

# Human Error & Safety Performance

## Impacting the behavioural aspects of human error

Recent scientific advances have shed considerable light on the neurophysiological basis of human error. Brining together advances in cardiac technology, signal processing techniques, systems theory and neurophysiology it has become clear why simulator training may not be sufficient to overcome the behavioural aspects of error. Specifically, it appears that at times of crisis, such as occur during and air incident, cognitive, perceptual and communicational processes are significantly inhibited by the afferent electrical and electromagnetic signals reaching the brain.

Thus when a critical incident occurs the afferent signals generated, particularly by the heart, become very chaotic and this inputs the brain stem and higher perceptual centres leading to *cortical inhibition*. This cortical inhibition is what necessitates the need for simulator training in the first place.

At times of challenge or crisis not only is there no time to think but also thinking ability is actually impaired. Since thinking is impaired automatic responses have to be established, through repeated experience as occurs in simulator training, in order that appropriate action can be taken. This automatic response has to be a “no-brainer” literally because there is no smart thinking available at times of crisis.

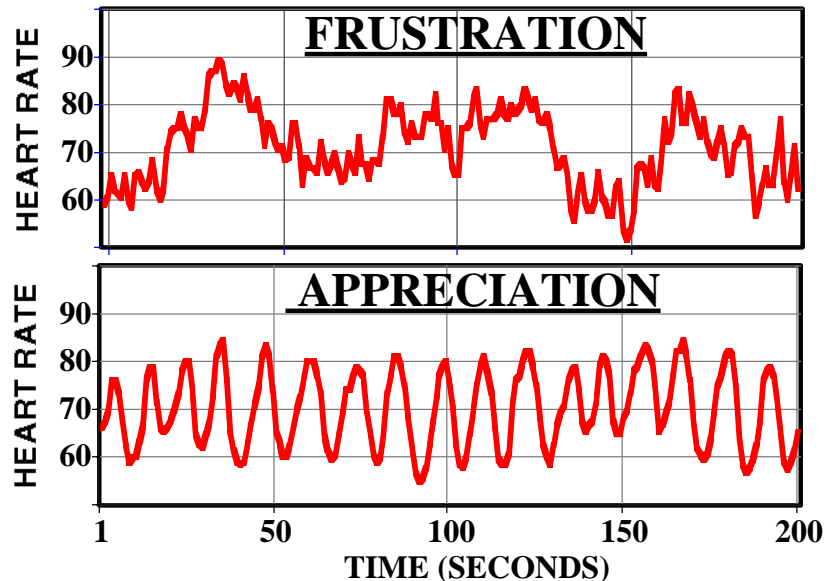
Hopefully these automatic responses will resolve the crisis successfully. However, if they do not then the real problems start because the brain is still inhibited. Consequently what tends to happen at such times is that individuals will repeat the same steps in the vain hope they will work a second time when they did not work first time around. The reason individuals do this is they can not think what else to do because the brain is inhibited.

The only way round this problem is to learn to control the quality of the electrical and electromagnetic signals that reach the brain from the heart to undo the cortical inhibition and achieve cortical facilitation. Fortunately techniques have been developed that enable individuals to change the quality of these internal physiological signals and these techniques form the basis of the Inner Quality Management® (IQM) programme.

The basis of these techniques is teaching individuals the ability to manage their emotional state since it is the emotional state that will change the quality of the afferent electrical signal to the brain. The electrical signal is measured by the beat to beat variation in the heart rate, and is know as the heart rate variability or HRV signal. The HRV signal changes from a chaotic, incoherent pattern to an ordered coherent pattern when individuals self-induce a positive emotional state such as appreciation (see Figure 1).

This coherent electrical signal not only alters perceptual processes and quality of communication but it has also been shown to affect the emotional centres such as the amygdala and the hippocampus and therefore affects psychological and emotional processes<sup>1</sup>. The heart’s afferent signal also inputs the brainstem autonomic nuclei and therefore can affect blood pressure and cardiovascular responses<sup>2</sup>. It also inputs the hormonal centres such as the hypothalamus and can over time alter hormonal set points<sup>3</sup> and immunity<sup>4</sup> (see Figure 2).

