

‘Hearts on their sleeves’: the use of systemic biofeedback in school settings

Brenda McHugh,^a Neil Dawson,^a Anthony Scrafton^a
 and Eia Asen^a

This article describes how a biofeedback device is used to ‘externalize’ internal physiological states. Heart rate monitors, emitting audible signals when a specific threshold is reached, are fitted to children and members of the family. This can help all those present to make connections between problematic behaviours and internal states of emotional/physical arousal. Devices may be worn for up to twenty-four hours and computer graph printouts of fluctuating heart rates can assist in contextualizing problematic interactions, particularly if other family members are also fitted with heart rate monitors. In this way biofeedback becomes ‘systemic’ as people are alerted to the interconnectedness of each others’ states. Participants are not only helped to identify stressors leading to heightened states of emotional arousal and resulting ‘out-of-control’ behaviours, but also to find ways of employing (self-)calming strategies. This article outlines the application of systemic biofeedback in school settings with children at risk of exclusion. With the help of these biofeedback devices pupils begin to manage themselves in situations which would previously have resulted in stressed, angry or violent behaviours.

Keywords: multi-family therapy school; systemic biofeedback.

Introduction

Violence and antisocial behaviour are the most common reasons given for the exclusion of children from school. School exclusion reports often describe a young person’s violent actions as ‘unprovoked’; it is frequently not the level of the violence that concerns the professionals involved so much as their own inability to understand the motivation and make sense of what happened. They perceive the escalation to anger and violence as too quick, too extreme and not justified by apparent antecedents, seemingly coming ‘out of the blue’. These

^a Head of Mental Health Intervention in Schools for CNWL CAMHS, Marlborough Family Service, 38 Marlborough Place, London NW8 0PJ, UK. E-mail: brenda.mchugh@nhs.net.

children appear to be easily aroused and present with 'out-of-control' challenging behaviours. Not only are the children unaware of how rapidly their emotional tension builds up internally, but similarly their families and teachers only become aware of this escalation once an external 'explosion' has happened.

Discussion about the contextual triggers for the volatile or angry outburst together with detailed description of the bodily experiences of the individual can be very helpful for many young people and can enable them to gain better control over themselves and their 'anger'. However, there is always a significant number of children who are able intellectually to understand the anger cycle and to name the triggers and even to describe their physiological experience of getting angry. They remain, however, unable to stop themselves from reaching the stage at which they lash out physically or verbally. They report that their recognition of the changes in their bodies, which many would interpret (Solms and Turnbull, 2002; Strathearn, 2007) as the combined effects of adrenalin and cortisol release on their autonomic nervous systems, comes too late for them to avoid or halt the angry event.

In order to read the warning signs earlier and to take preventive action, we started using heart rate monitors, capable of providing auditory signals (bleep) when the child's heart rate was significantly increased. These beeps not only offer instant feedback to children about their internal state of arousal, but also to those around them – be that the family, other pupils and teachers. This can offer concrete help in enabling all concerned to explore triggers for stress, episodes of anger or violence, as well as considering the use of self-calming strategies to control or bring down levels of arousal. We thought that by identifying and examining situations in the 'real here and now' family and school contexts in which stress can reach significant levels, we could aim to avoid or mitigate the effects of similar situations in the future, leading to a reduction in 'out-of-control' behaviour episodes. In short, a systemic biofeedback loop is generated, with the responses to the auditory signal raising levels of mutual awareness of an individual's autonomic system, leading to calming and defusing strategies. The result is that children – and adults – feel more 'in charge' of their affect and behaviours.

