in this first section. In his first chapter he introduces his time-tested High Risk Model of Threat Perception and elaborates on issues of Somatization and Psychophysiological Disease. In Chapter 5 Dr. Wickramasekera reviews the literature on the Placebo Effect and applies this to the use of biofeedback instrumentation in clinical practice. He also provides a broad overview of Hypnotherapy in Part II, Basic Clinical Tools. He includes in this review both traditional “State” theories of hypnosis represented, by researchers such as Hilgard, as well as more recent cognitive theories presented by Irving Kirsch and others, giving his chapter a well-rounded feel. While space doesn’t permit a discussion of each of the fine chapters in Part I, I did find the chapters by Angele McGrady, Don Moss, director of West Michigan Behavioral Health Services and past president of AAPB, very useful. While Dr. McGrady provides the Psychophysiological Foundations of Mind-Body Therapy, Dr. Striefel considers Ethics and Practice Standards as they relate to Mind-Body Medicine.

While Dr. Moss lists 16 Complementary and Alternative Medicine Therapies in his first chapter, only a few of these are given in-depth consideration in the Basic Clinical Tools section. In addition to the the section on Hypnotherapy, there are chapters on both Biofeedback and Biological Monitoring, Neurofeedback, Neurotherapy, and QEEG, Acupuncture, Cognitive-Behavioral Therapies for the Medical Clinic, and Relaxation, Autogenic Training, and Meditation. This section also contains an outstanding chapter by Stanley Krippner, of the Saybrook Graduate School, on Spirituality and Healing. In completing the Mind-Body-Spirit triad, Dr. Krippner provides a historical and world-view context for spirituality in healing while at the same time pointing out how deficient current Western Medicine is in providing this type of care to our patients. He goes on however to offer practical suggestions on how to begin to address spiritual issues with clients and enter this crucial but “uncharted” area.

Building on the discussion of Conceptual Models and Clinical Tools, Part III provides a full 17 chapters applying these tools to “Common Disorders”. Some of these chap-
ters cover a broad category area such as Sharon Williams Utz chapter on Caring for the Person With a Chronic Condition or the chapter on The Metabolic Syndrome by Angele McGrady, Raymond Bourey and Barbara Bailey. Most of the chapters however are quite specific and include topics such as Headache, Asthma, Temporomandibular Disorders and Facial Pain, Back Pain, Coronary Disease and Congestive Heart Disorder, Urinary Incontinence, The Functional Bowel and Anorectal Disorders, Fibromyalgia, Chronic Fatigue, Premenstrual Syndrome and Premenstrual Dysphoric DisorderMS, and Rheumatoid Arthritis.

One of the true values of this Handbook comes from being able to cross-reference the material in Part II and Part III. For example, Theodore J. La Vaque provides a nice history and overview, including a vocabulary lesson related to Neurofeedback, Neurotherapy and Quantitative EEG. While he also discusses applications, more detailed use of EEG can be found in Joel Lubar’s chapter on Attention Deficit Hyperactivity Disorder, Charles Lapp’s chapter on Chronic Fatigue Syndrome, in Don Moss’s chapter on Anxiety Disorders, and in Elsa Baeber and Peter Rosenfeld’s chapter on Mood Disorders. In Chapter 8 Christopher Gilbert and Don Moss provide an overview of many of the “traditional biofeedback” techniques including EMG, Skin Temperature, Skin Conductance, Heart Rate, and Respiration Feedback. Applications for these tools are found in many chapters including those of Steve Baskin and Randall Weeks on Headache, Gabe Sella’s chapter on Musculo-skeletal Skeletal Pain Syndrome, the chapter on Functional Bowel and Anorectal Disorders by Olafur Palsson and Robert Collins, Stuart Donaldson and Gabriel Sell’s chapter on Fibromyalgia and the chapter regarding Asthma by Paul Lehrer, Mahmood Siddique, Jonathan Feldman, and Nicholas Giardino. The use of hypnosis is suggested in disorders including asthma, sleep disorders, fibromyalgia, back pain, chronic fatigue and irritable bowel syndrome.

The final section of this book deals with focuses on the education of professionals in Mind-Body Medicine. Separate chapters are dedicated to the education of physicians, (Margaret Davies and Olafur Palsson), physician assistants, (Robert Jarski), nurses (Debra Lyon and Ann Gill Taylor), and behavioral health providers, (Richard Gevirtz). In both of the chapters dealing with physicians and physician assistants there is quick acknowledgment that the formal training has been quite neglectful deficient regarding Mind-Body Medicine. The authors of the chapter on nursing education point out that the roots of nursing come from a holistic nurse-patient relationship but that a desire to be “scientific” redirected much of the training in this area. Dick Gevirtz deals with the controversy within behavioral medicine over who should be providing services and clearly does not take the traditional “PhD only” stance in training or service delivery.

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The dessert comes in the final chapter when Dr. Moss offers Existential and Spiritual Dimensions of Primary Care: Healing the Wounded Soul. Following up on Sharon Utz’s earlier reference to “the Kingdom of the Sick”, Don provides eight key perspectives to build the case that an existential and spiritual outlook is needed not only in Mind-Body Medicine, but in all of medicine. I have no doubt that if this chapter was required reading for all physicians, nurses, psychologists, and administrators, our patient care, our outcomes and our job satisfaction would all be much improved.

In short, this book does a remarkable job in bringing together an impressive cast of authors to deal with a difficult and neglected area. Gabe Sella laments in his chapter concerning back pain that “...there are no funds available to look into what society does not want to see” (pg. 270). This book goes a long way in providing the evidence that what mainstream medicine has not wanted to see has been to the detriment of our health and that the integration of Mind-Body Medicine into traditional primary care is an essential step in providing new paths back to the Kingdom of the Well.

This book is available from AAPB’s bookstore, and 40% of each purchase price will go to support AAPB.

Eric K. Willmarth, PhD
President, Michigan Behavioral Consultants.
Use of biofeedback in Hong Kong can be categorized into three settings: the university, the hospital, and the sports institute.

University: At the Polytechnic University the Department of Rehabilitation Sciences has conducted research on mental workload using EEG on normal working subjects. They utilize a 40-channel NeuroScan™ and a 16-channel Harmoni™ system.

Hospitals: I have identified three hospitals in Hong Kong applying biofeedback therapy with their patients. They all use the Procomp+™ biofeedback system and the modalities are surface EMG, Heart Rate, Skin Temperature, Skin Conductance, and Respiration, but not EEG. The hospitals and departments involved are: (1) the Psychiatry and Clinical Psychology Department of the Queen Mary Hospital, which treat patients with Raynaud’s disease (loss of circulation to the hands and feet), insomnia, anxiety, and muscle tension/pain, (2) the Clinical Psychology Service Department of the Tuen Mun Hospital, which treats patients with chronic muscle pain, anxiety, and stress-related disorders, and (3) the Clinical Psychologists of the Staff Clinic of the Hospital Authority, which treats hospital staff members with insomnia, psychosomatic pain, muscle pain, and motor tension (tension throughout the entire body, which restricts mobility).

