

**The Effect of Physical Stress on Decision-Making Accuracy**

**Nathan Pearce**

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## **Introduction**

When thinking about refereeing as a career, several things enter my mind. Images of tightly fought test matches between rugby superpowers at large stadiums filled with screaming fans. A life of travel, afforded the opportunity to perform among those players who are the best at what they do, visiting foreign countries and meeting renowned dignitaries. All those wild dreams and aspirations of reaching the pinnacle of our chosen passion... refereeing.

After the buzz of personal expectation has died down and I turn my mind to how to achieve these lofty goals, I find myself looking for flaws in my game and how to transform them into strengths. I started breaking down the various facets of the ideal referee. Law knowledge, fitness, speed, agility, an empathy for the game, competitiveness and the ability to make many accurate decisions based on a rapid sequence of events to name a few. I explored how a person who was weak in any of these areas would improve their skills in that facet. For example, to improve your law knowledge you would read and memorise the law book, making sure you can relate to and understand each law. Not simple, but well and truly attainable. Or another example, you have a shortcoming of speed, agility and fitness. Several avenues are available to you for improvement, such as joining a gym, a training group or to seek coaching from a specialist. There may be physiological factors that may impede improvement in these areas but any aspiring referee can explore any number of avenues to improve their speed, agility and fitness.

Going through these various facets of a referees skill set, and identifying ways to improve performance of that facet, I became aware that a referee could have a gift for decision making, and could also be considered fit enough to handle the physical requirements of refereeing, but how do these two skill sets affect one another?

I came up with the observation that most high-ranking referees would have the ability and knowledge to deal with any hypothetical scenario on a rugby field. These skills should have been honed by continued discussion with fellow referees about any hypothetical scenarios. In practice these decisions may in fact be affected through the course of a game by physical stress in its various forms. This begs the questions what types of stress are there, and how could these be quantified? Why quantify? By quantifying the effect of stress upon decision-making, we can then hope to design methods to train and reduce the effect that fatigue may have.

## **Decision-Making**

Decision-making is an important part of a referee's role; Michael Tanzer's paper, "The Decision-Making Processes in Rugby Union Refereeing"(1994) suggests that we may make as many as 5000 decisions in an average 80-minute game. He suggests that decision-making can be broken into two types of decisions. First is the situation where a decision is to be made on a scenario that the referee has seen before, be it in practice or in theory. These decisions can be considered easy because we have dealt with them before and we would hope that we could easily reference a correct decision based on past decisions. The second scenario is where the decision is to be made on a set of stimuli that we have not encountered before. In this instance we are required to use our intuition to come up with what is hopefully the correct outcome. Tanzer (1994) suggests that in the first scenario we should be aiming for a success rate with our decisions that approaches perfect accuracy. Whereas the second scenario he suggests that at best our chances of a correct decision are fifty-fifty. Either we guess right or wrong.

## **Physical Stress**

Physical stress can be evident in many forms. Increased heart rate, heavy breathing and sweating are some obvious indicators. McArdle, Katch and Katch (1994) describe a person's heart rate as a good measure of physical stress. Essentially the human cardiovascular system provides for a rapid regulation of heart rate based on physiological demands placed on the body. That is put simply, when physical effort is performed, the heart rate will respond by rising. Thus for this paper I have decided the most practical way of identifying physical stress would be to use a heart rate monitor. Polar™ have a range heart rate monitors in the form of wristwatches that when combined with a chest strap can accurately provide readouts of a person's heart rate over a period of time. As you will see further on these readings can then be downloaded into graphical format.