Traditional and systemic biofeedback

Biofeedback has been around for some forty-five years and the term initially described laboratory procedures aimed at training experi-

mental research subjects consciously to alter brain activity, blood pressure, heart rate and other bodily functions that had previously been thought to be beyond voluntary control. Neal E. Miller (1975) suggested that the autonomic nervous system could be as susceptible to training as the voluntary nervous system, so much so that people could learn to control their heart rate and other bodily functions that seemed to be beyond their control. Since then many different biofeedback techniques have been used with some success in a wide range of conditions (Gwartney, 1979; Schwartz, 1987), such as headaches, disorders of the digestive system, urinary incontinence, high and low blood pressure, cardiac arrhythmias, Raynaud's disease, rheumatoid arthritis, epilepsy and motor-movement disorders. Methods used for feedback have included the measurement of muscle tension (via electromyograms), skin temperature (via thermal recordings) and galvanic skin response (via perspiration levels), as well as brainwave activity (via EEG), heart rate and blood pressure. These measures enable the detection and monitoring of internal bodily functions with considerable sensitivity and can provide important insights into the scope and limits of self-regulation of physical and related mental states. Individuals may experience the biofeedback tools as a kind of 'sixth sense', or a special window into their bodies and minds. In individual work, the biofeedback therapist acts as a coach, standing 'on the sidelines', and setting goals and limits on what to expect, as well as giving advice on how to improve performance. Individuals are helped to identify contextual stimuli and stressors which trigger their symptoms. They are then taught some form of relaxation exercises and specific techniques for gaining self-control (Lehrer, 2007).

Biofeedback techniques are rarely 'stand-alone' approaches but tend to be part of wider intervention programmes. In the systemic field Minuchin *et al.* (1975) and Fowler *et al.* (1976) first investigated the application of biofeedback ideas, including the measurement of blood sugar levels during family therapy in children presenting with brittle diabetes. In more recent years biofeedback work has been done with children diagnosed with ADD/ADHD, using neuro-feedback training to help change brainwave patterns, based on the hypothesis that decreasing slow wave and increasing fast wave activity might ameliorate ADD/ADHD symptoms. George *et al.* (2002) studied 100 children diagnosed with ADD/ADHD receiving Ritalin medication, parent counselling and academic support at school. Half the children also received EEG biofeedback training. All the children improved on

behavioural evaluation scales, but only those who had received EEG biofeedback input sustained the improvements when Ritalin was withdrawn. Birbaumer *et al.* (2006) investigated the effects of self-regulation of slow cortical potentials for children diagnosed with ADHD and showed that, after neuro-feedback training, significant improvements in behaviour, attention and IQ score were observed and maintained. Similarly, Leins *et al.* (2007) compared neuro-feedback training of Theta-Beta frequencies against training of slow cortical potentials (SCPs). Both groups of 8- to 13-year-old children were able learn to regulate cortical activity themselves and they showed sustained improvement in attention and other areas of cognitive functioning.

Biofeedback work, if carried out in a one-to-one setting, tends to only benefit the individual who is fitted with the device. Using biofeedback in a wider context, such as the family or a school setting, is an altogether different matter, since everyone present is potentially involved in the biofeedback 'loop', provided that the biofeedback readings become visible or audible to others. It is only then that a shared awareness of internal states becomes possible. A more complex 'systemic biofeedback' context emerges when more than one person is fitted with a biofeedback device, thus making the connectedness of feeling states and related behaviours of a number of people evident. In a couple or family context each person who carries the device is not only aware of their own arousal state(s), but also of those of others. In a school setting a teacher will be aware of the levels of arousal of all those pupils who are fitted with the device – as will they! This permits mutual 'tuning into' one another, tracking interactions and reactions, as well as taking preventive action, in the form of arousal-reducing interventions. Obvious though the idea of using biofeedback systemically in a family or school context may be, it is nevertheless surprising that there is a remarkable absence of reported work in this area.

Putting hearts on sleeves

When explaining the rationale for the use of heart rate monitors to children and their families, we first point out that there is a well-established connection between family relationships, coping styles, stress and cardiovascular disease risk factors among children and their parents (Hanson *et al.*, 1990). We state that the heart rate may be used as one measure of internal stress and we add that it also measures the degree of physical activity. We explain that heart rate monitors, if

fitted, for example, to a child and a parent, can help to identify how each may 'wind up' the other and how situations can get out of hand – and what to do to stop escalations by using self-calming strategies. We state that something similar may happen in classrooms, and that monitoring their own heart rates and how these accelerate in certain situations may help certain pupils to get a handle on their seemingly 'out-of-control' behaviours.