Sports Institute: I am employed at the Hong Kong Sports Institute, of the Hong Kong Sports Development Board, a government funded training center and sports science support center for all the elite/scholarship athletes in Hong Kong. Since 1992, biofeedback has been used to help elite athletes in Hong Kong to better understand their biological response in order to achieve self-regulation of arousal level. At the moment, we utilize two Procomp+™ biofeedback systems (Thought Technology). The parameters we usually use are Skin Conductance (SC), Skin Temperature (ST), Heart Rate (HR), and Respiration, not much different from other biofeedback practitioners. We did one research study regarding whether an individual’s preference of visual versus verbal imagery could influence the effectiveness of systematic desensitization in reducing competition anxiety. HR is used to monitor the changes during desensitization training. The results indicate that the athletic population preferred visual imagery as their cognitive style over verbal imagery. The results also demonstrate that the imagery based systematic desensitization procedure appeared to be equally effective for the reduction of anxiety for all participants, regardless of preferred cognitive style.

Another research study we did used a multi-disciplinary approach with collaboration of the Exercise Physiologist, the Biochemist and the Sport Psychologist, looking at the effect of motivational imagery on increasing power output. The reason we use a multi-disciplinary approach is that we believe that, most of the time, individuals undermine their potential/pain tolerance due to their past experiences. In this case, the physiologist monitors the power output using Cybex, the biochemist monitors the effort level using blood lactate, and the sport psychologist teaches mental skill to elevate the feeling of competency. Skin Conductance is used to monitor the relaxation and arousal level during imagery training. We find that both control and experimental group have increased power output at the post-tests. Most probably the imagery effect was confounded with the biochemistry feedback, blood lactate level. In normal practice, athletes learn to look at their lactate level as an indicator of their effort in each training session. In this investigation, we failed to prove that an increase of power output is due to the effectiveness of motivational imagery. However, we were able to prove that, with the help of objective feedback (either biochemical, physiological or biological response), one’s self-awareness can be improved, thus, full potential is more likely to be elicited.
ABOUT THE AUTHORS

Jeffrey R. Cram, PhD, is currently the clinical director of the Sierra Health Institute of Nevada City and the executive director of the Auburn Pain Clinic in California. He is the founding president of the Surface EMG Society of North America (SESNA), now the SEMG Division of the Association for Applied Psychophysiology and Biofeedback. He has authored three books on surface EMG and 35 scientific articles on a variety of topics related to applied psychophysiology. He is on the editorial board for four journals (American Journal of Pain Management; Applied Psychophysiology and Biofeedback; Journal of Manipulative and Physiologic Therapies; and International Journal of Healing and Caring) and is an advisor to the Biofeedback Society of California. Dr. Cram is an international expert on surface electromyography and teaches both nationally and abroad multiple times a year.

Polina Cheng, MPhi., is currently a Sport Psychology Officer with the Hong Kong Sports Development Board. She earned her bachelors degree at Cornell College in Mt. Vernon, Iowa, and her masters degree at the University of Hong Kong. She conducts workshops teaching sport psychology theory to coaches and workshops on performance enhancement to elite athletes and coaches. She worked with participants in the 1998 and 2002 Asian Games and 2000 Olympic Games preparing them for competition preparation and conducting post-game intervention. She is also preparing the Olympic qualifiers for the 2004 Olympic Games in Athens.

Ron Fuller, BA, PTA, is a licensed physical therapy assistant and the national aquatic specialist for HealthSouth Corporation, practicing at HealthSouth Rehabilitation Hospital in Concord, New Hampshire. Mr. Fuller attended the University of Texas in San Antonio, Texas where he received his certificate in Physical Therapy and Occupational Therapy techniques. He is an adjunct faculty at Franklin Pierce College and New Hampshire Community Technical College where he teaches aquatic physical therapy and advanced orthopedic techniques to physical therapy students. He is on the teaching faculty of Aquatic Consultants of Georgia and clinical faculty of the Biofeedback Foundation of Europe. He has authored several articles on aquatic rehabilitation and lectures nationally and internationally on aquatic physical therapy for orthopedic and neurologic conditions and the use of aquatic biofeedback in the treatment of upper and lower extremity conditions.

Bradley D. Hatfield, PhD, is a full professor in the Department of Kinesiology at the University of Maryland, College Park, with adjunct appointments in the Center for Neural and Cognitive Sciences and the Center on Aging. He received his PhD in 1982 from the Pennsylvania State University where he was supported by the Research Council of Canada as a predoctoral fellow. He has published in a number of scholarly journals such as Psychophysiology and Biological Psychology.

Scott E. Kerick, PhD, earned his PhD in 2001 from the Department of Kinesiology at the University of Maryland, College Park and is currently a National Research Council Postdoctoral Research Associate at the Human Research and Engineering Directorate of the U.S. Army Research Laboratory, Aberdeen Proving Ground, Maryland 21005. Dr. Kerick has published scholarly work in Biological Psychology, Medicine and Science in Sport and Exercise, and Neurobiology of Aging.

Katherine Gibney is a biofeedback therapist and Clinic Manager at NovaCare Rehabilitation in Oakland, California. She collaborates with Erik Peper in student research and Risk Management Prevention Programs at San Francisco State University. She is co-author of two books, Healthy Computing with Muscle Biofeedback and Make Health Happen: Training Yourself to Create Wellness, of numerous articles and research papers, and co-producer of Healthy Computing Email Tips. She is co-director of Work Solutions, USA, which provides work-site prevention and employee training utilizing biofeedback.

Jeff Leonards, PhD, is a licensed psychologist with Evergreen Behavioral Services, a division of the Franklin County Health Network (http://www.fchm.org ) in Farmington, Maine. Through this network, Dr. Leonards coordinates behavioral medicine services including consultation to Franklin Memorial Hospital, a rural 70-bed facility where he is an affiliate member of the medical staff. Dr. Leonards is an avid athlete, participating regularly in cycling, hockey, weight training, and nordic skiing. He holds a black belt in Tae Kwon Do, is a former ski-patroller, and is current president of the Western Mountains Hockey and Skating Association.

Erik Peper, PhD, is Professor and Director of the Institute for Holistic Healing Studies at San Francisco State University. He is President of the Biofeedback Foundation of Europe and past President of the Biofeedback Society of America, now AAPB. His most recent books are Healthy Computing with Muscle Biofeedback and Make Health Happen: Training Yourself to Create Wellness. He is co-producer of Healthy Computing Email Tips. His research interests focus on psychophysiology of healing, healthy computing, respiratory psychophysiology and voluntary self-regulation. Correspondence can be directed to ihhs@sfsu.edu

Lawrence M. Schleifer, EdD, CPE, is an Industrial Psychologist and Certified Professional Ergonomist (CPE) with the National Safety and Health Program, Internal Revenue Service, Washington, D.C. He also holds an appointment as an Adjunct Associate Professor in the Department of Kinesiology, University of Maryland and is currently the Principal Investigator of a research grant titled “EMG Gaps, Psychosocial Factors and
Musculoskeletal Disorders in Computer Work,” which is funded by the Johns Hopkins Center for Information Technology and Health Research.