**Figure 1. Changes in the afferent HRV signal in different emotional states.**



Thus the IQM programme teaches a number of techniques that enable people to consciously alter the quality of these internal electrical signals to the brain in order to maximise *cortical function*. Enhanced cortical function enables individuals to react faster, make better decisions, seize opportunities and be more perceptive and communicate more effectively. The IQM programme goes beyond the theory of performance and actually helps individuals to establish new behaviours, which can be sustained in the long-term.

Initially individuals are taught how to control their emotional state and therefore their internal physiological signals in non-threatening situations. But with practice many individuals become so proficient at doing this that they are able to achieve a coherent physiological state in situations that would normally induce chaos

For the last three years, Hunter Kane has been working at all levels with BP Amoco, Burmah Castrol, Shell and other global companies teaching individuals these new tools which help them to manage their performance during times of change. This has enabled individuals to achieve and sustain high levels of personal and professional effectiveness.

### **Impact of the Inner Quality Management® Programme**

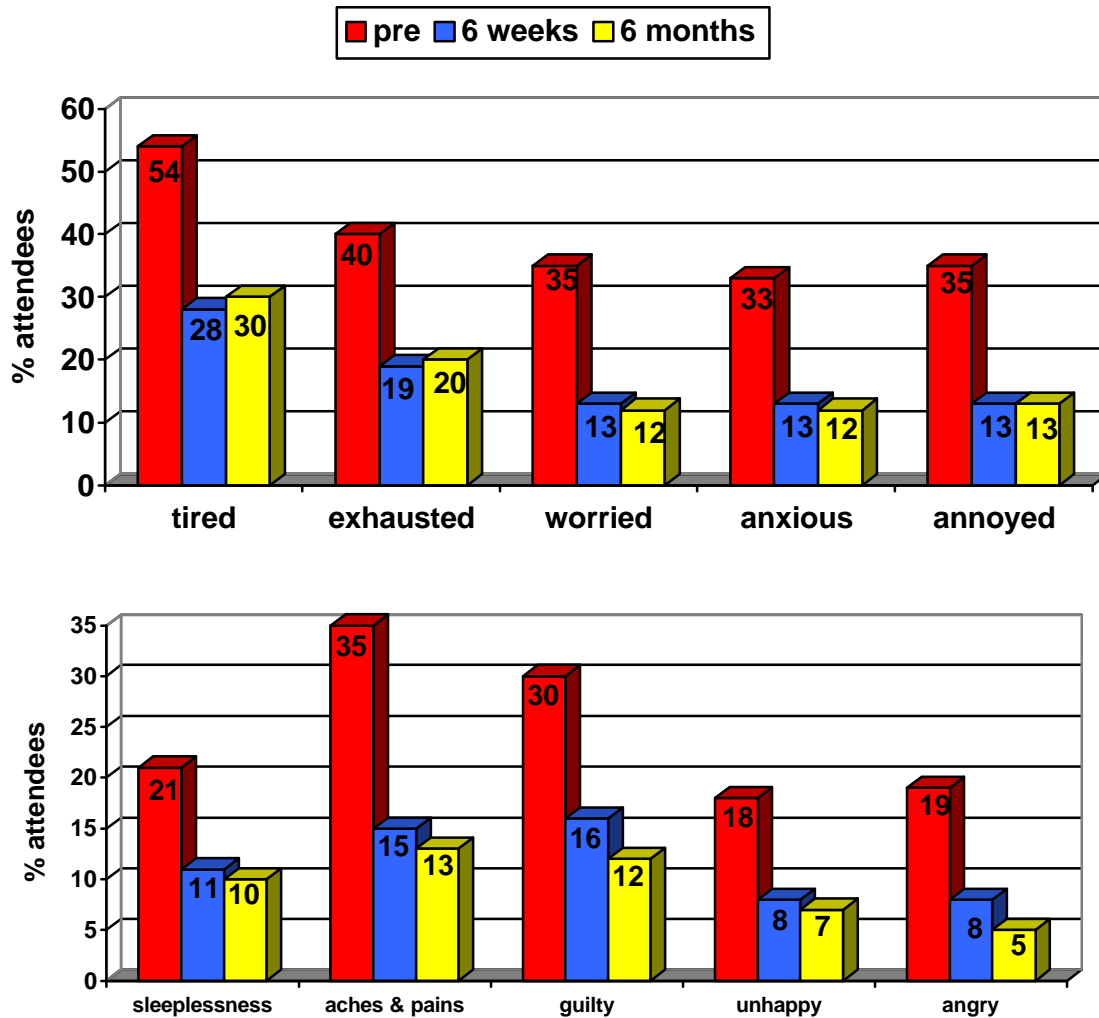
One of the unique points about the IQM programme is that its impact can be measured, by tracking changes in psychometric and physiological parameters over time. Measuring both the psychological and physiological changes before and after the IQM programme has demonstrated that there is a dual benefit on performance and health. This data is collected in collaboration with each organisation, the physiological data is gathered by a company's own medical team.