The heart rate monitors we use come in the form of a belt that fits easily and unobtrusively around the subject's chest and transmits its data wirelessly to a watch-sized monitor, worn on the wrist – wearing the 'heart on the sleeve', as it were. The 'watch' may be set to give an auditory alarm bleep whenever the heart rate goes above a predetermined threshold. In addition, data about the variation in heart rate over a certain time period (up to twenty-four hours) can be downloaded to a computer program, enabling graphs to be printed and permitting a subsequent contextual analysis – in which the whole family gets involved. At the outset, individuals and families are taught how to put on the monitors and working baselines are established by wearing a monitor continuously for five days. This makes it possible to set a 'lower threshold' heart rate, an 'average level' heart rate and an 'upper threshold' heart rate for each individual. The bleep sounds when this upper threshold is exceeded. Making their heart rate audible and visible provides opportunities to examine situations when individuals, couples or whole families get 'worked up'. The audible beeping caused by an elevated heartbeat appears to occur significantly earlier than the 'outburst', and closer to the triggering event. This means that the actual trigger is more likely to be identified by all concerned, and so a previously incomprehensible 'mood swing' or 'erratic behaviour' becomes contextually understandable. We discuss with children and their families how to identify ways of avoiding similar states and teach self-calming strategies, to be cued by the initial beeping. These may include breathing and relaxation exercises or guided imagery. Once the beeping has stopped and physical equilibrium has been regained, we encourage the individual and those around to reflect and 're-view' the whole sequence, including the antecedent triggers. The computer printout (for an example, see Figure 1) shows the variation in heart rate over time and helps to pinpoint the time when the body's physiological state started to change. It also gives an accurate recording of how long the stressful event lasted and therefore how long it took to calm down. Many children and parents have used this data to 'beat their own record' in

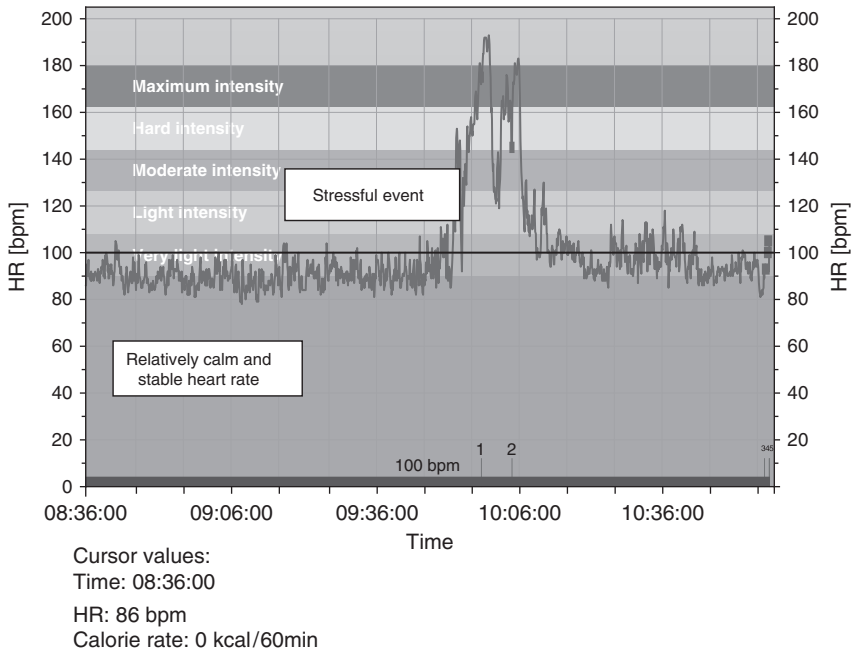


Figure 1. A typical computer-generated printout of heart rate over time.

seeing how they could reduce the length of the event and speed up the recovery process.