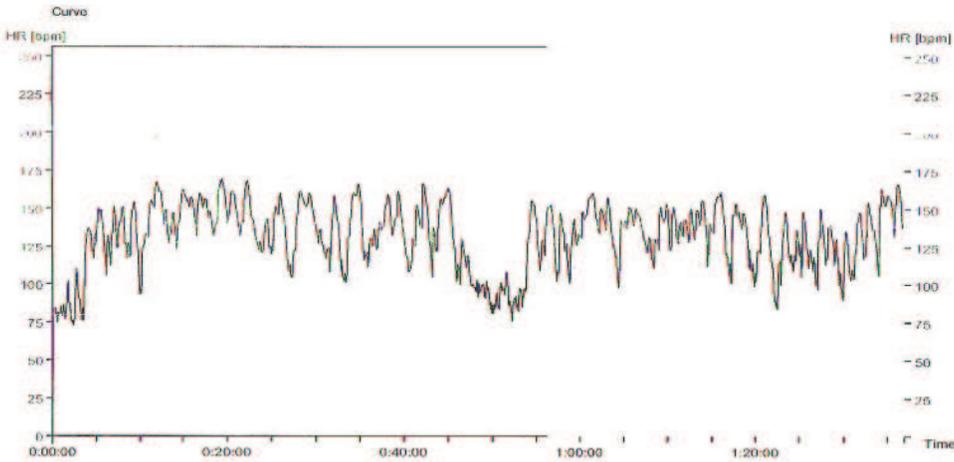
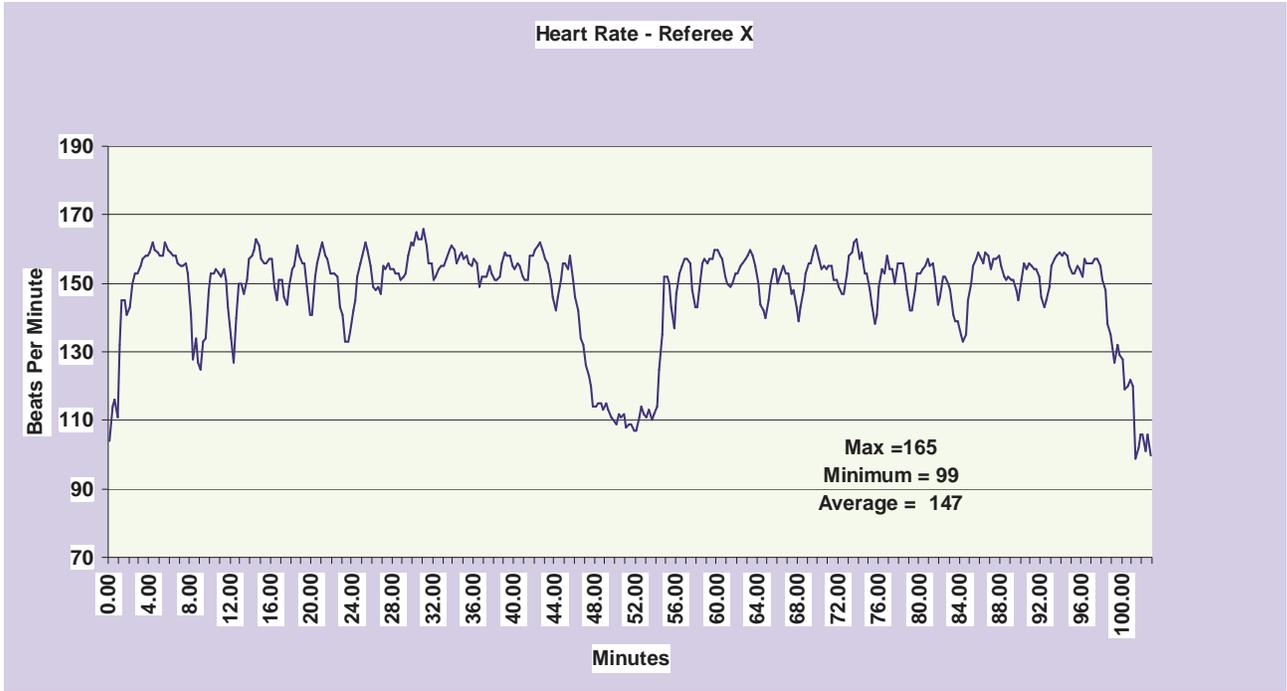
At this point it is worth noting that high heart rate readings can be achieved through many stimuli. The most obvious of these is physical exertion. Other factors such as fear, pressure, heat, cold and many others can also cause fluctuations in heart rate. (Van de Graaff & Fox, 1995)

## **Case Studies.**

I approached three current test referees to act as subjects for the experiment to see whether there was a correlation between physical stress (in the form of an elevated heart rate) and a decline in decision-making skills. Referee X and referee Y both returned significant results, whilst subject Z failed to submit his after two weeks of technical difficulties. Unfortunately I was therefore left with