David Siever graduated in 1978 as an engineering technologist. He later worked in the Faculty of Dentistry at the University of Alberta designing TMJ Dysfunction related diagnostic equipment and research facilities. He organized research projects, and taught basic physiology and a TMJ diagnostics course. Dave observed anxiety issues in many patients suffering with TMJ dysfunction, prompting him to learn and practice biofeedback and design biofeedback devices. In 1984, Dave designed his first audio-visual entrainment (AVE) device— the DAVID1. Since then he has researched and refined AVE technology, specifically for use in relaxation, and treating anxiety, depression, PMS, ADD, FMS, SAD, hypertension and insomnia. He presents AVE technology applications regularly at conferences and for special interest groups.

Thomas W. Spalding, PhD, is an assistant professor in the Department of Kinesiology and Health Promotion at the California State Polytechnic University, Pomona. He earned his PhD in health education in 1989 from the University of Maryland, College Park. His research focus is human stress reactivity and he has published scientific articles in journals such as Biological Psychology, Medicine and Science in Sport and Exercise, and the American Journal of Industrial Medicine.

Sebastian “Seb” Striefel, PhD, became a Professor Emeritus in the Department of Psychology at Utah State University in September 2000. For twenty six years he taught graduate level courses in ethics and professional conduct, clinical applications of biofeedback, clinical applications of relaxation training and behavior therapy. He was also the Director of the Division of Services at the Center for Persons with Disabilities at Utah State University. In that role he managed a variety of programs, including an outpatient clinic, a biofeedback lab and an early intervention program.

He is a past president of the Association of Applied Psychophysiology and Biofeedback (AAPB), current president of the Neurofeedback Division of AAPB, Secretary/Treasurer of the International Section of AAPB and regularly writes an ongoing ethics column and conducts workshops on ethics, standards, and professional conduct.

Eric K. Willmarth, PhD, is the president of Michigan Behavioral Consultants, P.C., a private practice specializing in pain management. He received his PhD in clinical psychology from the Fielding Graduate Institute. He is the past-president of the Michigan Society of Behavioral Medicine and Biofeedback, and the Chair of the Ethics Committee for the American Society of Clinical Hypnosis. He served as the Program Chair for the 33rd AAPB annual meeting in Las Vegas and was the 2001 winner of the APA’s Division 30 Hilgard Award. He has over 25 years of experience in biofeedback, hypnosis, and behavioral medicine.

**UPCOMING WORKSHOPS**

**Using Heart Rate Variability Biofeedback (HRVB) to Treat Functional Disorders**

Richard Gevirtz

October 12, 2003 • Arlington, Texas

This workshop has as its objectives 1) familiarizing participants with the theory and measurement of heart rate variability, 2) presenting biofeedback protocols which include HRVB techniques, and 3) applying these techniques to the treatment of disorders such as IBS, Asthma, Migraine, or Myofascial Pain. Demonstrations and hands on training will be offered to compliment the background information.

**Course Objectives:**

Each participant should be able to:

1. Describe the basic theory and measurement considerations involved in HRV
2. Demonstrate ability to administer a HRVB protocol to a sample patient
3. Apply the above principles to various "functional" disorders

**Bio:** Dr. Richard Gevirtz is a professor in the Health Psychology Program at the California School of Professional Psychology at Alliant International University in San Diego. He has been involved in research and clinical work in applied psychophysiology for the last 25 years. His primary interests are in understanding the physiological and psychological mediators involved in disorders such as chronic muscle pain and gastrointestinal pain. He is the author of many journal articles and chapters on these topics.

More information: biofdbk1@aol.com
The Heart and Mind of Biofeedback
Biofeedback Society of California
29th Annual Conference

Co-sponsored by the Biofeedback Society of California and the Association for Applied Psychophysiology and Biofeedback

November 6 - 9, 2003 • Pre-Conference Workshops: November 6-7, 2003

15 Hours of General Conference CEU are already approved

The pre-conference workshops, sponsored by AAPB, are the beginning of a journey through the depths of the Heart and Mind of Biofeedback. Internationally know presenters Lynda and Michael Thompson, and Paul Lehrer will be the faculty for these outstanding events.

Neurofeedback Fundamentals for Successful Assessment and Training   Presented by Lynda Thompson, Ph.D. assisted by Michael Thompson, MD

This workshop covers the basic science behind neurofeedback and provides practical pointers for how to assess and improve functioning in clients with a variety of problems: ADHD, learning disabilities, Asperger’s syndrome, seizure disorders, anxiety, movement disorders (Tourette’s, Parkinson’s) and depression. Participants will learn about quantitative EEG profiles (single channel and 19-channel) and how they differ according to symptoms. A logical approach to moving from assessment information to decisions about which frequencies and electrode placements to use is given.

There will be tips on how to set up training programs that combine neurofeedback and biofeedback. Included are methods for helping generalization of the training to home, school and work environments. The course will also mention how to use these techniques to optimize the performance of executives and athletes. What you will learn:

- Recognize EEG patterns that are typical for anumber of disorders.
- Understand one and two channel EEG assessments and describe the procedures for applying electrodes, collecting, and artifactual EEG data.
- Develop a rational intervention based on assessment data, and combine elements of neurofeedback, biofeedback and cognitive strategies for an individualized training program.

This course is suitable for those new to the field of neurofeedback as well as to experienced clinicians who want to review the most effective practices in our field and the science that underlies EEG work.

Cardiovascular Resonant Frequency Biofeedback, Presented by Paul Lehrer, Ph.D.

This workshop will introduce participants to cardiac variability, the complex patterns of oscillation that comprise it, interpretation of various rhythms, and effects of biofeedback for amplifying respiratory sinus arrhythmia (RSA). We will theorize and/or show how this method can improve homeostatic capacities, improve performance, enhance resistance to functional illness, and how RSA biofeedback is influenced by cardiovascular resonant frequencies. Experiential and applied exercises will be done, and treatment manuals and applications to autonomic and emotional dysfunction will be discussed. What you will learn:

- To identify the various known oscillations in heart rate, their link with breathing, and known physiological mediators.
- To examine the theoretical links between the body’s homeostatic capacity and both the complexity and amplitude of these oscillations.
- To recognize the differing resonant frequencies for heart rate and blood pressure, and implications for studying and training baroreflex activity.

You will also have the opportunity to advance your education and sharpen your professional skills by participating in any one of 5 panels, 4 keynote presentations and 18 outstanding short courses. Workshops, short courses, keynotes and panels on the Heart rate variability and EEG biofeedback will cover the latest research on the Heart and Mind. A special luncheon panel on Ambulatory Physiological Monitoring will be sure to bring new ideas to biofeedback and continuous monitoring of physiological stress levels. This year we are expecting more student involvement with a poster presentation session. Join us for an in-depth examination at the latest biofeedback hardware and software by spending time at a dedicated available for demonstrations and teachings. A special workshop from a new member coming from Mexico City will help to teach us how to work with children from Mexico.

Outstanding speakers include: Michael and Lynda Thompson, Paul Lehrer, Peter Litchfield, Rob Kall, Dick Gevirtz, Larry Jammer, Shari St. Martin (Mexico City, Mexico), Naras Bhat, and Eric Peper.