Work context

We have implemented the use of heart rate monitors in the Marlborough Family Education Centre (MFEC) where specific work with highly problematic and disruptive pupils and their families is carried out in a multi-family group setting. The aim is to help these children avoid exclusion from school. This 'families helping families' approach was developed to engage 'hard-to-reach' and reluctant families into systemic work (Asen *et al.*, 2001; Dawson and McHugh, 2000). The work is a mixture between education, therapeutic family and multi-family interventions, and it is mandatory for at least one parent or carer to be present in the classroom at all times with their child. The approach is carried out both in the MFEC, for the most complex families, as well as in the form of outreach multi-family group work in

local primary and secondary schools (Dawson *et al.*, forthcoming). Many of the children and adolescents who attend the MFEC present with highly volatile and reactive behaviours usually described by other family members as 'getting angry easily' or 'not being able to control their temper'. They are commonly referred because they are on the verge of being permanently excluded from school for, for example, fighting or being verbally abusive and threatening towards teachers. The intervention is carried out in a multi-family context where up to ten families observe, talk and learn together how to understand and manage anger and out-of-control behaviour. Families are encouraged to challenge and support each other in their attempts to bring about change.

Case studies

In this section we describe a number of case scenarios to illustrate the clinical usefulness of systemic biofeedback.

Case study 1 (Figure 2)

John, aged 12, was referred because he was at the point of exclusion from school on the grounds of his violent behaviour. When attending

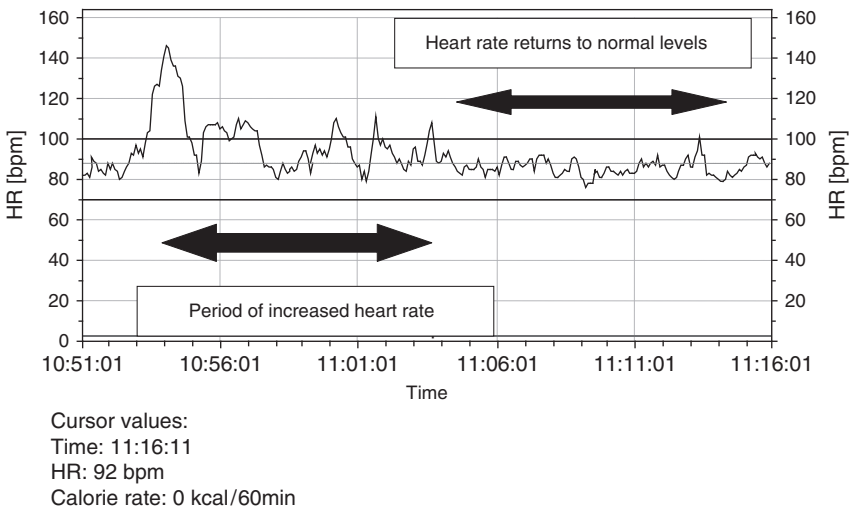


Figure 2. Anticipation of criticism in a 12-year-old boy.

the MFEC he worked cooperatively and well with teachers. When his mother, who had attended a parents' group, re-entered the classroom, John's heart rate monitor immediately began beeping. He later explained that he felt escalating tension owing to his anticipation of a verbal exchange with her in which she was likely to criticize him. He also complained that she generally ignored his feelings. When reflecting with both of them about the monitor 'results', John's mother was initially startled and then acknowledged that she had not previously recognized the impact of her criticism on her son. On another occasion John's monitor began beeping for no apparent reason. When asked about this, John said he had been thinking about an incident some years before when he had saved his younger sister from drowning.

One of the aims of reflective work in a multi-family group is to help children describe their emotions and thoughts overtly and for their parents – and other members of the group – to respond. John had not been skilled at verbalizing his distress, but via the heart rate monitor he was able to give 'voice' to what had been unsayable up until that point and for his mother to listen to his 'externalized' distress.

