

Stress, Epistemology and Feedlot Cattle

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You don't have to like feedlot cattle to read this. Come to think of it, you don't even have to like epistemology. I could probably have called it: An Attempt to Cope with Problems which Arise when You are Doing Applied Research - or even: Trying to Cope with Life.

My occupation is applied research and - funding arrangements being the force which drives such work - I am working with feedlot cattle at the moment. I have to find out whether they are unduly stressed and, if so, how to relieve it; also how much and what type of shade they require, and what are acceptable criteria of animal welfare. Like most research scientists, I also have a personal hobbyhorse which I can weave into my work. It is that stress affects the competence of an animal's immune system in subtle ways that have to do with its cognition. Alas, the plot thickens!

What is cognition, you may well ask; and do you mean human thinking or just the bovine kind? At the risk of answering in further riddles, I have to say that it is the fundamental advances in neurobiology made by Humberto Maturana and Francisco Varela which provide my inspiration. So each living thing is said to exist in the terms of its cognitive domain - and those of us who say this is so cannot claim to be exceptions!

What an epistemological conundrum we create! Although I'm mixing my farm animals, I will quote from W.B. Yeats (as borrowed from my friend, Alan Stewart):

*That this pragmatical pig of a world
Its farrow that so solid seem
Must vanish in an instant
If the mind did change its theme.*

To quote from Alan Stewart directly (Australasian Personal Construct Psychology Conference. 1992): 'a constructivist paradigm, including contributions from neurobiology, is required to explain - and render operational - concepts of self-regulation, autonomy and interactive

adaptation. . .', *i.e.* what I would call the workings of the cognitive domain which we so ignobly share with the 'subjects' of our research. The way of the constructivist seems to offer an avenue of hope along which we may pursue important epistemological issues in applied research, but it does not appear to be a road very frequently travelled at present.

So it is that someone like Fritjof Capra can speak of the shift from 'objective to epistemic' science, but those of us who are busy doing applied research tend to shy away from considering too closely how the process works.

I will not give any careful definition of epistemology - in fact, I've given up giving careful definitions of anything! I believe it is a branch of philosophy, to do with knowledge and how it arises. When we say that we know something, how do we know that we know it - or how did we come to know it? If our business in applied research is acquiring knowledge, *e.g.* to help the feedlot industry, obviously this should be important, at least in theory, but is it simply a philosophical issue or is it of any significance in the practical work that we do?

My concern about epistemology has grown from trying to make sense of the impact of environmental stress on farm animals. There are two noteworthy difficulties:

Firstly, the non-specificity of an animal's response to its environment - the fact that you see the same type of response to many different kinds of stressor (psychological, physical), *i.e.* a rise in corticosteroids, autonomic nervous responses, *etc.*

Secondly, the magnitude of the response is very variable - the same stressor may produce no response in one animal and a big response in another - or a big response one day and no response the next.

So the response is not closely related to the nature of the stressor.

This raises questions about how animals perceive changes in their environment, how they interpret these, how they adapt with time, or habituate, *etc.* It also raises questions about how I, as a scientist, interpret the data I collect - how I perceive it - and how I use it.

In the name of objectivity, what we do is hide behind our measuring instruments. After all, they would never tell us lies, would they?!

Observing animal behaviour you don't need many instruments (sometimes a telescope perhaps!). This gives rise to the impression that it is a bit subjective, even if quantified - it is subject to interpretation. My arena test of animal behaviour is an example of this. Subtle behavioural changes have been correlated with the sheep's immunity - but people say: your interpretation is crucial - what

do the data from the arena test really mean? (*cf.* the readout on our High Performance Liquid Chromatograph, the meaning of which is immediately accepted!). My new work - assessing the behaviour of cattle in feedlots, *etc.* has the same problem.

Assessing the colour of something is a similar problem. We are used to our spectrophotometers in which light of certain wavelengths is absorbed and the amount can be measured. But I would guess that the green of this apple and the green on that painting are quite different, physically. This orange, inside in short wave length artificial light reflects a certain spectrum of light and outside in sunlight a different longer wavelength spectrum, but we still call the colour orange. My wife takes dresses out onto the street to see what colour they really are. What colour are they really? (perhaps I should get her a spectrophotometer!)

The problem facing the neurobiologists who developed the new biology of cognition was similar to mine (with stress). Maturana was struck by the non-specificity of colour vision. He found a very poor correlation between neural responses and wavelengths of light on the retina. Comparing this apple with the painting, for example, he asked what is it that they have in common, if it's not their spectral composition?

It is, of course, not a property of the object - or, in my case, the stressor - it's the way of seeing the colour, or perceiving the stress. What is common is a property of the animal (as it relates to that object). We could call this a cognitive property - not meaning thinking, but a way of knowing something, of seeing oneself in the world, a way of operating in the world. You could say a way of responding, but that implies a passive animal reacting to its environment - which is obviously not the case (or there would be consistent responses).