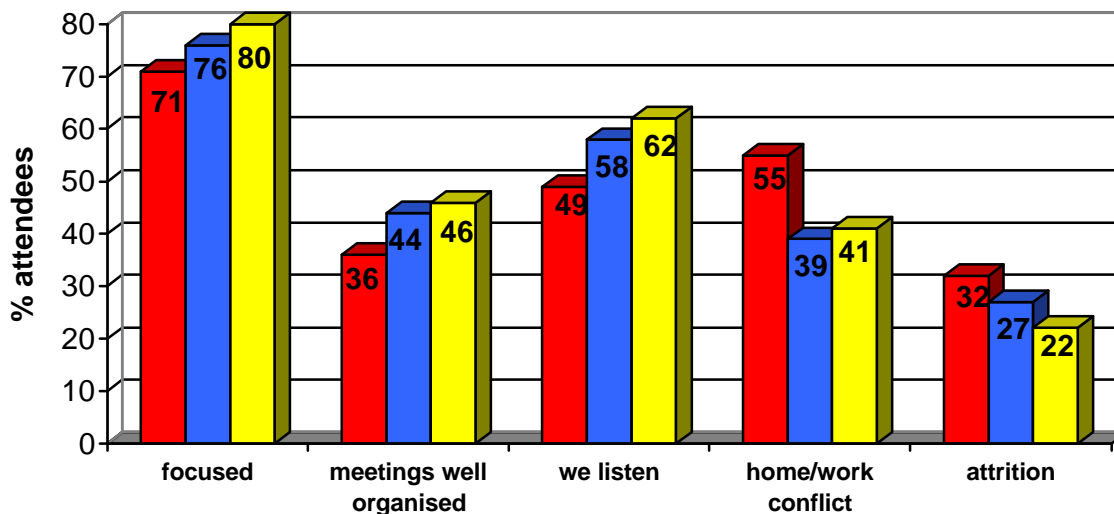
**a) Personal Data**

All individuals complete an extensive psychometric questionnaire before and 6 weeks and 6 months after the IQM Programme (Figure 2). This psychometric data tracks a number of individual and business performance issues.

The evidence gathered from training approximately 40,000 people in the USA, as well as over 2,500 in Europe the Middle, the Far East and Africa indicates that personal benefits of the programme sustain for over 12 months after a single day’s training. The impact of the IQM programme has been reproduced in many different cultures around the world, from the boardroom to the shop floor. Some of the key findings of the psychometric questionnaire from one major Oil Company are presented below.

