

When the work above was conducted, Green and his group were thinking of **processes underlying development of voluntary control**, not how to deal with health problems. Their program was initially named the Voluntary Controls Program reflecting their interest in the volitional aspects of human potential. His concept of empowerment became more **clinically** relevant when the following events (described in the next few papers) unfolded, opening a doorway to empowerment in health care. Decades later, we have only begun to cross the open threshold of this doorway. We remain restrained—from realizing the full potential of what has been opened for us—by societal forces that turn us toward interventions such as medications and surgery, rather than toward taking charge of our own health. We will return to this theme later, but first let us see just how the focus became more clinical. Elmer and Alyce summarize some of the events that led to this conceptual change in the following sections from their book chapter in **Biofeedback: Principles and Practice for Clinicians** (John V. Basmajian, Ed., 1st Edition, The Williams and Wilkins Co., Baltimore, MD, 1979). [Eds.]

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## GENERAL AND SPECIFIC APPLICATIONS OF THERMAL BIOFEEDBACK

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**B**efore World War II, the idea of psychosomatic disease was not accepted by most physicians. Today, the possibility and actuality of psychosomatic disease is accepted, but it is still not generally recognized that if a disease is psychosomatic, then its alleviation can also be psychosomatic. That is, therapeutic physiological change can be psychogenically induced. Perhaps it is reasonable to say that if disease can be psychosomatic, so can health.

Our decision to conduct research in temperature training (1964) was a direct reflection of the previous choice made by Johannes Schultz in the 1920s. He chose warmth in the hands as one of the primary indications that the body was ready to accept psychogenic programming. The other indicator, as previously mentioned, was a feeling of heaviness in the limbs. This development in autogenic training originated from his observation that hypnotic subjects who were influenced most successfully by the doctor in overcoming psychosomatic disorders almost always reported a feeling of heaviness (striate relaxation) and warmth in the peripheral parts of the body (sympathetic relaxation). Shortly after we noticed (1966) that recovery from an alleged migraine headache was accompanied by rapid vasodilation in the fingers (as

shown by a photoplethysmographic tracing) and by a 10 degrees F increase in hand temperature (dorsal and ventral thermistor placements), we were asked by the wife of a colleague to train her out of migraine. Without any promise of relief, the stress-limbic-hypothalamic-pituitary relationship was explained, she was given a short training session with the first two standard exercises of autogenic training, and was loaned a temperature feedback machine for twice-daily home practice. Within 3 weeks she had recovered from her 5-year bout with weekly migraine, stopped taking drugs, and has had no further trouble with migraine up to the present.<sup>1</sup>

**O**ddly enough, we never had another case so quickly and completely successful. Fortunately, it was the first case and its striking results aroused the curiosity of Joseph Sargent, M.D., an internist at The Menninger Foundation. He asked our Biomedical Lab to construct a dozen more machines and began a pilot research project in migraine control. Seventy-four patients, most of whom had failed to respond to other techniques of migraine control, completed their training with feedback machines in times varying from 3 weeks to 3 months (depending on individual learning rates), then practiced with autogenic phrases from 5-15 minutes each day At home without a machine. They visited the lab once a month (after the original learning period) in order to demonstrate their hand warming ability with a meter, and to deliver their report on headache and drug consumption during the previous month. This procedure was followed for a total period of 9 months.

Of the 74 migraine patients, 56 benefited from hand temperature training with amelioration ranging from moderate to very good. "Moderate," in a particular case, might consist of reducing day-long headaches to a few hours (numerically a 25-50 % reduction in recorded headache activity) accompanied by a reduction in drug consumption. "Very good" consisted in some cases of months-long relief from headache (75-100% reduction) with commensurate reduction in drug consumption.

These preliminary findings encouraged Sargent to develop a 3-year controlled-outcome research project with migraine and tension headache patients. Funded by NIMH, data gathering in this project is scheduled for completion in 1978. It is too early to report findings, but the results of

Sargent's 5 1/2 year follow-up of the original pilot group were reported at the 1977 meeting of the Biofeedback Society.<sup>2</sup> Follow-up showed on the whole, that patients did not lose their skill in headache control, and on the contrary tended to improve. Another 5-year follow-up of clinical findings with 58 patients who tried biofeedback training for headache control was reported by Charles and Sheila Adler.<sup>3</sup> Their findings are quite similar to Sargent's.

