

the thirsty idiots



Or: Pain is the conscious correlate of perceived threat to tissues that motivates us to get our tissues out of danger.

There's a road in Australia called the Gunbarrel Highway. It might be a bit generous to call it a road – in some places it has not been graded since it was originally constructed, several decades ago. It is about 1400 km long. It is called the

Gunbarrel Highway because the lead surveyor had a thing for neat straight lines on maps, so he did his best to make the highway as straight as possible. Because of the long straight stretches, his construction team got the nickname the 'gunbarrel team' and the name stuck. The highway links Wiluna in the west with Giles in the east. Wiluna is about 500 km nor-northeast of Kalgoorlie. Kalgoorlie is about 600 km east of Perth. Perth is officially the most isolated city in the world. I don't know what that makes Wiluna, but it sure doesn't have a Tube station. Giles is not far from Uluru¹⁵, that mighty monolith right at the heart of the Australian continent and its people.

Why one might want to link Wiluna and Giles is not completely obvious. Wiluna consists of a service station, to service vehicles as they prepare for, or recover from, the Highway; a general store; a pub and a camping ground. Giles consists of a remote meteorology station, known as Giles. The initial reason for building the road was to service a weapons research facility called Woomera. This part of Australia was considered by the British to be the best place in the world for a rocket range, presumably because it was a long way from Britain, and from where British constituents lived. It is certainly a part of the world not well suited to Europeans or their frigid descendents. Of course, people have been living happily in that part of the world for about 60 thousand years, but those people know things that most of us don't. At each end of the Gunbarrel Highway, there are strong warnings to take sufficient water for two days and enough fuel to get between stops, the longest gap being 600 km.

One pair of clever fellows, Adam and Tony, decided to drive the Gunbarrel Highway in their Lada Niva, as fast as they could. They were, apparently, experienced outback adventurers. They were also New Zealanders, which casts some doubt over the 'outbackness' of their adventuring, but that is a bit by the by. Adam and Tony had well designated roles and followed all the normal procedures.

15. Uluru: Once known as Ayers Rock

That didn't make up for the fact that they were in a Lada Niva, a vehicle notorious for being crap. The Lada lived up to its reputation and broke down smack bang in the middle of the longest unbroken stretch on the highway. All the electronics were out, which meant the car wouldn't work. More importantly, it meant the two-way radio wouldn't work.

These two fellows – Adam and Tony, were a thousand kilometres from anywhere worth being. It would have been 55°C in the shade (~ 130°F), if there was any shade. The point is, it was hot. Damn hot. This is obviously a potentially dangerous situation. Any experienced rally team would be prepared for such an event and indeed, Adam and Tony were prepared, although they didn't realise it.

One designated role that Adam had was to pack the water. After an hour or so in desert sun he went to get the water out of the back of the Lada and saw that it was missing. Adam told Tony that somehow he must have forgotten to pack the water. They resigned themselves to having to sit it out – the ranger at Giles would expect them in about two days time and would give them a few hours grace. Adam and Tony hoped that help would arrive before death did and if not, that death would arrive via sleep and not via the dingo's and eagles that would already be aware of the lame kiwis lying underneath their Lada Niva.

Now in this situation, one is sweating, as they say, 'like a pig' (which is a daft saying because pigs don't sweat). Sweating leads to dehydration, which makes one thirsty. We all know that thirst is pretty much an upside down measure of hydration (or a right-way up measure of dehydration). Don't we? Read on my fellow hydroheathens! As time went on, these two lads were getting very, very dehydrated. They were also getting very, very thirsty. Just less than 48 hours later, they heard the distinctive drizzly drone of the Royal Flying Doctor Service Cessna and scrambled, with what little energy they had, to get something to wave. There on the back seat was a silver thermal blanket, which would contrast beautifully with the red sands of the desert. On ripping the blanket out, Tony saw, and immediately remembered, that when he replaced the spare

wheel, he had moved the water from the trunk to underneath the thermal blanket on the back seat. They were so thirsty that the sight of the water sent them into a frenzy. They waved the sheet, noted the change in trajectory of the Cessna, which indicated that they had been seen, and started drinking. Adam and Tony drank like they were on their last legs, which they were.

Here is the groovy bit – by guzzling down a couple of litres or so of water, their thirst was quenched. The plane landed, the paramedics arrived, Adam and Tony indicated that *they* were not *thirsty* because they had just had plenty of water to drink. In actual fact, they were still so dangerously dehydrated that both lost consciousness before the plane had swung around to head for Kalgoorlie Base Hospital.

