BIOFEEDBACK AND THE HEADACHE

CHRISTOPHER M. McGEORGE
University of Canterbury

This paper is a consideration of the modification of headache behaviour written after the Berkeleyian style. *Part One* deals with the current knowledge of the etiology and classification of the headache. *Part Two* concerns the proposed mechanisms of the biofeedback treatment of both migraine and muscle tension headaches. *Part Three* looks at a theoretical application of these proposals. *Part Four* concludes that further research into the mechanisms by which biofeedback works is needed to validate the sometimes over-enthusiastically reported beneficial results.

PART ONE: HEADACHE ETIOLOGY

Scene: The peripatetum.

Enter: Philonous and Hylas walking and conversing on the said topic.

Philonous: Berkeley will not like this!

Hylas: Faith I have a sorry head. Who is Berkeley?

Philonous: Never mind Hylas, but tell me more about your headache. Did you have another fight with your wife?

Hylas: No she is visiting her mother at present. As my GP explained it to me I'm a migrainy sort of person. (What he means is that Goodell, Lewontin, and Wolff (1954) found that of children both of whose parents were afflicted, 69.2 percent had migraine headaches. Because Hylas' parents were both migraine sufferers, the GP feels Hylas' own headache to be thus sufficiently explained.) And according to the vascular theory of migraine, the cranial arteries, and chiefly the branches of the external carotid arteries, undergo occlusive vasoconstriction which in turn is followed by excessive and painful dilation and distension of the artery walls. My GP said, Sicuteri (1972) hypothesises that a depletion of serotonin permits the extracranial vasodilation and that the amines probably initiate the preheadache vasoconstriction. He prescribed Sansert for me.

Philonous: Well Sansert (methysergide maleate) is certainly an anti-serotonin agent and useful as a prophylactic, but serotonin seems to me to be approaching the status of a god. That is, as an explanatory hypothesis lacking credibility through its overuse.

Hylas: But no Philonous. Antony, Hinterberger, and Lance (1967) estimated that serotonin levels fell by 60 percent during migraine headaches from preheadache levels and that serotonin injections alleviated some cases. That seems good evidence to me.

Philonous: It is suggestive only. Your biphasic theory is not really adequate for several reasons. The Sansert you take, together with

the ergot drugs used during attacks, both have peripheral vasoconstrictor effects as well as their significant central effects and the disorder hence is more likely to be a complex vasomotor disturbance. Also, in addition to exaggerated cranial arterial responsiveness, cranial vascular variability is a characteristic of migrainous individuals (Tunis and Wolff, 1953). The cranial variability may reflect a more general problem with autonomic stabilizing mechanisms and these should be detectable in physiological changes mediated by these systems outside of the cranial vasculature. One way is to compare migraine and nonmigraine subjects on the peripheral reflex vasodilation response. Appenzeller (1963, 1969) found migraine subjects failed to show the normal reflex but other researchers (Franch, Lassers, and Desai, 1967) have shown the response to be similar.

So you see Hylas, even for a strictly diagnosed migraine the etiology is associated with both excessive cranial vasculature responsitivity and some sort of autonomic nervous system variability (both in need of further clarification) and that your Sansert is attacking only half the problem.

Hylas: I stand enlightened. But what do you mean "a strictly diagnosed migraine"? I thought people either had them or did not.

Philonous: The classification of headaches is not quite the quagmire of psychiatric disorder classification, but still the Ad Hoc Committee on the Classification of Headache (1962) delineated 15 categories. The most common being (a) the vascular of the migraine type, (b) the muscle contraction headache, (c) a combination of (a) and (b), and (d) those of hypochondriacal origin.

Would you say your headache history is of a recurrent type with unilateral onset, sometimes preceded by sensory motor disturbances and usually associated with anorexia and perhaps nausea?

Hylas: Why no, I ate a good breakfast this morning.

Philonous: Is it then more of a tightness and persistent bandlike pain?

Hylas: That is more like it, especially in my forehead and sometimes at the back of my head in the occipital area.