Contact BSC at (800) 272-6966 or (714) 848-0022 for more information, or see http://www.biofeedbackcalifornia.org/2003%20Conference.htm.
Dear colleagues:

ISNR and AAPB are co-sponsoring a one day workshop on the "Fundamentals of General Biofeedback" on September 17 at the ISNR conference in Houston. Knowledge and skills in general biofeedback can broaden the kinds and numbers of referrals which your neurofeedback practice can accept. You will be able to address more diagnoses and disorders, help more people, and recruit referrals from a larger market. General biofeedback is also an excellent tool to prepare patients for neurofeedback. Learning simple physiological control assists the individual to gain a stronger internal locus of control. Neurofeedback often proceeds faster when interspersed with such basic biofeedback modalities as thermal biofeedback and respiratory biofeedback.

Two experienced clinicians and teachers, Drs. Fred Shaffer and Don Moss, will be teaching this workshop, which will cover the following objectives: 1) introduce the students to the basic modalities of peripheral biofeedback, 2) review the common well-documented applications of peripheral biofeedback, 3) review autonomic nervous system physiology relevant to biofeedback, 4) review ANS mediated biofeedback treatment interventions, and 5) review conceptual models for the efficacy of biofeedback therapies, including general stress theory, operant conditioning, the stress-diathesis model, and non-specific therapeutic effects.

This workshop will also provide eight didactic hours toward BCIA certification, and will include demonstrations with several general biofeedback modalities. The workshop will be taught at the introductory level.

For more information on the workshop, see the following prospectus. To register for the ISNR conference and this workshop, please go to http://www.isnr.org/2003/main2003.htm

Sincerely,

Lynda Kirk, MA
President, AAPB

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Make your plans now to join us in HOUSTON on SEPTEMBER 18 – 21, 2003 for the 11th Annual ISNR Conference!

Bring your string tie and fancy boots. Rustle on over to the Westin Oaks where the rates aren’t Texas sized, but the discounts ARE - $99 per night – single or double occupancy! We continue the tradition of good science and good times!

Our conference highlights some of the most prominent neuroscientists and clinicians in the world. Our Keynote and Invited speakers include Donald Bars (Switzerland) Anat Barnea (Israel), John Gruzelier (Great Britain), John Hughes, Wolfgang Klimesch (Austria), Juri Kropotov (Russia), Norman Moore (Australia), Rolland Parker, Karl Pribram, Alan Scheflin, Barry Sterman, Gabriel Tan, Robert Thatcher, Lynda & Michael Thompson (Canada), and Eran Zaidel.

As in previous years, the ISNR conference is the place to learn about the latest research and clinical techniques that are being applied in the field of EEG Biofeedback. The presentations and workshops this year include several basic introductory sessions for the beginner, diverse clinical applications (including LORETA) with various patient populations for the clinicians, and several QEEG and ERP studies for the researchers in our society. No matter what one’s interest is or level of expertise, there is something for everyone in this exciting conference!

See our website, www.isnr.org for a list of pre- and post-conference workshops, and a complete conference schedule! Don’t forget the registration form! See y’all there!
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Invest wisely in your practice - insist on flexibility, ease of use, and affordability!
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“I want to tell you all how truly honored I am to serve as your president. I have a strong love for this field and for AAPB. You are my friends and colleagues, and you have mentored me, nurtured me, and taught me much. I promise to do my very best to help this organization and our field to grow and thrive so that we can reach the many, many people who need what we do. Now perhaps more than at any time in our history, what we have to offer is really important. In the next several paragraphs, I want to take you on a brief journey from our past to our present to a vision of our future. What we do greatly affects the future of this field. It’s up to us. We have much important work to do.

As I did research preparing my talk for AAPB’s 34th Annual Meeting, I was awed by the length of time we human beings have been on a quest for tools of transformation. Since the beginning of human history, there is plenty of evidence that our ancestors attempted to understand and influence the internal and external “powers-that-be.”

From the prehistoric cave drawings, to the great pyramids in ancient Egypt almost 5000 years ago; to megaliths such as Stonehenge, to shamans and healers down through the ages, we humans have sought tools of transformation. We have continued this quest in explorations of the mysteries and wonders of nature, mathematics, and science, and in our longing for connection to the Absolute.

And in our more recent history, from the Greens’ early work at Menninger and the work of many other biofeedback pioneers such as Kamiya and Basmajian to our current biofeedback applications, we have seen stunning successes in transforming and healing mind, body, and spirit.

St. Augustine said, “Miracles do not happen in contradiction to nature, but only in contradiction to that which is known to us about nature.” Our current technologies allow us ever-increasing knowledge about nature. We can now map the human brain and map the human genome. We have technologies to map both inner and outer space. Our tools of technology have become powerful tools of transformation.

Our current biofeedback tools allow us to guide people from states of dysfunction to function all the way to optimal function. As you know, biofeedback can help people with the following dysfunctional states become more functional: anxiety disorders, panic disorders, OCD, sleep disorders, stress disorders, depression and mood disorders, PTSD, ADHD, pervasive developmental disorder, Tourette’s, conduct disorder, addictions, learning disabilities, and more. It is nothing less than transformative for a patient with anxiety or depression to use biofeedback to reduce their symptoms and their need for medication simultaneously. You and I have very many patients who go back to their referring physicians and thank them dearly for suggesting biofeedback.

Complaints more often categorized as “medical” where biofeedback can improve function are myriad: chronic pain, migraine and tension headaches, myofascial pain disorder, fibromyalgia, chronic fatigue, autoimmune disorders, asthma, irritable bowel syndrome, TMJ syndrome, hypertension, Raynaud’s, epilepsy, brain injury, cardiac arrhythmias, coronary disease, gastrointestinal problems, acid reflux, esophageal spasm, chronic constipation, urinary incontinence, dysfunctional voiding, interstitial cystitis, vulvodynia, vaginismus, muscle spasm, dystonias, and more. Patients with these presentations are the ones who were historically referred to biofeedback as a last resort. I am thankful that this is no longer the case. Yet, even though biofeedback is considered mainstream, we’re not reaching enough people.

Biofeedback technologies are also an integral part of optimal function training, whether the application is to health and wellness, to sports and athletics, to business, to education, to performing and fine arts, or to life. The common thread in all these applications is self regulation.
With EEG biofeedback, we can now self-regulate our brainwaves. Let’s use ADHD as an example. According to the American Academy of Pediatrics, ADHD is the most common neurobehavioral disorder of childhood, with an estimated 6-9% of children in the U.S.A. having ADHD. There are a number of valid public health concerns about medication treatment of ADHD. Medications fail to produce desired improvements in 30-40% of patients. Gains from pharmacotherapy are state-dependent (i.e. they wear off). 20-50% of patients experience side effects from medications. And there is well-documented potential for medication abuse.

We have an excellent rationale for EEG biofeedback versus medication management for ADHD. As I tell the University of Texas Medical School residents who cycle through my clinic during their Integrative and Complementary Medicine rotation, EEG biofeedback can be an effective, drug-free alternative for patients who have side-effects from medication, who have poor medication response, who are concerned about medication’s long-term effects, or who simply refuse to consider medication.

With biofeedback we can now self-regulate our physiology. As one of my patients told an Austin magazine, “I have no more migraines and way less stress. I wish the doctor had made the suggestion to do biofeedback earlier instead of wasting time and money on pills that don’t work.”