Aside from narrowly missing the Darwin Awards¹⁶, Adam and Tony's experience demonstrates a critical aspect of thirst. After their big drink they were then *no longer thirsty*, but they were still *severely dehydrated*. So, thirst does not tell us about hydration. Rather, it makes us drink. It works like this:

As you become dehydrated, blood volume starts to drop and receptors in your cardiovascular system respond to that drop. These receptors sit on the end of small diameter myelinated neurons. When the receptors are activated, they cause those neurones to send action potentials into the central nervous system and thence to the brain. The brain, outside of consciousness, evaluates this information in light of every other piece of information available, and evokes a response. In the first instance, the response may be to constrict blood vessels, reduce blood flow to non-critical areas, reduce respiratory rate. If the brain evaluates the situation as requiring a

16. The Darwin Awards: The Darwin Awards are given to people who die because they did a remarkably stupid thing. The awards honour the contribution that such morons make to natural selection, by removing themselves from the gene pool. <http://www.darwinawards.com/>

behavioural response from the organism, then a conscious experience will emerge – thirst. That's the thing about thirst – it is the single best way to get someone to drink. As the proverb goes – 'You can take a horse to water but you can't make it drink. Unless it is thirsty'¹⁷. So, it is thirst that motivates us to do what is required to get a drink. When you look at it this way, it is clear to see that thirst is a conscious experience that makes us do something. The Wiggles, a children's music band and Australia's most successful entertainers, put it so eloquently in their absolute classic: "Drink drink, drink some water, it's so good for you".

The other critical thing about this system is that when the brain is satisfied that enough has been done, then it will stop creating the experience of thirst. This is how we can make sense of what happened to Adam and Tony.

17. Dodgy proverb: This may not be a completely accurate account of the famous proverb.

So, what has the thirsty idiots got to do with pain?

The one sentence take home message: Pain, like thirst, is a conscious experience that motivates you to do something to protect your body.

These are the points that I like to get out of this story:

1. Thirst, like vision, is an experience we are all pretty comfortable with, not stigmatised, and so-on and so-forth. Thirst, like vision (and pain), is dependent on unconscious evaluative brain processes, such that it does not accurately reflect the world, but our place in it.
2. Thirst is a conscious experience that motivates us to do something to survive. The reason that it is effective is that it is sufficiently unpleasant to make us want to stop it. That is, **thirst does not provide a measure of dehydration, thirst makes us drink.**

Pain is like this. *Pain is a conscious experience that motivates us to do something to protect the tissues that the brain perceives to be under threat. Explain Pain* ^{Ref List No. 1} and Patrick Wall's superb book, *Pain: The science of suffering* ^{Ref List No. 4} make this point really clear, by drawing on experimental and anecdotal evidence. That is, ***pain does not provide a measure of the state of the tissues, pain makes us do something to protect tissues that are perceived to be under threat.***

3. When the brain is satisfied that enough has been done, it will stop *creating* the experience of thirst. This confirms that thirst is not a measure of hydration. If it was, Tony and Adam would have been thirsty until their hydration was back to normal. I reckon that the 25 minutes or so between drinking the water and blood volume etc returning to normal is the most poignant aspect of the story because there was severe dehydration and no thirst. This proves that thirst is not a measure of hydration.

Pain is like this. *If the brain is satisfied that enough has been done to get the tissues out of danger, then it stops making the body part painful. This is a really nice way of understanding why inert pills and injections can still reduce pain – the brain has every good reason to conclude that what you have just done should reduce the danger level, so it reduces the pain. There are good studies that look at how it does this and we know it involves opiate-related and non-opiate related bits¹⁸. If you take this principle further, you can say that if pain reduces, it shows that the perceived threat to body tissues has reduced. It is very tricky to know what it was that changed that perception. This principle is defended in the following papers and chapters:*

1. *Melzack, R. Gate control theory. On the evolution of pain concepts. Pain Forum 5, 128-38 (1996).*
2. *Wall, P. in Ciba foundation symposium 174, experimental and theoretical studies of consciousness 187-216 (Wiley, New York, 1993).*
3. *Wall, P. Pain. The science of suffering (Orion Publishing, London, 1999).*
4. *Moseley, G. L. A pain neuromatrix approach to patients with chronic pain. Man Ther 8, 130-140 (2003).*
5. *Moseley, G. L. Reconceptualising pain according to its underlying biology. Physical Therapy Reviews. In Press (2007).*
6. *Jones, L. & Moseley, G. L. in Tidy's physiotherapy (ed. Porter, S.) In press (Elsevier, Oxford, 2007).*

18. Opiate-related: Opiates are officially called *narcotic alkaloids*, which is why we call them opiates. Morphine is the most famous opiate. The opiate-related system refers to neurones that use opiates to communicate. The nervous system uses opiate-systems as natural pain-killers, but there are other pain-killing systems that don't use opiates. We call those systems non-opiate systems.

4. Thirst is not the only thing that happens when hydration reduces. Lots of things happen outside of consciousness. For example, changes in blood flow, respiration, motor output, renal flow etc. All of that happens outside of consciousness. Thirst is a sign that the brain perceives that those things alone are not enough to maintain sufficient hydration.

Pain is like this: *When tissues are perceived to be under threat, a whole lot of stuff happens outside of your consciousness. For example, blood flow changes, motor output changes, immune system activates, autonomic system activates. Pain is a sign that the brain perceives that those things alone are not enough.*