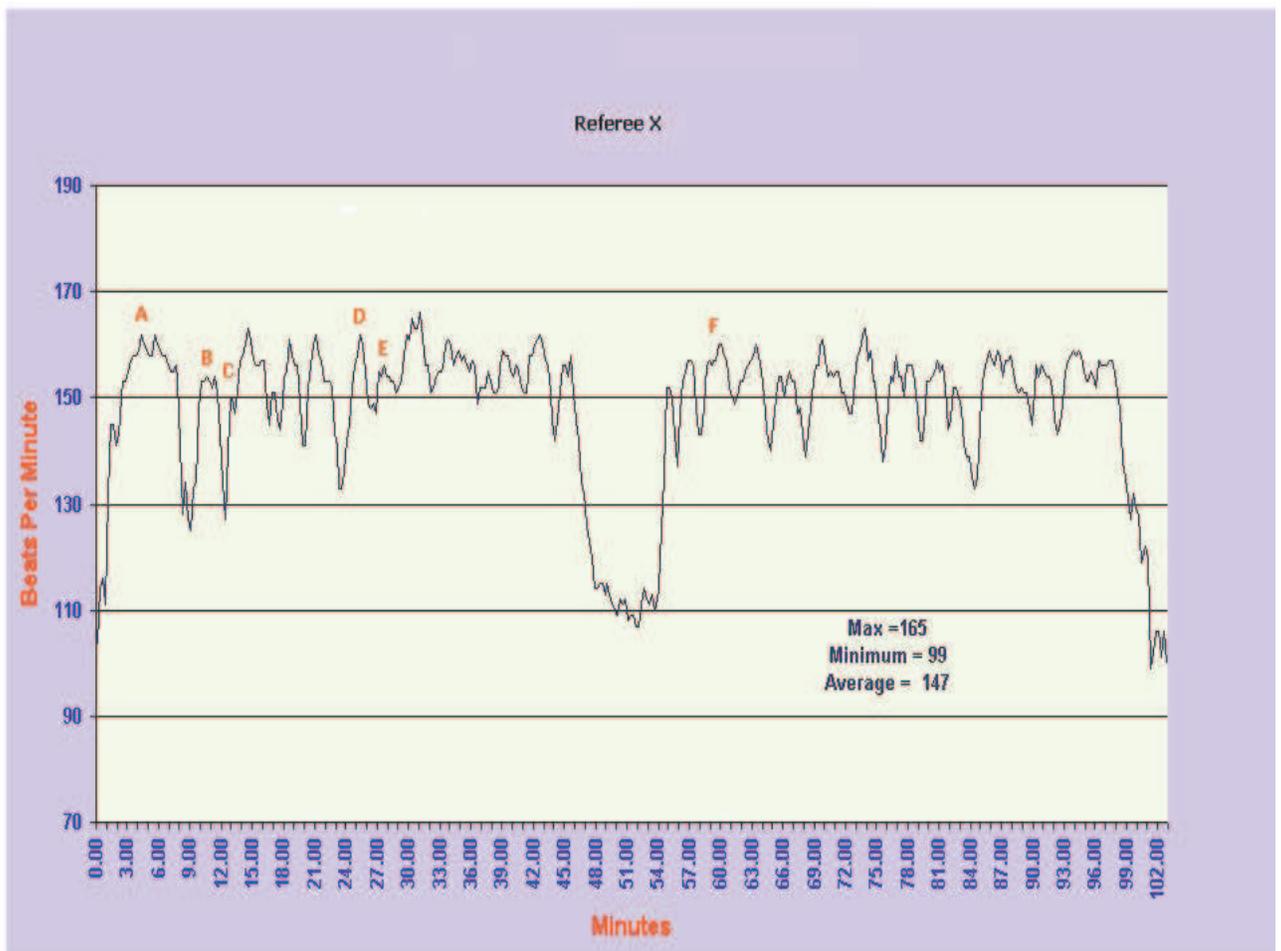
only two case studies, but I was then satisfied to find both subjects then performed admirably in their active roles in the 2003 RWC. The subjects weren't high in quantity, but their quality made up for it I believe.

Each subject was asked to wear a heart rate monitor for a Sydney first grade game within the finals series. Referee X and Y both returned the charts below, which show their heart rates for the period of the game. Bear in mind both charts show a dip around the 45-minute mark. This is the half-time interval.