With biofeedback we can now self-regulate our emotions. Another of my patients who was interviewed in the newspaper stated, “I don’t do depression anymore. I don’t react angrily very often any more, and when I do I get over it real quick. I credit EEG biofeedback for making it possible. I’ve got a new appreciation of life. They say life begins at 40. Well for me it began at 41 because that’s when I finished my biofeedback training.”

With biofeedback we can now self-regulate our cognition, our intellect, and our consciousness in ways that were not previously possible. This unprecedented ability heralds a dramatic breakthrough in the shift of power to the individual. This is perhaps the most powerful thing we have to offer – we can empower people – and shift their locus of control from external to internal. They can own the ability to self-regulate.

William James said, “The greatest thing, then, is to make the nervous system our ally instead of our enemy.” Our transformational tool of biofeedback has the potential to shift our old paradigms of healthcare and healing and launch new paradigms of psychophysiological self-regulation.

We now have the potential to produce enormous social and economic changes with biofeedback and psychophysiological self-regulation. Take seizures as an example. The chance that a medically uncontrolled candidate for temporal lobectomy can be saved with EEG biofeedback is estimated to be about 50%. Surgery costs are between $50,000 to $100,000. You figure the math (not to mention the risks of surgery, infection, downtime and more). Yet how often is biofeedback considered an option?

If we look back at Gene Peniston’s work with alcoholic veterans over 13 years ago, subsequent hospitalizations were reduced by 80%. Using fiscal projections from 10 years ago, the cost of hospitalization was over $100,000 compared to the $3000 to $5000 cost of the biofeedback Peniston used to get these results. This is yet another example of biofeedback being the tools of transformation in the lives of these vets and their families.

What are the potentials and possibilities for us and our field? I propose to you that the sky is the limit. Consider what associate editor neurologist Frank Duffy, MD wrote in his editorial in the journal Clinical EEG: “The literature, which lacks any negative study of substance, suggests that EEG biofeedback therapy should play a major therapeutic role in many difficult areas. In my opinion, if any medication had demonstrated such a wide spectrum of efficacy, it would be universally accepted and widely used.”

“Build it and they will come.” We have the tools of transformation before us. What we must build, my friends and colleagues, is increased awareness in the professional and lay public about biofeedback and psychophysiological self-regulation. We MUST get the word out and make biofeedback more widely available to a public that is hungry for self-regulation. What we have to lose by inaction on our part is the opportunity to make a real impact on unnecessary human pain and suffering. What we have to gain by building increased awareness of our powerful tools of transformation is quantum leaps in health, creativity and human potential. The time is now. It’s up to us.
Awards and Recognition

At the AAPB awards and recognition breakfast in Jacksonville on March 30, 2003 the following individuals were honored. The presentations were made by President Paul Lehrer and the following comments are from his presentation.

The first two recognitions go to pioneers in our field—Marjorie and Hershel Toomim. These two folks have been true pioneers in biofeedback, in clinical practice, in training and in the development of instrumentation. They have given years to our field and we recognize their contributions with a plaque. Congratulations Marjorie and Hershel.

The next presentation goes to an old friend, a colleague, a teacher and a mentor—Dr. David Shapiro. Dave was also a pioneer in this field who inspired many of his students to follow a science career in the study of applied psychophysiology.

This year we honor Dr. Donald Moss as the recipient of the Sheila Adler Service Award for AAPB. The Awards Committee selected Donald P. Moss PhD for his major contributions to AAPB and to the field. As Editor of our magazine, Biofeedback, he turned the newsletter into a first class magazine of which the membership can be proud. As chair of the primary care interest group, he nurtured its growth into an active section of AAPB. He served as chair of several AAPB committees and completed his term as president of AAPB a year ago. As editor of his new book, *Mind Body Medicine for Primary Care*, he led the effort to present the best clinical applications to the national and international primary care audience.

The second recognition goes to Edward B. Blanchard PhD as the recipient of the AAPB Distinguished Scientist Award. His outstanding research over many years has garnered recognition and grant support by NIH and by numerous scientific journals that have published his work. His research has been highly influential in advancing science and practice in the areas of headache, hypertension, irritable bowel syndrome and post traumatic stress disorder. He has shared his vision and his expertise with his graduate students, who have gone onto independent careers at academic institutions, and with his colleagues in AAPB, who have been educated and inspired by his work. AAPB is proud to confer the Distinguished Scientist Award to Dr. Ed Blanchard.

I turn to my close friend and colleague, Richard Sherman 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 or organization who provides outstanding service to AAPB and to applied psychophysiology as recognized by the President. This year we want to recognize Larry Klein and Hal Myers the founders of Thought Technology Ltd. They too are pioneers in our field who helped develop and nurture its growth. Over the years they have been strong supporters of AAPB, helping promote our meeting, our programs and membership development. Their contributions have included advertising our programs in the printed materials, contribution of complete instrumentation systems to qualified students and sponsorship of meeting events note your wonderful tote-bags. Thank you for being our friends and partners.

In our enduring relationship with corporate members, we thank you for your support this past year. Without your development and new products, our field would not progress. Although your plaque was presented to you at your booth, I would like these company representatives to stand up and be recognized: Bio-Medical Instruments, Inc.; Heritage Medical Services; Stens Corporation, and Thought Technology, Ltd.

This year’s student scholarship awards recipients were: Elizabeth Bigham, Ashley Burden,
I started this column hoping to add my two cents on complementary and alternative medicine. As I reflect back on our Jacksonville annual meeting, I keep hearing Jim Gordon’s words on mind-body medicine. He emphasized the therapeutic benefit of groups to facilitate social support across the spectrum of health care. In a sense, mobilizing the power of a supportive “home-like” environment to empower and heal.

Let me digress. I travel a bit and in times of chaos, either personal or community-wide, it is always a bit unnerving to leave home. Leaving Connecticut for LaGuardia airport to attend our annual meeting, I felt a vague sense of disquiet. There was a war beginning, and at 6:30 AM on a weekday morning, there was surprisingly little traffic into NYC. When I got to the airport, I was amazed at how empty it was. Close to 8 AM and I am the only person at a boarding pass machine. A lonely agent walked over and said, “Excuse me sir, thanks for flying Delta, do you need some help.” The slight feeling of dread increased a bit when she noticed my 3 one-way tickets and my luggage was sent straight to radiology. I was allowed to board and spent the flight studying the program for the annual meeting. Rich Sherman had put together an incredible group of speakers covering a large area of the biofeedback and applied psychophysiology waterfront. I began thinking about AAPB, the uniqueness and diversity, the wonderful friendships formed over the years. My unease was lifting.

I went to the Allied Health Professional section meeting and was impressed with their ideas and energy. A student from California told me how much he was enjoying the meeting and how he felt that it was provocative, stimulating and fun. He had a plan to get more students involved in our association. He suggested that all the “senior” members, which unfortunately, I think, included me, should give 10 talks a year to student groups, exposing them to our work and ideas and encouraging them to join. Ten might be a bit much, but I did one last week at Yale, that bastion of seriousness. I did the necessary power point psychophysiology of migraine talk. However, my message to them was to never join a professional group, or any group for that matter, that’s spiritually constipating. I introduced them to AAPB; diverse, unique, challenging but friendly, lots of innovation and excitement, peppered with the occasional characters and renegades. My professional home. Vital and full of strong opinions. I’ve always believed it’s easier to lower the volume than to raise it. We need to proselytize, a bit. Go forth “senior” members and bring in some new faces.