**Figure 2**  
**Oil Company Personal & Business data before and after IQM (sample size = 530)**  
 (Percentage of individuals responding to the top two of five possible answers)





**b) Physiological:  
Heart Rate Variability (HRV)**

In addition to the significant improvements in the personal and business data cited above, there were also significant improvements in objective physiological data, as measured by heart rate variability (HRV). HRV is a very sophisticated measure of overall health and underpins human performance and vitality: it is derived from a standard 24-hour electrocardiogram (ECG).

The HRV of 46 individuals has been measured before, and 8 weeks after, the IQM programme. Of these 46 individuals 34 were practicing the techniques taught during the programme and 12 individuals were not. The results show that the users of the techniques improved their physiology significantly while the non-users deteriorated (Figure 3).

The significance of this result is that HRV has repeatedly been shown to be a very powerful predictor of all-cause mortality. The scientific literature suggests that HRV should remain stable over time, with a gradual deterioration with age. Significantly reduced HRV suggests an increased risk of disease, premature ageing, poor overall health and impaired performance.

The improvement in physiology seen in those practicing the techniques was achieved in just 8 weeks, despite most individuals being involved in and driving a major company-wide re-organisation. This improvement would enable individuals to increase their performance and become more dynamic and flexible.

**Blood Pressure Results**

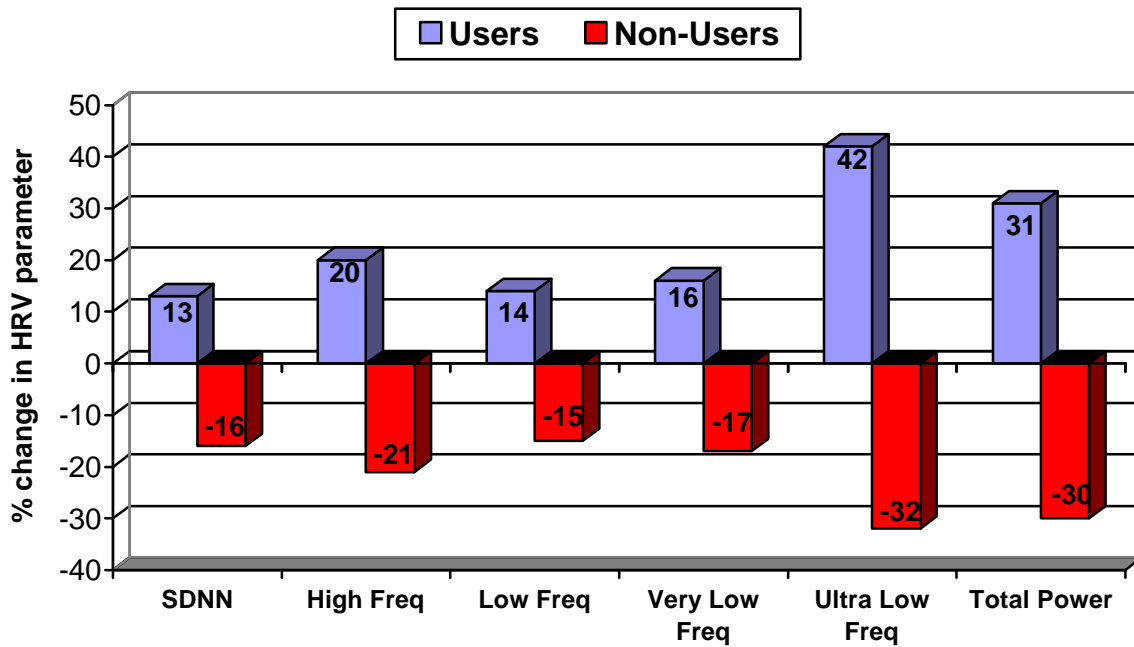
In addition to significant improvements in HRV we have tracked the blood pressure (BP) of a number of individuals before and eight weeks after the IQM programme in several organisations. In Organisation 1 the group average BP prior to the programme was 126/80mmHg.