Philonous: Well I should change your GP as the first set of symptoms I related are the classical migraine as described by the Ad Hoc Committee on Headache (1962), whereas the second set typifies the tension or muscle contraction headache. But it may well be that you have a combination and hence your physician may have been misled by the symptoms presenting at the time of diagnosis.

Hylas: I hope so Philonous, but tell me what you know about the tension headache half.

Philonous: Again the etiology is poorly researched but it is believed to stem from chronic contraction of the skeletal muscles about the face, scalp, neck and shoulders. However despite the claims of the biofeedback evangelists there is only one study (Sainsbury and Gibson, 1954) showing increased electromyographic readings from

the frontalis muscle for those with headache present compared to a group in a nonheadache state.

In addition there are problems in measurement as the electrodes are placed on the forehead, four inches apart and one inch above each eye. In this position, as well as measuring frontalis muscle tension, the electrodes also pick up activity from muscles in the eye region, for instance those used for expression, for controlling the eyelids, and also the globes themselves. Alexander, French, and Goodman (1975) feel that electrical activity arising from the muscles of the orbits and globes may militate against successful feedback assisted tension reduction during frontalis training because they found lowering of electromyograph (EMG) levels only in their group receiving auditory feedback with eyes closed and not in groups receiving auditory feedback with eyes open, or visual feedback.

Again, while the EMG level of the frontalis muscle/headache correlation is generally accepted and forms the rationale of Budzynski, Stoyva, Adler, and Mullaney (1973)'s biofeedback therapy, Lader and Mathews (1971) concluded that there is considerable dissociation between the two in that curare paralysis is not associated with a reduction in subjective tension nor are central nervous system drugs reducing subjective tension, always associated with a reduction in EMG voltage levels.

A further possibility is indicated by Tunis and Wolff (1954) who measured extracranial pulse amplitude and found it to be lower for headache subjects than for nonheadache subjects with another fall when the former group were in the headache present condition. It is felt that this reflects a form of response patterning involving autonomic and striate muscle system measures.

Hylas: You must have read a book on the subject Philonous.

Philonous: Yes, a very large one.

Exeunt severally.

PART TWO: HEADACHE TREATMENT

Scene: Philonous' laboratory two days later. The pair are already seated.

Hylas: I have read that Blanchard and Young (1974) article you gave me and the biofeedback approach sounds very attractive. That is, the idea that without drugs, autonomically mediated responses can be trained in order to alleviate somatic disorders, such as migraine headaches. But I do not quite understand the handwarming business prescribed for migraines. Surely it is just a disguise for positive thinking or the power of suggestion. I had enough of your sugar pills last time I was here.

Philonous: That is about three questions in one. Firstly the rationale of handwarming. The excessive dilation of the arteries in the head-

ache phase of a migraine attack is believed to be caused by an excessive sympathetic nervous system outflow and hence if this can be reduced it should decrease the dilation and its attendent pain. Now the peripheral vascular structure does not have a significant parasympathetic innervation and thus vasoconstriction in the hands is a function only of sympathetic outflow.

From their clinical experience, Sargent, Walters, and Green (1973) hold that all normal individuals have the physiologic capability of producing warmth in their hands, that is, the capability of vasodilating. This has been supported in a report by Snyder and Noble (1968) who found that their experimental group showed an increase in the number of vasoconstrictions in the finger during biofeedback-assisted acquisition whereas matched controls and base line controls did not. The finding was regarded as evidence against the theory that only classical conditioning of visceral responses is possible because the conditioned vasoconstriction was independent of gross bodily movement, muscle tension in forearm and finger, heart rate, and respiratory irregularities.

The proposed inducible vasodilation is not the object of the training, but serves as a one variable indication of a decrease in sympathetic outflow. Again, the object of handwarming training is not to increase the blood volume in the hand but to stem sympathetic outflow and hence the excessive and painful dilation of the cranial vasculature.

Secondly your query about positive thinking. This is merely a response class of covert operant control (L. Homme, 1965). It is subject to conditioning laws just the same as other response classes like the one we are to try here. Positive thinking is not an "inner force" but a piece of behaviour under the control of certain stimulus conditions.