**FROM THE PRESIDENT-ELECT**

**Finding a Professional Home: President Elect’s Column**

*Steve Baskin, PhD*

We had lunch, (Mark for the second time), and talked about our work, families, health, and Mark gave me a viewing of the wonderful new edition of his classic book. We laughed a lot. We talked about being members of other professional groups and how AAPB is clearly our professional home.

Then I ran into the Medical College of Ohio crowd; Angele McGrady, Tom Fine, and Guillermo Bernal. Now I knew I was home. Talking NCAA basketball with Angele, “belly” laughs with Tom and Guillermo, the kind where your eyes are tearing and your nose runs. We caught up, talked a little shop and we laughed and laughed some more. These wonderful experiences kept happening. The combination of the terrific scientific program, the vitality of our membership and the warm welcoming environment made me feel at home. Kind of like the healing properties of groups, according to Dr. Gordon.

I went to the Allied Health Professional section meeting and was impressed with their ideas and energy. A student from California told me how much he was enjoying the meeting and how he felt that it was provocative, stimulating and fun. He had a plan to get more students involved in our association. He suggested that all the “senior” members, which unfortunately, I think, included me, should give 10 talks a year to student groups, exposing them to our work and ideas and encouraging them to join. Ten might be a bit much, but I did one last week at Yale, that bastion of seriousness. I did the necessary power point psychophysiology of migraine talk. However, my message to them was to never join a professional group, or any group for that matter, that’s spiritually constipating. I introduced them to AAPB; diverse, unique, challenging but friendly, lots of innovation and excitement, peppered with the occasional characters and renegades. My professional home. Vital and full of strong opinions. I’ve always believed it’s easier to lower the volume than to raise it. We need to proselytize, a bit. Go forth “senior” members and bring in some new faces.

**Awards and Recognition continued from Page 3A**


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 Christine Hovanitz concludes her service at this meeting. Also, Don Moss completes his term as Past President.

Worth the ending of a term also comes new beginnings and it is with pleasure that I turn the gavel to Linda Kirk to start her term as President.

I would like to also announce that Steven Baskin was elected to serve as your President-Elect and the newly elected Board member is Aubrey Ewing. We are not going to let go of Don Moss just yet however, as he has accepted an appointment to serve the remaining one year term as treasurer while Steve moves to president-elect.
Only one biofeedback provider delivers such a breadth of professional training programs and equipment. Stens offers professionally run biofeedback and EEG certification programs, as well as application workshops in Chronic Pain, RSA and Stress Management. Now there is more! You can also receive a free one-day advanced biofeedback or EEG workshop with the purchase of a ProComp+/MultiTrace or Bio Integrator system. It's easy to see why there's only one clear choice when it comes to biofeedback — Stens.

**Professional Biofeedback 4-Day Certificate Program**

<table>
<thead>
<tr>
<th>Location</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago, IL</td>
<td>July 19 - 22, 2003</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>Aug. 16 - 19, 2003</td>
</tr>
<tr>
<td>Austin, TX</td>
<td>Sept. 20 - 23, 2003</td>
</tr>
<tr>
<td>Anaheim, CA</td>
<td>Oct. 18 - 21, 2003</td>
</tr>
<tr>
<td>Ft. Lauderdale, FL</td>
<td>Nov. 15 - 18, 2003</td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>Dec. 6 - 9, 2003</td>
</tr>
</tbody>
</table>

**Professional 4-Day EEG Certificate Program**

<table>
<thead>
<tr>
<th>Location</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago, IL</td>
<td>July 24 - 27, 2003</td>
</tr>
<tr>
<td>Austin, TX</td>
<td>Sept. 25 - 28, 2003</td>
</tr>
<tr>
<td>Anaheim, CA</td>
<td>Oct. 23 - 26, 2003</td>
</tr>
</tbody>
</table>

**Free 1-Day Advanced Application**

| Biofeedback  | (Every month) |
| EEG          | (July, Sept., Oct., Dec.) |

**2-Day Workshops**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Pain &amp; Headaches</td>
<td>(December)</td>
</tr>
<tr>
<td>Stress Management</td>
<td>(August)</td>
</tr>
<tr>
<td>RSA</td>
<td>(August)</td>
</tr>
</tbody>
</table>

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- Set Thresholds to Trigger Music & devices such as CDs, E-Stim based on physiology levels

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Hand-held EEG Neurofeedback Trainer
The ABT Bioscan™ is the world's lowest priced hand-held NF trainer. It offers three training ranges (7, 10 and 14 Hz). It is highly sensitive, offering a bar graph that reads to 30 microvolts peak-peak and a variable tone output to 45 microvolts p-p. Ideal for inhibit or enhancement training. The ABT Bioscan™ is ideal for treating ADD, insomnia, depression, anxiety and other conditions. Dim: 2.5"x3.5" $450.00US

Audio-Visual Entrainment Devices (AVE)
The DAVID Paradise XL™ is an affordable, effective, non-drug approach to reduce the symptoms of stress, anxiety, chronic pain, insomnia, depression, anxiety, fibromyalgia, ADD, SAD, CFS and hypertension. AVE has been shown to restore neuronal regulation and is effective as an adjunct to NF. TQVA results show AVE outperformed six leading NF (ADD) studies. Research available. Dim: 3.5"x6" $460.00US

Electrodermal Biofeedback Devices (EDA)
The EDA Bioscan™ measures small electrical changes in the skin conductance in response to changes in sympathetic arousal. It identifies stressful thoughts and helps in learning to relax. It features sturdy sensors, volume controls, sensitivity, pitch control, bar graph to "see" state arousal and set trait arousal, variable sensitivity, and a tape/CD input. Dim: 2.5"x3.5" $185.00US

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—Donald Moss, PhD, Editor, Biofeedback

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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 call 310-276-9181 or fax 310-275-7894.

The Neuropathways EEG Imaging® Neurofeedback system is protected under the following United States patents: 4919143,5024236,5571057 and patents in England, Germany and Japan.
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Full Compatibility

Current users of Thought Technology products can rest assured that the new Infiniti Technology Platform will work perfectly with their existing hardware or software. For example, the new ProComp Infiniti encoder device is completely compatible with existing BioGraph® software, while ProComp™ users will find that their ProComp™ performs seamlessly with the new BioGraph Infiniti Legacy software suite.

Of course, using the new ProComp Infiniti hardware together with BioGraph Infiniti software allows you to take full advantage of all our new features and enhancements.¹

Infiniti Hardware Platform

Our new ProComp Infiniti and FlexComp Infiniti encoder devices incorporate cutting-edge technology, while enhancing the signal quality, resolution and integrity that made earlier generations of Thought Technology hardware synonymous with quality and reliability.

FlexComp Infiniti, our top-of-the-line encoder, is the ideal data acquisition and psycho-physiological monitoring device for power users. It offers ten high-speed channels (2048 samples/sec.) that can acquire data from any Thought Technology sensor.