Case study 2

Ten-year-old Michael was permanently excluded from his primary school because of his violent and unexplained outbursts of anger. He and his mother attended the MFEC and once his behaviour had improved sufficiently he was able to return to a new school to resume full-time education. However, there remained some anxiety about his extreme volatility in the school playground and he was only allowed limited time to play at break or lunchtime because of the risk that he posed to himself and others. Michael reported that after each playtime his brain would feel like it was in 'complete meltdown' and that this made it extremely difficult subsequently to focus and concentrate on work or how to behave 'properly' in class. It was decided that he and his mother would return to the MFEC for a short 'top-up' to see if the difficulty with play could be overcome. When Michael started to use the monitor, he, and particularly his mother, were very surprised to hear it sounding for prolonged episodes on his return from break-time play, even though he showed no other visible signs of being excited or distressed. When studying the computer graph printouts it was evident that Michael's heart rate

would elevate rapidly and take a long time to return to its normal resting levels. During the periods when his heart rate was raised he was less articulate, more distractible and prone to arguments and fights. Michael used the monitor and the printouts (Figure 3) over a three-week period in the MFEC, continually trying to 'beat his own record' in reducing the time that his heart rate took to return to normal resting levels. He used breathing control and focused relaxation techniques, initially with his mother's assistance and later on his own, and he was able to visibly demonstrate his improved self-control via the changes in the graphical recordings. He returned to school full-time after a month and has managed well in all situations, including playtime.

This example suggests that heart rate feedback is a useful tool in helping children to learn to calm themselves down with the help of significant adults, such as parents or teachers. Children who show no obvious outward signs of arousal are often accused of being cold and capable of premeditated violence. Indeed, research indicates that individuals who suffer from behavioural disorders experience general physiological under-arousal, including 'lowered heart rate' (Mezzacappa *et al.*, 1997; Rain *et al.*, 1990). Michael's example shows that, at least for some individuals, an apparent 'calm before the storm' may in fact hide a significant heart rate increase.

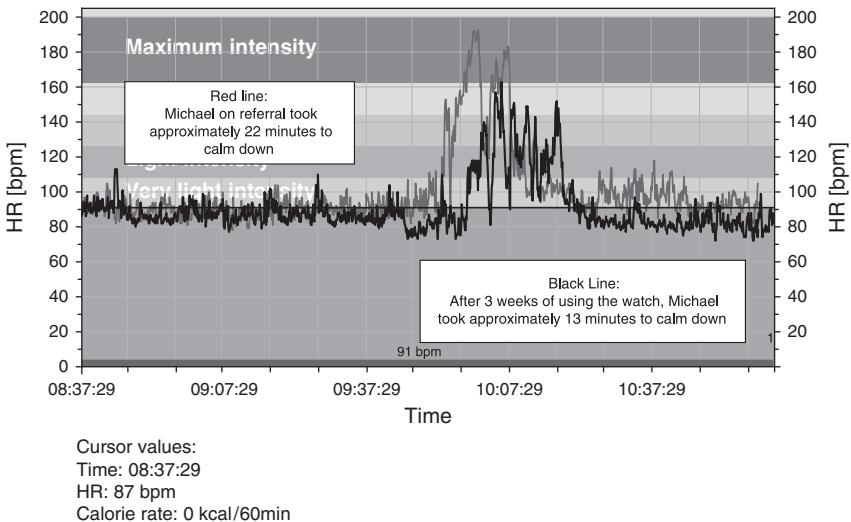


Figure 3. Effect of heart rate feedback on calming-down period.

Case study 3

Joanna, aged 15, was referred because of her high volatility and her inability to resolve conflicts in school. She was reported to become often abusive and storm out of meetings with teachers. When attending the MFEC, she and her father were both fitted with heart rate monitors and when an argument between them began to escalate, both monitors would beep at the same time. Joanna's father reported that he found this useful, as it gave him concrete evidence that his daughter was 'genuinely' upset and that she was not behaving 'just for effect'. Even though other members of the multi-family group had previously commented on what they saw as a deeply ingrained pattern between daughter and father, it was only the 'evidence' of the monitors that enabled father and daughter to recognize the issues for themselves and take some avoiding actions. As things improved, Joanna wore the monitor at a school disciplinary meeting and she surprised her teachers by her new-found ability to stay in the room and address and resolve the issue calmly without resorting to abuse or running away. On the following day, Joanna proudly displayed the printout of the heart rate monitor (Figure 4) which 'proved', she said, that