Your third point carries much weight though Hylas as some have even said it is probably not possible to separate the specific real effects of biofeedback from the placebo element (Stroebel and Glueck, 1973). That is, isolating what biofeedback does from the effects of altering cognitive set, responses to suggestion, and subject expectancy. The latter is especially important in this area as, because of biofeedback's extensive popular publication, naive subjects are extremely scarce.

To this add the possibility that all claimed physiologic effects of biofeedback could be due to the nonspecific treatment or placebo part as evidenced by Shapiro's (1971) ability to cite data supporting the potential of this effect in nearly all treatments, even in the area of incurable malignancies. For instance Sternbach (1964) produced stomach motility (stimulated, relaxed, and no effect) in accordance with anticipated effect of drug which was in fact merely tablets of identical plastic coated magnets. Fortunately there are animal studies demonstrating the active principle of biofeedback.

No slander is intended when Stroebel and Glueck (1973) label biofeedback as the ultimate placebo however, as they are merely defining it as a procedure that provides the patient with an effective means of preventing illness by helping him regulate his daily life style, thought patterns, and body processes. Indeed Budzynski (1973) would agree. One of the leaders in the field, he sees biofeedback as simply reflecting some aspect of physiology and squarely placing the patient in a position of importance in the prevention and treatment of illness.

It cannot however provide the motivation for his self achieved therapy, nor therapy for the contributing environmental factors in the presenting complaint, such as your wife Hylas.

Hylas: She is alright really Philonous, but besides that the placebo effect does seem to be a stumbling block in determining treatment effectiveness. Is there not some way round it?

Philonous: Most researchers get round it by ignoring it on the Berkeleyian principle that if you are not perceiving something, it does not exist. However Stoebel and Glueck (1973) have devised a Placebo-Active Therapy Index model (PATI) which attempts to measure the effect of the placebo component in therapy and gives a concurrent and prognostic index as to the likely effectiveness of a particular treatment. For example a subject with high expectations but moderate active control of the physiologic process in question would, according to the PATI have a high concurrent effect but a questionable long term effect due to a loss of enthusiasm outside of the demand characteristics of the laboratory. Alternatively a subject with low expectations and moderate active control would be predicted to have a moderate concurrent effect but a poor long term outlook by the PATI.

Although formulated against a research programme of alpha wave conditioning I think the model could be usefully applied in our handwarming biofeedback research because as Stroebel and Glueck (1973) point out exclusive consideration of the active component of biofeedback, without consideration of placebo expectancy, is an inadequate basis for meaningful clinical applications. Further, by achieving a balance of active and expectancy factors in biofeedback (which gives the best PATI reading) we may provide a meaningful basis for helping man acquire active involvement in the therapeutic process and hence in his becoming his own ultimate placebo.

Hylas: And all at only $12 an hour.

Philonous: Er, yes Hylas.

Hylas: Before I pay perhaps you would care to explain the low success rate attributed to the Menninger group by Blanchard and Young (1974). For $12 an hour I want something better than a 29-39 percent improvement chance.

Philonous: It does not sound very good on their analysis but it may be that the analysis is misleading. Blanchard and Young (1974)'s exact words are ". . . after running some 75 patients, the authors can only confirm some degree of clinical improvement in 29-39 percent of the total sample" (p. 587).

However Sargent, Walters, and Green (1973)'s sample of 75 comprises 57 migraine sufferers, five with combined, two with cluster, and 11 with tension headaches. As the treatment technique is specifically a migraine one and this group is specifically labelled a pilot study a little tolerance may be shown as to what might be expected from this heterogenous sample. A further clarification may be made by stating that Sargent, Walters, and Green (1973) claim their 81 percent improvement rate only on those completing the project's criterion of 150 days, that is, on 42 subjects and as a minimum follow up period of a year is intended their report can only be taken in the spirit intended. As a preliminary report on a pilot study and not as hard experimental evidence. The latter would require the use of some sort of control and an assessment of the effectiveness of the various treatment package components. That is which one or combination of, biofeedback, suggestion, and autogenic training lead to the observed effects.