Six weeks after the programme, with no other lifestyle changes, the average blood pressure had fallen to 118/78mmHg. That is an 8mmHg drop in systolic blood pressure and a 2 mmHg drop in diastolic blood pressure. Similarly, in a second organisation, the group average BP dropped from

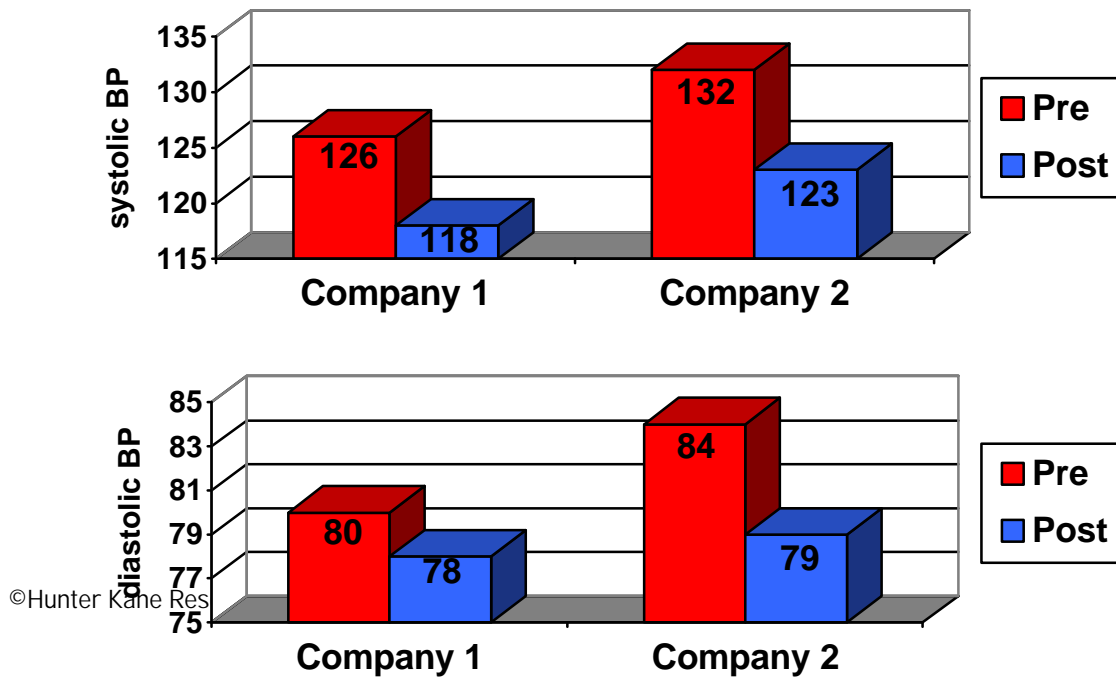
132/84 to 123/79 mmHg, a 9mmHg drop in systolic blood pressure and a 5mmHg drop in diastolic blood pressure (Figure 4).

This level of blood pressure reduction, if repeated in a large clinical trial, would reduce the incidence of stroke by approximately 60%. The reduction in blood pressure in these studies was in keeping with the reduction in blood pressure seen in other organisations that have run the IQM programme.

**Figure 3.**  
Percentage change in some standard HRV parameters after the IQM programme



**Figure 4.**  
Systolic & diastolic blood pressure changes before and after IQM



**Conclusion**

The effective management of safety begins with an individual's enhanced ability to manage themselves. With these new-found skills individuals can more successfully manage themselves at times of crisis and maintain problem solving abilities and communicational skills despite difficult circumstances.

The improvements in performance whether this is personal, communicational, business, health or safety performance following the IQM programme can be measured. The improvements seen in personal data is underpinned and supported by the objective physiological data, which shows that individuals who practice these techniques gained significant benefit, while non-users experienced a deterioration in their physiological flexibility making it harder to cope with their changing environment.

The IQM programme can be run as a "stand-alone", or integrated into an organisation's own Behavioural Safety Programmes, complementing existing activities depending on need.