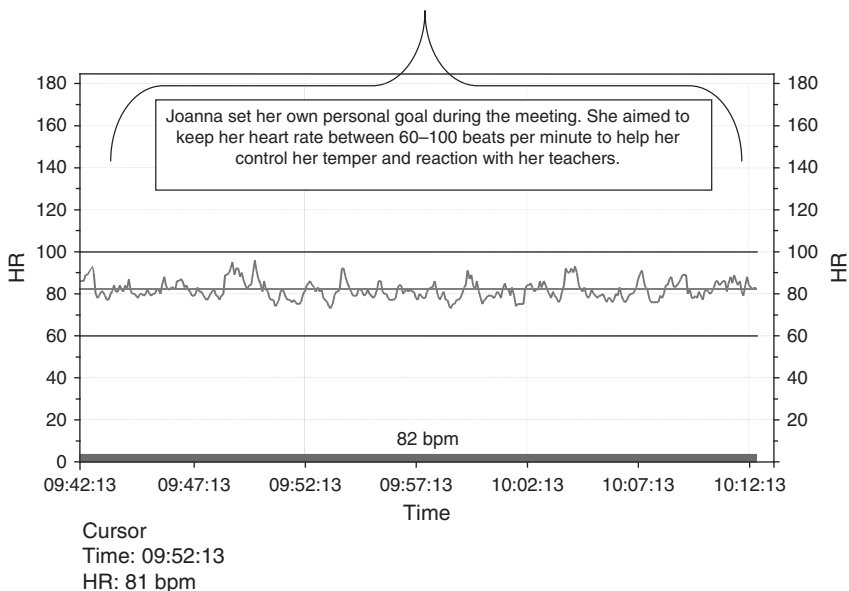


Figure 4. Heart rate of a 15-year-old girl during a school disciplinary meeting.

she had been able to maintain her heart rate within the 'safe' target range throughout the meeting.

Using heart rate monitors with parents and children simultaneously makes any escalation visible to all involved. Techniques such as calling 'time to cool off' when the monitors signal the buildup of stress enables parents and children to learn to stop and think, and so to avoid intensive confrontation.

Case study 4

One morning a fight broke out between two boys attending the MFEC. The parents separated the boys and started the process of calming the children down and helping them talk about the argument. At that time all the pupils attending the Centre were wearing heart rate monitors. It was noted that some of those not involved in the fight actually became more aroused and found it more difficult to calm down than the two protagonists. Two of these seemingly uninvolved 'observers' who remained highly aroused for a significant length of time then spoke about having witnessed domestic violence in their respective families of origin during their early years. With the help and close guidance of his mother, one of these children subsequently became involved in reading the instructions for a game he wanted to play and, as he became engrossed in the text, the beeping stopped. The other child calmed down only when his mother soothed and comforted him by massaging his hands and arms (Figure 5). This raised the other families' curiosity and they began to ask questions, searching for clues to the difference in the children's reactions.

Mapping 'minefields'

Children – and adults – vary markedly in the time it takes to regain composure after arousal. Many children also have similar patterns of recovery to their parents. We have encouraged individual clients, both children and adults, to imagine problematic situations or hypothetical scenarios as a means of 'exploring' or 'tuning into' their internal states, with the aid of the monitors. It is striking to observe how merely thinking about a conflictual situation can accelerate the heart rate, or how the monitor 'spots' emotional 'swamps'. The more familiar the 'minefields' of this emotional terrain become, the easier it is to time the initiation of self-calming strategies.