Closely related to migraine headache is Raynaud's disease. These two health problems are conditions (rather than diseases, from our point of view) that differ in the fact that while migraine patients have cool or cold hands (in the seventies or low eighties) and an excess of blood in scalp arteries during attacks, Raynaud's patients have very cold hands (sometimes in the sixties, with almost no circulation in the fingers) and have only minor dysfunctions in cephalic circulation. In both cases, however, hand temperature training serves to ameliorate the condition.

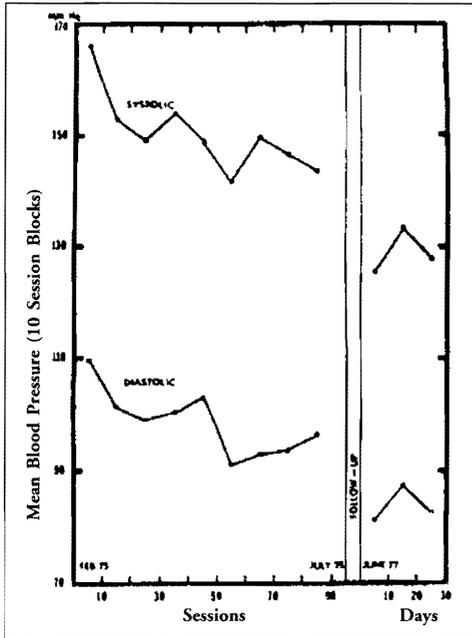
**C**oncerning the neuroanatomical mechanism, it is most interesting that the peripheral vascular system has no significant parasympathetic innervation and the smooth muscles of blood vessel walls that are activated in the hands during vasoconstriction are operated only by the sympathetic nervous system. If peripheral sympathetic firing decreases, the blood vessels of the periphery dilate, and more blood is found in the hands. In order to significantly increase the temperature of the hands, it is necessary to reduce sympathetic firing, and this is controlled from the hypothalamus. Because of this neurovascular arrangement, temperature in the hands (ignoring slight evaporative cooling effects under the tape that holds a thermistor in place), is in main a one-variable indicator of general sympathetic tone.

In learning to warm the hands we must infer, therefore, that it is the hypothalamus and its associated machinery that are being trained. Recovery from migraine does not seem to be a simple hydraulic problem, however, merely shifting blood to the hands in order to get it out of the head. We have noticed that "skillful" patients can learn to warm their hands and at the same time maintain a migraine headache. We conclude that recovery from vascular problems is not so much the learning of a vascular "trick" as it is a normalization of hypothalamic homeostasis.

**C**oncerning normalization of homeostasis, consider the following example of control of hypertension through biofeedback training, especially through temperature feedback from the hands and feet. A 39 year-old hypertensive woman was referred to us by a local physician in 1975. She had been treated with hypertensive drugs for 16 years and at the time we met she was taking four Inderol and four Aldomet tablets daily, yet her blood pressure ranged around 200/110 mm Hg. After discussing the general biofeedback rationale with both the patient and physician, we explained that the particular rationale for hypertension control had been supplied to us by a former surgeon at the Mayo Clinic. At one of our biofeedback workshops which he attended, we had mentioned the puzzling fact that one of our hand temperature trainees had apparently normalized her blood pressure in a few days. He asked if she was a generalizer, the kind of person who would probably warm both hands and both feet at the same time if she learned to warm one finger. Looking back, we agreed that she probably was that kind of person. If she were, he said, then she no doubt administered to herself “a reversible sympathectomy,” and he pointed out that in the days before a variety of drugs were available, surgeons often cut the sympathetic nerves to the legs in order to create massive vasodilation. This was accompanied by a significant blood pressure reduction. Side effects of this procedure were not pleasant and the solution was not permanent, but it was sometimes the only feasible “remedy.”