So stimuli are not instructive - this is one of the conclusions of the new biology of cognition. And I think it is very important in my work. However, it's also very challenging and makes me rethink a lot of things that I've previously taken for granted.

I sit in meetings where people say we need objective measures of stress and welfare which can be used to counteract the subjective opinions of people who disapprove of intensive animal husbandry. I must say that this objectivity-subjectivity dichotomy really is a "dead loss" - it does not serve us well - and this new biology of cognition puts a different slant on it, altogether. And what is of practical importance - it suggests some different ways for a scientist to go about addressing this kind of problem.

In biology, we have been thinking of stimuli as instructive since the late 1940's when Shannon introduced information theory - which took

over everything. This information model has been a smokescreen hanging over all applied science from molecular biology to psychology - mainly causing confusion - until progress in systems theory has begun to clear the air a bit.

In biology, we deal with systems which are open systems in terms of energetics (food, oxygen and so on), but closed so far as their organisational property is concerned - that is what we know as biological autonomy. It is the identity or integrity of any living thing - which arises in the process of living. Biological autonomy involves a lot of mathematics - but this idea of cognition is quite simple. It's an active process of self-determination which is achieved by this way of operating in the world - not by receiving and processing information.

It's known as a structure-determined system - where internal coherence determines what happens, not outside events - they merely trigger or perturb the system - it compensates, but only according to its internal structure at any particular time. For example, light falling on the retina is a trigger, not a bit of information - it doesn't determine anything about the subsequent activity in the optic nerve.

There simply couldn't be instructive interactions in a living system - we see why this couldn't work in the story of King Midas who talked Dionysus into granting him the power to turn everything he touched into gold - which was a disaster!

We say that cognition is biologically constitutive - it's the way an organism defines itself - in relation to its world. It's the way it forms its own meaning by operating in the world. It is not given this. The word, information, derives from *in formare*, meaning formed within.

So what we know as our world and what we know as ourselves are part of the same process - they're inseparable. As humans we see this in our conversation - *con versare*, meaning turn together. The way we live together is like dancing.

Let's look at the conversation in science. I'm talking about science, not for discovering an objective reality which is independent of us - but, like anything else we do, as a way of operating in the world - with a particular set of rules, of course. It could be the most influential type of conversation in the world, today.

What we call objectivity is just a necessary rigour so that we can repeat experiments and minimise personal bias - and shouldn't be mistaken for discovering some objective truth which can then be delivered to somebody else.

Something like stress isn't objective or subjective. It has no validity at all outside our saying it - our using the word in our conversation. It is

quite impossible to validate independently of us as observers.

And we are always observers - we are only observers - always talking to another observer, even when we're talking to ourselves (which in my case is quite often, when I'm talking about this sort of thing!). We are only observers, but what we say we observe is crucial, because that's our knowledge - and it exists in our language.

Our language is essentially connotative, not denotative. In other words, we only pretend that what we say denotes some external reality. That we agree about something doesn't prove that it's right - only that we can agree. The meaning is not in the words - nor in what they describe - it's in us, as we relate to that something. So it's context-dependent - meaning different things at different times.

So stress, or animal welfare, or even disease, can't be validated independently of us as observers. What we are doing is trying to reach agreement as observers about what we will choose to call stress or what will be acceptable welfare criteria.

I find that it's only by letting go of the idea that there ever could be objectively determined stress (or anything else) that I begin to get comfortable with the idea of a consensus of knowledge which arises in our conversation - in our living together - not through the properties of something independent of us.

The other half of this argument is that meaning is not transferable - it is formed individually in the course of conversation. This is why technology transfer is such a problematical issue - why it can't be done. There is no direct information transfer. It's a process of triggering, matching shapes - as every good salesman knows.

It also explains why you may not understand a word of what I'm saying. I take absolutely no responsibility for whatever you think I said, today!

However, I do try to take responsibility for what I am saying - for the language that I use. I am very interested in how we use our scientific data - or justify what we do - having faced the epistemological dilemma that our knowledge is far more personal than we care to admit - is not securely grounded in an independent reality, but is generated in our cognitive domain. I personally feel much more comfortable when I'm being as honest as I possibly can - with myself and with everyone else. So I can't just cite a 'Smith and Jones,' 1992, as if that lets me off the hook.

It gives me great satisfaction to acknowledge that scientific data is important because it helps to shape the meaning which we form in the course of our conversation, but it does not determine that meaning.

So I feel the need to do a lot more talking than I used to do - about my data and how it might possibly fit into the scheme of things.

The animal welfare issue, the disease problem in feedlots, the greenhouse effect - all exist in our conversation. Therefore we improve the situation by talking - and talking scientifically is powerful. Elsewhere, I have given some examples of how I think this can be employed to develop acceptable indices of animal welfare in feedlots.

We have great opportunities if we are not talking 'facts', but offering scientific opinion - not claiming to be harbingers of any 'truth' at all, but simply custodians of valued scientific data which can make a very helpful contribution to the networks of conversation which make up our human culture and, ultimately, our continued existence as living things.