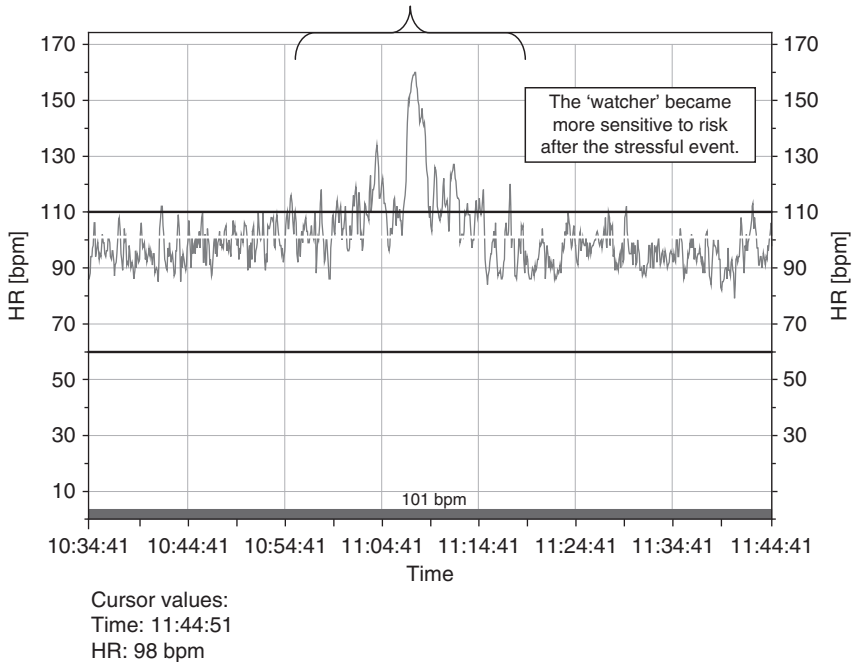


Figure 5. Heart rate of 'uninvolved' pupil watching fight.

In a multi-family setting the 'lesson' learned by one family frequently has beneficial 'ripple effects' for others in the group. Observing other people experiencing difficulties, and finding alternative ways to resolve them, helps many to apply similar strategies to their own families (Asen *et al.*, 2001). People engage more readily with the management of their own overwhelming psycho-physiological responses when they see other adults and children acknowledging and attempting to cope with theirs. When parents and their children are at the same time 'wired up' with heart rate monitors, they can explore how they affect each other and how confrontations can escalate. Discussions often arise as to 'who bleeped first', for example, and in a group context multiple perspectives and 'outside' views can be offered. Once the bleeping has stopped and a psycho-physical equilibrium has been regained, it is possible to involve the individual, or individuals, in reflective thought about the whole sequence, including any possible antecedent triggers.

Hearing about the heart monitor feedback work and observing the 'evidence' from the printouts seems to help teachers and other

education professionals to think differently about their 'problem pupils' and their attempts to change. Similarly, when the children's parents open up about their own stress reactions, teachers have often found it a humbling experience and they have become less ready to criticize the parents.

Concluding comments

Heart rate monitor feedback in a family or school context has huge potential to assist other systemic interventions. To date, some twenty-nine pupils and their parents have participated in our pilot project which takes place in a specialist educational setting, working with children and adolescents who have been excluded – or are at risk of being excluded – from mainstream schools. Parents and teachers have commented on the beneficial effects and increased self-control and anger management of many of the pupils. They have said that many of the volatile behaviours no longer need to be seen as the child's deliberate intention or 'fault', or that it is the child who is 'out of control'. Instead some of the behaviours are seen as the peculiar working of their autonomic system that needs recalibrating!

We have found that the heart rate monitor is a highly effective way of capturing the interest of children and it provides a focus, as well as a fun way, of addressing specific issues. It offers the opportunity to do something practical about difficulties that may, to the individual parent or child, have appeared entrenched and immutable. The use of the monitors in highlighting mutually escalatory interactive processes, particularly between children and their parents, appears to be very powerful. Several parents have said that the monitors helped them to realize that, for their child to change, they themselves would need to change. Heart rate monitors can be worn unobtrusively by children (and adults) while they continue their everyday activities but they offer a way in which individuals can get connected to what goes on inside others. Then they can offer insights and help. Feedback from children, young adults and parents has been consistently positive. The use of heart rate monitors in schools enables teachers to support the child in recognizing triggers for stress, particularly in finding ways to reflect on difficult situations with peers, staff and the curriculum.

Biofeedback using heart rate monitors has many different areas for application in the systemic field, for example, in couple work. A couple can be encouraged to discuss a problematic issue, but with the

task of suppressing the monitors' likely bleeps ('Try to talk about this, but remain cool, do it in a way that your heart rate doesn't go up and there is no bleeping'). This can enable warring couples to rehearse new ways of negotiating or resolving conflicts. Couples can take the monitors home and transfer experiences from one to another context.