After explaining this to the new patient, we suggested a temperature feedback training program to be followed at home, first with the hands and then with the feet, accompanied by autogenic phrases for heaviness and warmth, a breathing exercise, and two EMG training sessions per week at the lab.

Results shown as 10-session (home training) averages of systolic and diastolic data in Figure 2.4 were encouraging and after 3 weeks of training her cardiologist reduced her medication by one tablet. There were some interruptions in her training (one of 6 weeks' duration) but in general he continued to reduce her medication by one tablet every 2 weeks of training. On the day that he removed the last tablet, after 6 months of training, her urologist also discontinued her medication for control of a hypertension-related kidney infection. This patient, a registered nurse, has continued taking her own blood pressure once a day and, after 2 years of no medication, her blood pressure remains normal. Readings taken on occasion in the lab have not differed significantly



*Figure 2.4. Thermal Biofeedback. Blood pressure control through biofeedback training. Having suffered from hypertension for 16 years, this patient was taking four Inderol and four Aldomet tablets daily during the first 15 sessions. Then the medication was reduced one tablet approximately every 10 sessions until medication was ended at 90 sessions. Blood pressure was normal at 2-year follow-up.*

## GENERAL MEDICINE: NONPSYCHOSOMATIC

By applications of temperature training in non-psychosomatic medicine, we mean application to such problems as infections, pain from physical trauma, neuromuscular damage from stroke, accident, or surgery, etc. Some physicians feel that infections, diabetes and a host of other problems that might be thought to be non-psychosomatic nevertheless have a psychosomatic complaint, strong or weak. In any event, it is clear that there is no sharp division between psychosomatic problems and problems that are purely somatic, and to us there is no significant difference in training procedures. We are not concerned with the genesis of the problem as much as with the "here and now" and what can be done.

from her home readings. This patient was a labile hypertensive who apparently had not suffered much structural damage. For cases with a great deal of structural damage, it seems reasonable to assume that such good results might not be forthcoming. Although a research program on hypertension control using the above techniques has recently been initiated at the Foundation, it has not yet shed light on this question.

There is not sufficient space to consider additional applications of temperature training for control of psychosomatic disorders, but it can be safely assumed that for every application of heaviness and warmth exercises mentioned by Luthe in Autogenic Therapy there is also a potential application for EMG and temperature training.<sup>4</sup>

If a dysfunction is congenital, the question is, "Can we go anywhere from here?" As in a clear-cut psychosomatic case, the biofeedback rationale is discussed and the usefulness of temperature training for sympathetic turn-off is reviewed. This latter is explained in part as a useful step in preparing the body to receive instruction, even though it may appear at first glance to be unrelated to a problem such as congenital spasticity, for example. In some problems the direct significance of temperature training is obvious to the patient, since blood brings almost all of the repair material to the site of tissue recovery.

Sometimes a patient says that he thought the body was supposed to know how to do this without help. In principle that may be true, but the fact is that almost everyone who has a body-disrupting accident, or who undergoes surgery, unconsciously interferes with the body's recovery through a kind of visualization that can only be called "negative." A skier with a broken leg is likely to worry about a variety of problems, and induce in himself or herself a series of minor or major psychosomatic effects. We all know of patients in whom the physiological effects of anxiety were worse than the problem that aroused the anxiety.

**I**n order to reduce the effects of negative visualization, we provide the patient with a positive visualization, and we also give them the old yogic instruction, "Do not fight negative thoughts, merely replace them with positive ones." The negative ideas and emotions such as fear, with its limbic correlates, inhibit the programming of the body. So rather than fight fear, it is better to construct the image of what body behavior is desired and return the thought to this positive program whenever it drifts into a fight or flight pattern.

We also emphasize the benefits of striate relaxation, of course, and as in psychosomatic cases, we include EMG feedback (usually of the forehead muscles) along with temperature training, autogenic phrases and a breathing exercise. It is safe to say that research in this area has a host of fascinating problems to grapple with, especially (for theory) in the modification of congenital defects.

