

Peak Performance Programme

Heart Rate Variability (HRV) Interpretation Guide

Overview - to be read in conjunction with personal feedback

Heart Rate Variability (HRV) is a sophisticated measure of an important and fundamental aspect of an individual's physiology. It is known to be able to diagnose, and to be predictive of certain diseases and can be a measure of vitality and performance. Heart Rate Variability is analysed in two ways, either over time (Time Domain) or in terms of the frequency of changes in heart rate (Frequency Domain). The front sheet of the report shows the summary of all an individual's data.

Time Domain Analysis

The two key time domain measures are the SDNN and the SDNN Index. The SDNN assesses HRV every hour, and all 24 readings are then averaged to generate the 24hr SDNN measure. Both the hormonal and the nervous systems influence hourly variability and the SDNN. In contrast, the SDNN Index measures the variability every 5 minutes and therefore is solely influenced by the nervous system. In most people their SDNN and SDNN Index are normal. However, comparing the two figures can suggest whether their hormonal or nervous system is the more robust depending on which parameter, the SDNN or the SDNN Index, is higher compared to the age-related reference ranges given.

Comparing these two scores can suggest whether the ability to respond quickly, dynamically and effectively to a crisis is better than average or whether endurance is above average. If the SDNN is low, which is the more common pattern, we may be feeling pretty tired by the end of a hard week and may find that the weekend is needed to recover. In addition, it may be difficult to find the energy to engage socially and fully with the family while trying to “recover”.

The *Peak Performance* programme has been shown to enhance energy as well as improving endurance by increasing DHEA levels. In the USA DHEA is called the “vitality hormone”.

Turning to the top panel of page 2 we see how the heart rate varies over the entire 24 hours. This shows us how active a day we had. The pattern of the drop in heart rate at night is normal and we particularly look at this on the trace. The heart rate should drop quickly when asleep and stay low throughout the night before rising quickly when on waking. A gradual downslope can suggest some anxiety whereas a gradual upslope can be indicative of a low mood.

Frequency Domain Analysis

The panel at the top of page 3 shows the Frequency Domain analysis. Here low frequency (LF) power is plotted along the horizontal axis. LF is determined by the slightly slower changes in heart rate and is driven by the “accelerator” or adrenaline side of the nervous system. Along the vertical axis we plot the high frequency power (HF), which is determined by the rapid (hence high frequency) changes in heart rate and is driven by the “brakes” or acetylcholine part of the nervous system.

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The highlighted box is the age related reference range. A dot anywhere inside this box indicates that one is physiologically healthy, but for optimum performance should want to aim for the top right hand corner (ie powerful "brakes" and a powerful "accelerator").

Pressure, stress and ageing all move an individual's dot in a south-west direction (bottom left-hand corner). The speed with which the dot "deteriorates", or moves south-west, depends upon the speed of the individual's ageing process and the degree of stress/pressure that we are under and how well we cope. Individuals who are tired and exhausted or even "burnt out" will sit just outside the bottom left hand corner. The further outside the box, the greater is the risk of ill health. As we age the "brakes" tend to deteriorate first and then the "accelerator". So the dot moves south first and then starts to move west or downwards and then to the left.

a) "Brakes"

The lower panel on page 3 shows the detail of the Frequency Domain. These we tend to refer to as the "specific fuel tanks". Thus high frequency (the far right tank) shows the amount of energy in the "brakes", i.e. that part of the nervous system responsible for controlling rapid (high frequency) accelerations and decelerations in heart rate. This, to some extent underpins the ability to unwind. The vertical line in each fuel tank represents the normal range.

An exercise programme or gym attendance tends to improve the "brakes" but can have little effect on other aspects of the physiology. The *Peak Performance* programme has also been shown to improve HF measures.

b) "Accelerator"

The low frequency tank indicates the power of the "accelerator", that part of the nervous system allowing us to make an effort and raise the heart rate and our game, over 5-8 beats rather than 1-2 beats (brakes). People with high blood pressure often have elevated LF data in the early stages and if this continues unchecked the "accelerator" eventually becomes "burnt out".

c) "Balance"

The LF/HF Ratio indicates the balance between the "brakes" and "accelerator". A lack of balance in the system suggests that performance is maintained by overusing either LF or HF.

d) "Water Balance & The Body Clock"

Very low frequency (VLF) is to do with the "accelerator" and water balance. It can be useful to compare the VLF to the LF (accelerator). A low VLF with a higher LF is often seen in the early stages of high blood pressure, as the VLF decreases prior to the LF. If a trace shows this pattern we would suggest keeping a check on blood pressure. We might see a change in VLF and LF with consistent practice of the tools taught on the *Peak Performance* programme.

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e) Physiological Stamina or Endurance

Ultra low frequency (ULF) reflects the longer-term, more hormonally driven changes in the heart rate. Therefore it tends to reflect stamina levels. The *Peak Performance* programme has been repeatedly shown to increase the hormone DHEA, which underpins this physiological stamina. With consistent practice of the tools ULF could increase significantly.

f) “Vitality”

The "total power" is the overall vitality in the system across all frequencies. Again we would expect to see a significant improvement in this parameter with regular practice of the tools taught on the *Peak Performance* programme.

Circadian Rhythm Analysis

Looking at page 4 we see how some parameters vary over the 24 hours (the shaded box shows sleep period). The top panel should show that heart rate slowed during the night, which is to be expected.

a) Brakes

The second panel down shows the brakes (HF), which should kick in at night as we become more relaxed. Most people experience three or four cycles moving from stage I to stage IV sleep (stage IV being deep sleep) depending on how long they are asleep. These sleep cycles should be apparent on the trace.

b) Accelerator

The third panel down shows the "accelerator" (LF). We should see the "accelerator" on during the day and it should decrease at night. People in industry often keep running their "accelerator" at night, which suggests that they never really “switch off” even when asleep.

This inability to switch off will tend to undermine the quality of sleep, and could lead to a depletion of reserves. Again one of the potential benefits from the *Peak Performance* programme is to learn how not to continually carry the emotional content of each experience around so that we end up taking all these issues to bed at night and therefore never really switching off.

c) Body Clock

The fourth panel down on page 4 shows the body clock (circadian hormonal variations). The optimum pattern should be a flat trace during the day and an upsloping trace during the night with the four sleep cycles clearly shown. This trace shows, for example, how well we cope with long hours or any international travel.

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d) Sleep Quality

The bottom panel shows sleep quality by plotting "accelerator" and "brakes" on the same scale. Normally a perfect night's sleep should show the upper line (the accelerator) decreasing at night and meeting the lower trace, the "brakes", which tend to increase. The two lines should make contact all through the night and then diverge again during the day.

If a trace shows that the two lines only approximated during the night on two occasions this suggests that the quality of sleep was poor. Again learning how not to continually carry around the emotional content of our experiences should improve the quality of sleep and increase energy and vitality during the day.

One of the consistent benefits of the *Peak Performance* programme, in our experience, is that it has been shown repeatedly to improve the quality of sleep. We would expect this trace to improve following training.

The three 8-hour traces, covering the whole 24-hour period, indicate what was happening every five minutes (each small square is a 5-minute window) during the day. When compared to the personal diary information it should give an indication of how the HRV tracing looked during each meeting or event.

Conclusion

In conclusion an HRV trace illustrates a particular aspect of physiology and indicates areas that could be improved. If we are interested in feeling better more of the time, being more in control of our lives and working more effectively without becoming drained by our efforts, it starts with learning to control our own physiology more effectively.

Repeating the HRV trace can tell us how well we are progressing in implementing the techniques learnt on the *Peak Performance* programme.