Hylas: Will you take a cheque Philonous?

Philonous: Certainly . . . why have you stopped writing?

Hylas: (Pen poised.) I seem to remember your saying that my headache was perhaps a combination of both vascular and tensions origins but here you are proposing a migraine specific treatment and in your eloquence almost had me signed up for what is virtually half a treatment.

Philonous: Purely in the interests of science, Hylas. You have brought up another critical area in that one of biofeedback's hallmarks is a confounding methodology.

Hylas: Pardon?

Philonous: You will remember the Sargent, Walters, and Green (1973) study used both temperature feedback and autogenic training. Autogenic training itself involves the simultaneous regulation of mental and somatic functions by meditating on passive activities and as such combines self instruction and relaxation training so that the resulting confounding leaves the effective variable hidden.

So too with Budzynski, Stoyva, Adler, and Mullaney (1973)'s EMG work. Their treatment combines EMG frontalis muscle feedback (in itself confounded with other muscle activity) with home relaxation practise. Also this latter is carried out without specific instruction in their 1970 and 1973 experiments and hence anything could be going on with the result that the feedback variable is confounded with the "something" at home variable. In addition, systematic desensitization is suggested by Budzynski (1973) as a technique for reducing the drug dosages of those, who while their

headaches are reduced by biofeedback, feel so anxious about not taking their usual daily dose that they get a headache anyway.

Mitchell and Mitchell (1971) contribute another confounding variable in their showing the efficacy of assertive training in combination with muscle relaxation and desensitization for migraine relief.

Directions out of the bog have been pointed out however, Hylas, because Wickramasekera (1973) found biofeedback with deep muscle relexation more effective for tension headaches than relaxation alone and in 1972 he showed that false frontalis EMG feedback does not reduce tension headache behaviour whereas real such feedback does.

Thus Hylas, for me honestly to earn your money I have to be able to say I have gained or rather have helped you gain stimulus control over your headache behaviour and hence we will begin with temperature feedback alone and introduce EMG frontalis muscle feedback if the first treatment fails.

Hylas: When do I start?

Exeunt stage left.

PART THREE: BIOFEEDBACK TRAINING

Scene: Philonous' laboratory three weeks later. During this time Hylas has been subjected to rigorous testing. Philonous follows Sargent, Walters, and Green (1973)'s holistic approach with electroencephalograph readings, skull X-rays, an echoencephalogram, chest X-rays, serology, and urinanalysis. As Hylas is without severe psychologic or physical disorder he has been a suitable candidate for treatment. There being no current reduction in his headache frequency or intensity from the temperature feedback training Philonous introduces the second treatment condition, EMG frontalis muscle training.

There remains the possibility as mentioned by Budzynski (1973) that Hylas may be unwilling to give up his headache behaviour because contributing environmental factors (his wife) may be leading him to use the problem as a social coping strategy in order to avoid anxiety arousing situations. As Hylas' wife is still visiting her mother Philonous hopes biofeedback alone will be sufficient.

Philonous: Now we begin EMG training for the hypothesised tension part of your complaint.

Hylas: (Whose PATI count has dropped through a lack of enthusiasm.) I hope it is more effective.

Philonous: It should be. EMG feedback training is the oldest and soundest work in the biofeedback area and it is also a speedily assessible technique. Budzynski, Stoyva, Adler, and Mullaney (1973) report resting EMG levels can decrease 50-70 percent in only three to six, 20 minute feedback sessions.

Hylas: Oh, but should not I be doing home exercises in relaxation

as well? I mean Epstein, Hersen, and Hemphill (1974) found institution of home practice in relaxation without further feedback training lead to a marked reduction of headache frequency and besides Tasto and Hinkle (1973) successfully treated tension headaches using only training in deep muscle relaxation.