## PSYCHOTHERAPY

It seems to us that a psychotherapeutic component is associated with almost every use of temperature training and we hope that this observation will be

fully researched. It is not possible for a patient to realize for the first time that normally involuntary processes of the body can be controlled, to some extent, without at the same time undergoing a modification of self-image. This was first brought forcibly to our attention in 1970 when a member of the Board of Directors of the Foundation was a demonstration subject in a “science day” program. He was given the autogenic phrases in front of a group of directors, while attached to a temperature feedback machine. At the phrase, “My hands are warm,” his temperature began to drop, decreasing by several degrees in a few minutes. The subject was not aware of this decrease until we asked him at the end of the session what feelings he had experienced during the session. He replied that his fingers had begun to tingle, and that reminded him of an exercise in self-hypnosis he had practiced several years previously, learning to make his fingers tingle. “So this is warmth,” he thought, and he “really made them tingle.” It was explained that he had made a mistake, that in his case tingling meant cooling, but the fact that the temperature had dropped was of no consequence in the demonstration. The significance lay in the fact that he was the one who had done it.

**T**wo months later he surprised us by writing and saying that that 15-minute demonstration was one of the most important events in his life. Until then, he said, he had not really believed he could control anything. But in the last 2 months he was able to lose 12 pounds and now was able to clear all the correspondence off his desk in the first hour each morning, something he had not been able to do previously.

This type of change in self-image is not uncommon in biofeedback trainees, though sometimes it might not be noticeable for several weeks. With many patients, as in the example above, temperature training serves to help reorganize their lives, not because it is necessarily good to have warm hands but because of the feeling of self-mastery they get. That feeling, if it could be put in mathematical terms would be called “an enabling function.” It enables the patient to take positive action in a variety of ways. In other words, the gains from temperature training as well as from other kinds of feedback training, are not merely physical. Comments recorded after a home temperature training session often suggest movement toward increased mental comfort as well.

Patient MLF was learning to use the temperature feedback machine and was frustrated at the beginning of her session because her starting temperature of

90.2 degrees F seemed too high, in comparison with previous starts, and she thought she was doing something wrong. The frustration made her hands cool, and finally she understood (probably for the first time, even though she had been repeatedly informed) that the machine reflected her psychological state and that the high temperature at the beginning indicated that she was more relaxed than usual when the session started.

Under “thought, fantasies, and imaginings,” she revealed a basic fear, “I can’t stand prosperity. (Why?)” At the bottom of the page she said she liked the total relaxation, but did not like, “the truth, I must discipline myself.”

**A** question which arises, of course, is how can temperature training result in such significant insights. The answer seems to be quite similar to Wilhelm Reich’s answer explaining how total striate relaxation can be accompanied by psychological insights.<sup>5</sup> Continuous striate bracing, he said, was associated with defense against certain kinds of self-awareness. When the bracing (sometimes referred to as character armor) was removed through total striate relaxation, self-awareness often came to the surface because the information was needed and at the same time could be tolerated. In the same way, we seem to have a kind of “character armor” in the sympathetic nervous system, and when it is removed through hand warming (sympathetic turnoff) self-awareness can come to the surface. Autonomic character armor must logically derive from limbic armor, and when it is released it signifies a change in the limbic response to stress. From MLF’s report, it is clear that the self-mastery effect is in a beginning phase.

Whether our patients practice with temperature, EMG or EEG machines, the report form is essentially the same, and in almost every case we find similar kinds of psychotherapeutic response. In our estimation, it is important that the patient understand how useful these reports are. They provide a kind of psychological awareness-sharpening that no machine can supply, and it is apparently this kind of information that bridges the gap in many patients between voluntary and involuntary, between conscious and unconscious. Without a report on body, emotions and thoughts to themselves, the awareness that brings the body under voluntary control seems to develop more slowly. The crux of the matter here is self-awareness, although this is not true for conditioning, of course. For true self-regulation, however, it is a “must.”