Researchers and clinicians will appreciate its flexibility to display raw, median frequency, RMS, peak-to-peak, 2D and 3D frequency and power spectrum, sEMG, EEG and EKG signals. Up to four encoders can be connected together to produce a forty-channel "window" into a subject’s physiology.

From the lab to the field, FlexComp Infiniti has the power to record and save complex data instantaneously to the computer or Compact Flash (for remote data storage).
THE INFINITI

Thought Technology systems are recognized as the standard of excellence by clinicians, therapists and researchers throughout the world. We are committed to design and manufacture physiological monitoring and biofeedback instruments that are precise and reliable – for both computer-based and stand-alone applications. Our vision is to expand the exciting potential of behavioral, technology, psychophysiological and non-invasive medicine in the 21st century, so that we may further enhance human health and self-efficacy. The Infiniti Technology Platform incorporates the latest advances in hardware and software architecture. Its modular design offers maximum flexibility and ease of use across a wide range of applications.

PLATFORM
The ProComp Infiniti is an eight-channel, multi-modality encoder that has all the power and flexibility you need for real-time, computerized biofeedback and data acquisition in any clinical setting.

Housed in an ergonomically-designed case and requiring only a USB port, ProComp Infiniti can be used with any IBM-compatible laptop or desktop PC. The new high-speed TT-USB connection allows for higher sampling rates. The first two sensor channels provide ultimate signal fidelity (2048 samples per second) for viewing raw EEG, EMG and EKG signals. The remaining six channels (256 samples/sec) can be used with any combination of sensors, including EEG, EKG, RMS EMG, skin conductance, heart rate, blood volume pulse, respiration, goniometry, force, accelerometers, torsiometers and voltage isolators.

What's more, not only can ProComp Infiniti capture data in real time by connecting directly to the PC via its fiber-optic cable, but it can also store data on a Compact Flash memory card for uploading later to the PC.

In short, ProComp Infiniti covers the full range of objective physiological signals used in clinical observation and biofeedback in any environment.
The ProComp2™ is a compact yet powerful two-channel device that allows clinicians to set up a second clinical system — or to empower their clients by offering them a take-home device that is convenient to wear on a headband or a shirt collar.

The ProComp2 contains a built-in EEG sensor (simply connect an extender cable for EEG monitoring and biofeedback), and it can use any two of the ProComp Infiniti sensors. The ProComp2 system contains all the peripherals to easily connect it to a desktop or laptop IBM-compatible PC.

**Benefits for you and your clients**
- Ability to expand your clinical practice quickly and economically by adding training rooms
- Power to train in home environment, thereby enhancing long-term compliance and improved outcomes
- Capacity to monitor peripheral measures as well as EEG for greater flexibility

Channels A & B provide ultimate signal fidelity (2048 samples per second) for viewing RAW EEG, EMG and EKG signals.

Channels C, D, E, F, G & H (256 samples/sec) can be used with any combination of sensors, including EEG, EKG, RMS EMG, skin conductance, heart rate, blood volume pulse, respiration, goniometry, force, accelerometers, tonometer and voltage input.
Complete Range of Sensors

Skin Conductance
Measures the conductance across the skin, normally connected to the fingers or toes. Supplied with two finger bands.

Pre-amplified EMG, EEG and EKG sensors
amplifies the signals at the measurement site, and can detect signals as small as 0.10 microVolts. Low noise wire and gold-plated protected-pin connectors ensure unparalleled accuracy, even when moved.

Temperature Sensor
Small bead thermistor measures temperature from 50 - 115°F/10 - 45°C with >0.008°F resolution.

Respiration
Electronic sensor with Velcro belt for monitoring respiration rate, amplitude and rate.

Blood Volume Pulse (BVP)
Finger-worn photoplethysmograph displays the pulse waveform, and measures amplitude and heart rate.

Thought Technology's advanced design and active electronic sensors meet exacting standards for instrument accuracy, sensitivity, durability, and ease of use.

All sensors are completely non-invasive and require little or no preparation for use.

After-Sales Service
- A one-year warranty policy (optional three years) on all encoders and sensors provides peace of mind.
- Training courses at various skill levels help you maximize the use of your system.
- Our professional and friendly technical support staff makes getting assistance stress-free.
- Prompt and reliable service gives you what you are looking for when you buy the best.

Specifications

<table>
<thead>
<tr>
<th></th>
<th>FlexComp Infiniti (SA7550)</th>
<th>ProComp Infiniti (SA7550)</th>
<th>ProComp+ (SA7400)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>5.1” x 3.7” x 1.5” (130 mm x 95 mm x 37 mm)</td>
<td>5.1” x 3.7” x 1.5” (130 mm x 95 mm x 37 mm)</td>
<td>2.3” x 2.8” x 0.75” (60 mm x 71 mm x 19 mm)</td>
</tr>
<tr>
<td>Connection to PC</td>
<td>Fiber Optic to USB through TT-USB interface unit</td>
<td>Fiber Optic to USB through TT-USB interface unit</td>
<td>Fiber Optic to USB (TT-USB) or DO4 port (Pro-SB)</td>
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<tr>
<td>Sensor type</td>
<td>External sensors</td>
<td>External sensors</td>
<td>Internal EEG or any 2 External sensors</td>
</tr>
<tr>
<td>Impedance checking (with EEG-Z sensor)</td>
<td>All channels</td>
<td>All channels</td>
<td>Channel B only</td>
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<tr>
<td>Self-calibration</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Compact Flash memory storage</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Fast channels (rate, bandwidth)</td>
<td>10 channels, 2048 samples/sec, DC - 512 Hz</td>
<td>2 channels, 1048 samples/sec, DC - 512 Hz</td>
<td>2 channels, 256 samples/sec, DC - 45 Hz (shared with slow channels)</td>
</tr>
<tr>
<td>Slow channels (rate, bandwidth)</td>
<td>Emulated protocols only</td>
<td>5 channels, 256 samples/sec, DC - 8 Hz (shared with fast channels)</td>
<td>2 channels, 52 samples/sec, DC - 8 Hz (shared with fast channels)</td>
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<tr>
<td>Emulated protocols</td>
<td>ProComp Infiniti, ProComp+</td>
<td>ProComp+</td>
<td>ProComp+ (2 channels active)</td>
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<tr>
<td>Power source</td>
<td>4AA batteries, single-use alkaline or NiMH rechargeable</td>
<td>4AA batteries, single-use alkaline or NiMH rechargeable</td>
<td>1 AA battery, single-use alkaline</td>
</tr>
<tr>
<td>Battery life (alkaline cells)</td>
<td>30 hours typical, 20 hours minimum</td>
<td>30 hours typical, 20 hours minimum</td>
<td>10 hours typical</td>
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<tr>
<td>ADC output</td>
<td>14 bits</td>
<td>14 bits</td>
<td>13 bits</td>
</tr>
</tbody>
</table>

*See our software brochure for more information. This brochure describes the encoders in their Infiniti modes not Legacy settings.

*Contact Thought Technology or your local representative for availability.
ProComp+/BioGraph 2.1

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

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Mini C2 General Purpose Monitor

A powerful, pocket sized version of the popular full size C2, with fast USB interface and five channels of feedback.