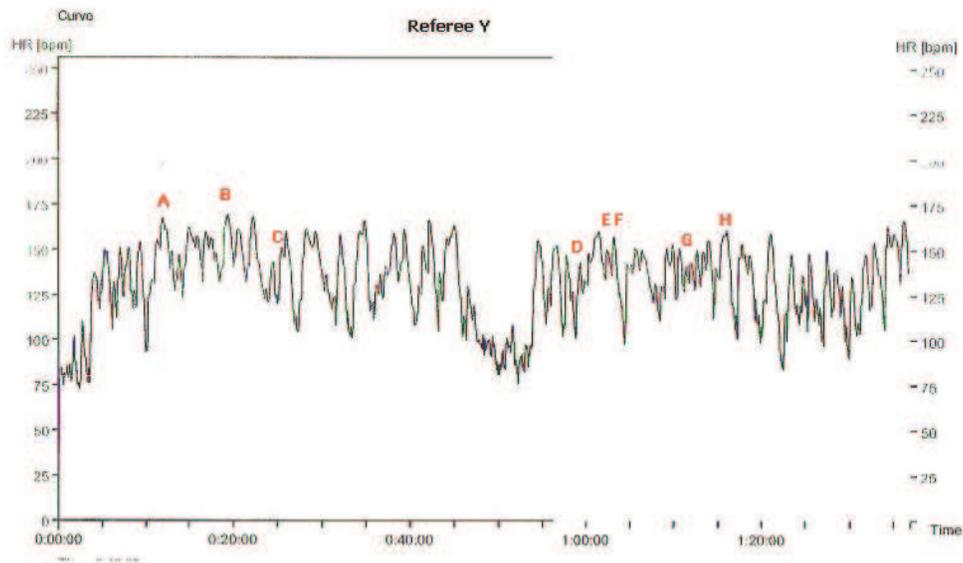


Once this data was captured I then performed an assessment on each game based on the IRB criteria. This data was deemed to represent incorrect decisions. This appears to be the best way to analytically show incorrect decisions. It also represents the areas that we are hoping to improve; as they are the areas we are losing marks in.

The times of these incidents were then plotted onto the charts as shown below. Referee X had six instances of non-compliance. Referee Y had eight instances of non-compliance. (A small footnote to these non-compliance scores. A level III referee coach calculated Referee X's assessment, whilst I calculated Referee Y's.)



Referee X has the following relevant statistics. Age 48 years with a maximum heart rate of approximately 172 beats per minute with a resting heart rate of around 50. From this information it can then be said that of his six occasions of non-compliance recorded, that five of the six (A, B, D, E & F) show the heart rate to be above 80%. (Above 150 beats per minute) Therefore five out of six of the errors were under physical stress.



Referee Y has the following vital statistics. Age 35 with a maximum heart rate of 185beats per minute with a resting heart rate of around 60 beats per minute. From this information it can then be said that of his eight occasions of non-compliance recorded, that six of the eight (A, B, C, E, F & H) show the heart rate to be above 80%. (Above 160 beats per minute) Therefore six out of eight of the errors were under physical stress.

### Conclusion

From this small case study it can be seen that there does appear to be a correlation between high heart rate (above 80% of maximum) and errors in compliance. From this it appears that physical stress can impact negatively upon decision-making.

### Discussion

After establishing a potential link between high levels of physical stress and errors in decision-making, the next step is discovering ways of avoiding these potential errors. In his paper on decision-making by Rugby Union Referees, Michael Tanzer (1994) points out that the best way to improve decision-making is through practice and experience. The more regularly we expose ourselves to difficult decision-making situations, the more efficiently we will be able to make the correct decision. He also points out that another way to improve decision accuracy is by reducing the factors that may lead to a decision cue (the data we are exposed to that will require a decision to be made upon) being undetected. The three most common factors that will cause this to go undetected are stress, fatigue and an over-aroused referee. Over-arousal by a referee can often lead to misinterpretation of these

cues. Tanzer suggests the best ways to improve on these is three fold. Firstly by gaining experience, secondly by practicing making decisions, perhaps by using a video of a tough game, and thirdly by maintaining a high level of appropriate physical fitness. It would also be worthwhile investigating and practicing Angie Calder's suggestions of reducing and managing fatigue as outlined in her training Study Pack entitled "Recovery Training" (2000)

Another way of using this data to improve refereeing performance is to be aware of our physical stress levels and use them as a cue to focus our concentration. Cues are a commonly used method of focussing concentration during problem areas. For example, a referee who has problems at certain time periods in a game may use those time frames as a cue to re-invigorate their concentration during that perceived problem area. Ways of being aware of our physical stress levels are by using heart rate monitors and being aware of what ranges of beats per minute are likely to place us under physical stress. For instance referee X may like to use a heart rate of 150 beats per minute as a cue to focus of high levels of awareness.

### **Suggested areas for future research**

This information could possibly be furthered with some further quantification of these case studies. It also leads into other areas such as focusing in particular on what effects the various forms of fatigue can have on refereeing performances. These types of fatigue as described by Calder (2000) are as follows; metabolic (energy stores), neurological (peripheral nervous system), psychological (central nervous system and emotional) and visual. Perhaps the most relevant would be psychological, in particular the emotional side of it. Emotional issues, whilst hard to quantify, do tend to have an enormous effect on refereeing performances.

## **References**

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