After awareness and self-regulation are achieved, they can be relegated to the unconscious (preconscious might be a better word). After a bad psychophysiological habit is consciously replaced with a good habit, it need not remain in the forefront of consciousness. Everyone knows this is true in the striate domain, as when we learn to drive a car or play a musical instrument, but it is also true in the autonomic domain. When a more relaxed, poised, alert, sensitive way of life becomes habitual, it no longer needs to be consciously practiced. It literally becomes a way of life. This is the goal of our training program for patients, whatever their problem, and the number of successes makes the game worthwhile.

## CONTRAINDICATIONS

**A**t the 1976 annual meeting of the Biofeedback Society, Wolfgang Luthe made a strong plea for caution in using biofeedback methods in manipulating the body's normal homeostatic mechanisms. An example he referred to was the research of French *et al.* in which a group of men who first learned to increase blood flow in the hands, during a month of temperature training, transferred the visualization of warmth to the scrotum, with 5 days of training, with the effect of heating the sperm and temporarily causing sterility.<sup>6</sup> What might be the long-term effects of this, he asked. As far as is known, no untoward sequelae have been reported from that research, but it is interesting that yogis who can demonstrate conscious manipulation of normally involuntary autonomic processes, also give warning. A few yogis whom we studied with psychophysiological equipment in India, warned against careless manipulation of the heart's firing patterns and named some of their brethren who now had defective hearts.

When Swami Rama was in Topeka in 1971, he demonstrated that it was possible to make one leg and foot become quite red while at the same time the other leg and foot become pasty white and edemic, so that a finger pressed against the foot left a slow-changing indentation, as in putty. In attempting to photograph this, we asked him to perform more than once, and he warned against repeated manipulations of the involuntary nervous system without allowing the body at least half an hour to return to normal between trials. He said that the body could "get out of control." One got the impression that

repeated pressings against “the homeostatic net might poke a hole in it,” to use Luthe’s phrase.

**A**nother warning concerns the use of biofeedback training with epileptics, hypertensives, and others whose disease syndrome is under drug control. Medical monitoring is essential in such cases because as training begins to change various neurohumoral processes, shifts will be needed in the drug regimen. We have heard of several undocumented cases in which insulin needs were not watched with sufficient care. Although only minor perturbations ensued in these cases, the warning stands. In one patient with hypertension, the blood pressure dropped very low after a few weeks of feedback training, startling the cardiologist. He had considered the training to be merely an inconsequential fad and had not decreased drug consumption in his patient in line with training-induced blood pressure changes.

Fortunately, in using temperature training with patients we are almost always in the position of helping the body return to normal, rather than deviate from normal. It is not normal to produce blood-shot eyes, however, and any technique that can produce such an effect, such as hypnosis and various kinds of visualization training (including biofeedback) might well be carefully considered for possible undesirable consequences before application.

## FUTURE DIRECTION IN THERMAL TRAINING

One of the most interesting areas of research and application in temperature training seems to us to lie in the domain of internal-medicine organ-specific visualizations. As a teaching device in the use of such visualizations, for example, implanted temperature sensors whose readings are telemetered out of the body could well be used for feedback of internal vascular behavior. Apropos of this, we know of one off-the-record case in which bleeding from a bladder cancer (visually observed in a transparent catheter) was used as a feedback device, not by the patient but by two physicians, to successfully reduce the cancer by hypnotically induced circulatory starvation. Cancers usually have a remarkably well developed vascular tree that automatically supplies their energy needs. The smooth muscles in the walls of this system are under hypothalamic control, however, and if vasoconstriction can be self-programmed, such cancers might come under voluntary control.

In the hypnotic case mentioned above, several metastatic growths disappeared while the bladder growth was being reduced.

George Eversaul has suggested that oxygenation of tissues has an important effect in certain kinds of arthritis and that an increase in blood flow to arthritic areas of the body has been beneficial in some cases.<sup>7</sup> Both clinical and laboratory research could easily focus on this kind of problem, without the need for telemetering transducers.

The above kinds of ideas could theoretically be extended to cover every organ and tissue problem in which blood flow is involved. An attempt to make such an extension would be laborious, though, as well is beyond our ken, so we close with the thought that temperature training, and every other kind of biofeedback training has probably only begun to explore the new volitional world of psyche-soma relationships.

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