Philonous: Well you could be doing home exercises and certainly Budzynski, Stoyva, Adler, and Mullaney (1973) feel it is essential for transfer to real life. Their failures seem to stem directly from not carrying out regular home practice but in your treatment Hylas I am trying to get away from the shotgun approach of the other researchers in this field and derive some hard experimental data, which all means would you accept a 10 percent reduction in fees if you persist in this design?

Hylas: 15 percent.

Philonous: Very well. In this area there are some good indications towards the most effective procedure.

Firstly, if you remember from the etiology section, Alexander, French, and Goodman (1975) suggested that visual feedback militated against successful tension reduction of the frontalis muscle so we will use what they found to be the most effective mode, auditory feedback with eyes closed.

Secondly we will use real time information feedback of some of your favourite Madrigali Amorosi. In this we will be following Budzynski, Stoyva, Adler, and Mullaney (1973)'s lead which has been further justified by Kinsman, O'Banion, Robinson, and Staudenmayer (1975).

Hylas: Firstly what is real time information? And secondly what exactly was justified?

Philonous: Real time information is defined as "data transmitted, received, and processed as the events concerned take place as against historic data which is only passed after a delay". (Strategic Survey, 1974, p. 47.)

Secondly, to test the efficacy of the EMG feedback the Budzynski, Stoyva, Adler, and Mullaney (1973) study compared real, with false, with no feedback at all. As you will recall from the Blanchard and Young (1974) article it was the real feedback that produced the significant effects but Kinsman, O'Banion, Robinson, and Staudenmayer (1975) point out that they are really making a comparison between information positive and information negative feedback. It could be that any other way of presenting positive information would be as effective as the biofeedback. The Kinsman, O'Banion, Robinson, and Staudenmayer (1975) group hence compared real time feedback with equivalent positive information but presented verbally at the end of each trial. As they found the effectiveness of biofeedback lies in its being real time and information positive in nature.

The training commences.

PART FOUR: BIOFEEDBACK EPILOGUE

Scene: The peripatetum two weeks later. Hylas' headaches have continued unabated.

Enter: Philonous and Hylas walking and conversing on the treatment's apparent failure.

Philonous: The most reasonable hypothesis now Hylas seems to me to be that you are unwilling to give up your headache behaviour because you are using it to manipulate other people. Are you sure your wife is still visiting her mother?

Hylas: (Ignores the comment.) I disagree. From what I have learned during the course of this discussion I do not think the state of biofeedback science allows you to draw such a strong conclusion. Even in our present experiment, the treatment variable has been confounded because the design did not allow for my continuing to take Sansert while undergoing biofeedback training.

Philonous: ! ! !

Hylas: Further, for all your citing the evidence you should bear in mind Bakal (1975)'s comments that the studies so far have failed to specify the critical psychological and physiological changes that are believed to underlie the reduction in headache. That is, the etiological significance of the EMG and finger temperature measures remains largely unknown.

Philonous: You appear to be more on top of the subject than I now.

Hylas: Perhaps, but the only way of knowing more now, is to do more research along the lines we tried instead of this endless philosophising so shall we return to your laboratory?

Philonous: (Heartened.) By all means.

Hylas: By the way Philonous I do not think Berkeley would mind.

Exeunt stage right.

REFERENCES

Ad Hoc Committee on Classification of Headache. Classification of headache. *Journal of the American Medical Association,* 1962, 179, 717-718.

Alexander, A. B., French, C. A., and Goodman, N. J. A comparison of auditory and visual feedback assisted muscular relaxation training. *Psychophysiology,* 1975, 12, 119-123.

Anthony, M., Hinterberger, H., and Lance, J. W. Plasma serotonin in migraine and stress. *Headache,* 1967, 1, 93-102.

Appenzeller, O. Vasomotor function in migraine. *Headache,* 1969, 9, 147-155.

Bakal, D. A. Headache: a biopsychological perspective. *Psychological Bulletin,* 1975, 82, 369-382.

Blanchard, E. B., and Young, L. D. Clinical applications of biofeedback training—a review of evidence. *Archives of General Psychiatry,* 1974, 30, 573-590.