There is another potential application, in line with the increasing trend of therapists to be 'transparent'. Clinicians may on occasion consider wearing heart rate monitors during consultations, thus making accessible to their clients their own feeling states, if not counter-transference. Both client and therapist can then speculate and reflect on the therapist's fluctuations in response to the presented 'material'.

References

- Asen, E., Dawson, N. and McHugh, B. (2001) *Multiple Family Therapy – The Marlborough Model and its Wider Applications*. New York and London: Karnak.
- Birbaumer, N., Goth, G., Hinterberger, T., Klinger, C., Leins, U. and Strehl, U. (2006) Self-regulation of slow cortical potentials: a new treatment for children with attention-deficit/hyperactivity disorder. *Pediatrics*, **118**: 1530–1540.
- Dawson, N. and McHugh, B. (2000) Family relationships, learning and teachers – keeping the connections. In C. Watkins, C. Lodge and R. Best (eds) *Tomorrow's Schools – Towards Integrity*. London: Routledge.
- Dawson, N., McHugh, B. and Asen, E. (forthcoming).
- Fowler, J. E., Budzynski, T. H. and Van den Bergh, R. L. (1976) Effects of an EMG biofeedback relaxation program on the control of diabetes: a case study. *Biofeedback Self Regulation*, **1**: 105–112.
- George, S., Monastra, D. M. and Monastra, V. J. (2002) The effects of stimulant therapy, EEG biofeedback, and parenting style on the primary symptoms of attention-deficit/hyperactivity disorder. *Journal of Applied Psychophysiology and Biofeedback*, **27**: 231–249.
- Gwartzney, R. H. (1979) Biofeedback in psychosomatic medicine. *Psychosomatics*, **20**: 513–514.
- Hanson, C. L., Klesges, R. C., Eck, L. H. and Cigrang, J. A. (1990) Family relations, coping styles, stress, and cardiovascular disease risk factors among children and their parents. *Family Systems Medicine*, **8**: 387–400.
- Lehrer, P. M. (2007) Biofeedback training to increase heart rate variability. In P. M. Lehrer, R. L. Woolfolk and W. E. Sime (eds) *Principles and Practice of Stress Management* (3rd edn). New York: Guilford Press.
- Leins, U., Goth, G., Hinterberger, T., Klinger, C., Rumpf, M. and Strehl, U. (2007) Neurofeedback for children with ADHD: a comparison of SCP and theta/beta protocols. *Applied Psychophysiology and Biofeedback*, **32**: 73–88.
- Mezzacappa, E., Tremblay, R. E. and Kindlon, D. (1997) Anxiety, antisocial behaviour, and heart rate regulation in adolescent males. *Journal of Child Psychological Psychiatry*, **38**: 457–469.

- Miller, N. E. (1975) Clinical applications of biofeedback: voluntary control of heart rate, rhythm and blood pressure. In H. I. Russel (ed.) *New Horizons in Cardiovascular Practice*. Baltimore, MD: University Park Press.
- Minuchin, S., Baker, L., Rosman, B. L., Liebman, R., Milman, L. and Todd, T. C. (1975) A conceptual model of psychosomatic illness in children. Family organization and family therapy. *Archives of General Psychiatry*, **32**: 1031–1038.
- Rain, A., Venables, P. H. and Williams, M. (1990) Relationships between central and autonomic measures of arousal age 15 years and criminality at age 24 years. *Archives of General Psychiatry*, **47**: 1060–1064.
- Schwartz, M. (1987) *Biofeedback: A Practitioner's Guide*. New York: Guilford Press.
- Solms, M. and Turnbull, O. (2002) *The Brain and the Inner World*. London: Karnac.
- Strathearn, L. (2007) Exploring the neurobiology of attachment. (In L. Mayes, P. Fonagy and M. Target (eds) *Developmental Science and Psychoanalysis*. London: Karnac.