Includes: EMG, EEG, GSR
Temperature and Respiration sensors and leads, Ulead Windows Software

BMI Price: $1995.00
www.bio-medical.com/c2-gp.html

BrainMaster 2E

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

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BMI Price: $975.00
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* 48 hour Turn Around *

<table>
<thead>
<tr>
<th>Service Description</th>
<th>Price</th>
</tr>
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<tbody>
<tr>
<td><strong>Full Package #1-6: Minimum recommended for Neurotherapy</strong> includes priority mail</td>
<td>$195.00</td>
</tr>
<tr>
<td><strong>Full Package #1-5: Without report (1-5 only):</strong> includes priority mail</td>
<td>$165.00</td>
</tr>
<tr>
<td>* If only one choice is made the minimum is $75.00</td>
<td></td>
</tr>
<tr>
<td>1. NxtLink - N.Y.U./E. Roy John Normative Database Eyes Closed</td>
<td>$60.00</td>
</tr>
<tr>
<td>2. Neuroguide - R. Thatcher Normative Database</td>
<td></td>
</tr>
<tr>
<td>A. Eyes Closed Linked Ears Z-scores</td>
<td>$60.00</td>
</tr>
<tr>
<td>B. Eyes Open Linked Ears Z-scores</td>
<td>$60.00</td>
</tr>
<tr>
<td>3. Neurep - W. Hudspeth QEEG Analysis System</td>
<td></td>
</tr>
<tr>
<td>A. Eyes Closed - Weighted Average, Z-scores, Magnitude, % Power, LaPlacian, Average Spectrum</td>
<td>$60.00</td>
</tr>
<tr>
<td>B. Eyes Open - Weighted Average, Z-scores, Magnitude, % Power, LaPlacian, Average Spectrum</td>
<td>$60.00</td>
</tr>
<tr>
<td>4. Nova Tech EEG - Loretta/QEEG Analysis System and Adult Normative Database Eyes Closed</td>
<td>$60.00</td>
</tr>
<tr>
<td>5. Thatcher TBI Discriminant Analysis and Severity Index</td>
<td>$60.00</td>
</tr>
<tr>
<td>6. Clinical Correlations and Neurotherapy Recommendations by Bob Gurnee</td>
<td>$60.00</td>
</tr>
<tr>
<td></td>
<td><strong>Value $480.00</strong></td>
</tr>
<tr>
<td>7. Conventional Medical EEG - Read by Neurologist</td>
<td>$125.00</td>
</tr>
<tr>
<td>8. Nova Tech EEG - Loretta/QEEG Analysis System: Eyes Open</td>
<td>$60.00</td>
</tr>
<tr>
<td>9. SKIL Topographic Analysis - Sterman/Kaiser Imaging</td>
<td>$60.00</td>
</tr>
<tr>
<td>Eyes Closed or Open, or Task - Clinical and CoModulation Topographic Maps (data and stat) Topometric Display for Delta, Theta, Alpha, SMR, Beta 1 and Beta 2</td>
<td>$60.00</td>
</tr>
<tr>
<td>10. Neurep - W. Hudspeth QEEG Analysis System: Task</td>
<td>$60.00</td>
</tr>
<tr>
<td>Weighted Average, Z-scores, Magnitude, % Power, LaPlacian, Average Spectrum</td>
<td></td>
</tr>
<tr>
<td>11. Supervision and Training Hourly Rate</td>
<td>$100.00</td>
</tr>
<tr>
<td>12. Extra set of Printed Maps</td>
<td>$35.00</td>
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<tr>
<td>13. Q-Metrix Medical Reports</td>
<td>$350.00</td>
</tr>
<tr>
<td>Conventional EEG Analysis, Maps and medical report on maps</td>
<td><strong>additional $8.50</strong></td>
</tr>
<tr>
<td>14. Overnight Shipping &amp; Handling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Order $</td>
</tr>
</tbody>
</table>
The Heart and Mind of Biofeedback

Biofeedback Society of California
29th Annual Conference

Co-sponsored by the Biofeedback Society of California and the Association for Applied Psychophysiology and Biofeedback

November 6 - 9, 2003

Pre-Conference Workshops: November 6-7, 2003

The pre-conference workshops, sponsored by AAPB, are the beginning of a journey through the depths of the Heart and Mind of Biofeedback. Internationally known presenters Lynda and Michael Thompson, and Paul Lehrer will be the faculty for these outstanding events.

Neurofeedback Fundamentals for Successful Assessment and Training
Presented by Lynda Thompson, Ph.D. assisted by Michael Thompson, MD

This workshop covers the basic science behind neurofeedback and provides practical pointers for how to assess and improve functioning in clients with a variety of problems: ADHD, learning disabilities, Asperger’s syndrome, seizure disorders, anxiety, movement disorders (Tourette’s, Parkinson’s) and depression. Participants will learn about quantitative EEG profiles (single channel and 19-channel) and how they differ according to symptoms. A logical approach to moving from assessment information to decisions about which frequencies and electrode placements to use is given. There will be tips on how to set up training programs that combine neurofeedback and biofeedback. Included are methods for helping generalization of the training to home, school and work environments. The course will also mention how to use these techniques to optimize the performance of executives and athletes.

What you will learn:
- Recognize EEG patterns that are typical for a number of disorders.
- Understand one and two-channel EEG assessments and describe the procedure for applying electrodes, collecting, and interpreting EEG data.
- Develop a rational intervention based on assessment data, and combine elements of neurofeedback, biofeedback and cognitive strategies for an individualized training program.

This course is suitable for those new to the field of neurofeedback as well as experienced clinicians who want to review the most effective practices in our field and the science that underlies EEG work.

Cardiovascular Resonant Frequency Biofeedback
Presented by Paul Lehrer, Ph.D.

This workshop will introduce participants to cardiac variability, the complex patterns of oscillation that comprise it, interpretation of various rhythms, and effects of biofeedback for amplifying respiratory sinus arrhythmia (RSA). We will theorize and/or show how this method can improve homeostatic capacities, improve performance, enhance resistance to functional illness, and how RSA biofeedback is influenced by cardiovascular resonant frequencies. Experimental and applied exercises will be done, and treatment manuals and applications to autonomic and emotional dysfunction will be discussed.

What you will learn:
- To identify the various known oscillations in heart rate, their link with breathing, and known physiological mediators.
- To examine the theoretical links between the body’s homeostatic capacity and both the complexity and amplitude of these oscillations.
- To recognize the differing resonant frequencies for heart rate and blood pressure, and implications for studying and training baroreflex activity.

You will also have the opportunity to advance your education and sharpen your professional skills by participating in any one of 5 panels, 4 keynote presentations and 18 outstanding short courses. Workshops, short courses, keynotes and panels on the Heart rate variability and EEG biofeedback will cover the latest research on the Heart and Mind. A special luncheon panel on Ambulatory Physiological Monitoring will be sure to bring new ideas to biofeedback and continuous monitoring of physiological stress levels. This year we are expecting more student involvement with a poster presentation session. Join us for an in-depth examination at the latest biofeedback hardware and software by spending time at a dedicated available for demonstrations and teachings. A special workshop from a new member coming from Mexico City will help to teach us how to work with children from Mexico.

Contact BSC at (800) 272-6966 or (714) 848-0022 for more information, or see http://www.biofeedbackcalifornia.org/2003%20Conference.htm.