Budzynski, T. H. Biofeedback procedures in the clinic. In L. Birk (Ed.), *Biofeedback behavioural medicine.* New York: Grune and Stratton, 1973.

Budzynski, T. H., Stoyva, J. M., Adler, C. S., and Mullaney, D. J. EMG biofeedback and tension headache: a controlled outcome study. In L. Birk (Ed.), *Biofeedback: behavioural medicine.* New York: Grune and Stratton, 1973.

Epstein, L. H., Hersen, M., and Hemphill, D. P. Contingent music and antitension exercises in the treatment of a chronic tension headache patient. *Journal of Behaviour therapy and Experimental Psychiatry,* 1974, 5, 59-63.

French, E. B., Lassers, B. W., and Desai, M. G. Reflex vasomotor responses in the hands of migrainous subjects. *Journal of Neurology, Neurosurgery and Psychiatry,* 1967, 30, 276-278.

Goodell, H., Lewontin, R., and Wolff, H. G. Familial occurrence of migraine headache. *Archives of Neurology and Psychiatry,* 1954, 72, 325-334.

Homme, L. Laws of private behavioural events. *Psychological Record,* 1965, 15, 501-511.

Kinsman, R. A., O'Banion, K., Robinson, S., and Staudenmayer, H. Continuous biofeedback back and discrete posttrial verbal feedback in frontalis musicle relaxation training. *Psychophysiology,* 1975, 12, 30-35.

Lader, M. H., and Mathews, A. M. Electromyographic studies of tension. *Journal of Psychosomatic Research,* 1971, 15, 479-486.

Mitchell, K. R., and Mitchell, D. M. Migraine: an exploratory treatment application of programmed behaviour therapy techniques. *Journal of Psychosomatic Research,* 1971, 15, 137-157.

Sainsbury, P., and Gibson, J. G. Symptoms of anxiety and tension and the accompanying physiological changes in the muscular system. *Journal of Neurology, Neurosurgery and Psychiatry,* 1954, 17, 216-224.

Sargent, J. D., Walters, E. D., and Green, E. E. Psychosomatic self regulation of migraine headache. In L. Birk (Ed.), *Biofeedback: behavioural medicine.* New York: Grune and Stratton, 1973.

Shapiro, A. K. Placebo effects in medicine, psychotherapy and psychoanalysis. In Bergin, A. E., and Garfield, S. L. (Eds.), *Handbook of psychotherapy and behaviour change: an empirical analysis.* New York: Wiley, 1971.

Sicuteri, F. Headache as possible expression of deficiency of brain 5-hydroxytryptamine (central denervation supersensitivity). *Headache,* 1972, 12, 69-72.

Snyder, C., and Noble, M. Operant conditioning of vasoconstriction. *Journal of Experimental Psychology,* 1968, 77, 263-268.

Sternbach, R. A. The effects of instructional sets on autonomic responsitivity. *Psychophysiology,* 1964, 1, 67.

Strategic survey, 1974. The International Institute for Strategic Studies: London, 1974.

Stroebel, C. F., and Glueck, B. C. Biofeedback treatment in medicine and psychiatry: an ultimate placebo? In L. Birk (Ed.), *Biofeedback: behavioural medicine.* New York: Grune and Stratton, 1973.

Tasto, D. L., and Hinkle, J. E. Muscle relaxation treatment for tension headaches. *Behaviour Research and Therapy,* 1973, 11, 347-349.

Tunis, M. M., and Wolff, H. G. Studies on headache: long term observations of the reactivity of the cranial arteries in subjects with vascular headaches of the migraine type. *Archives of Neurology and Psychiatry,* 1953, 70, 551-557.

Wickramasekera, I. Electromyographic feedback training and tension headache: Preliminary observations. *American Journal of Clinical Hypnosis,* 1972, 15, 83-85.

Wickramasekera, I. The application of verbal instructions and EMG feedback training to the management of tension headache—preliminary observations. *Headache,* 1973, 13, 74-76.