Communications

Bateson stories: reflections from a classroom

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> Reading [Bateson] for the first time is vertiginous, challenging familiar habits of thought. Rereading it is surprising, revealing new layers of meaning. (Forward by Mary Catherine Bateson in Bateson, 2000, p. xii)

Meta-comments

I first uncovered meaning in Bateson's writing from the following two extracts. The first is a story about monkeys he had observed in a zoo in San Francisco in 1952, the second a description of a therapeutic setting.

Story 1

> I saw two monkeys *playing*, *i.e.*, engaged in an interactive sequence of which the unit actions or signals were similar to but not the same as those of combat. It was evident, even to the human observer, that the sequence as a whole was not combat, and evident to the human observer that to the participant monkeys this was "not combat".
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> Now, this phenomenon, play, could only occur if the participant organisms were capable of some degree of meta-communication, *i.e.*, of exchanging signals which would carry the message "this is play." (2000, p. 179)

Story 2

> Before therapy, the patient thinks and operates in terms of a certain set of rules for making and understanding of messages. After successful therapy, he operates in terms of a different set of rules. (Rules of this sort are in general, non-verbalised, and unconscious both before and after.) It follows that, in the process of therapy, there must have been communication at a level *meta* to these rules. There must have been communication about a *change* in rules. (2000, p. 191)

The first story I read as a type of logical 'proof' that the two monkeys had a meta-communicative exchange. They were exhibiting behaviour that is associated with fighting but both interpreted these actions as something other. The only way this could occur is if there had been a previous communication *about* the actions, *i.e.*, the meta-communication: "this is play".

I read in much of Bateson's writing a promise that there might be some rules or laws of communication. The thought of being able to apply ideas of proof in the seemingly unpredictable world of classroom communication appealed to me as I first read the stories. I had just begun a career teaching mathematics and was experiencing the continually shifting sands in learning to find my place in a classroom as something of a shock after the certainties of my own mathematical schooling.

The second story linked to my experiences of teaching students who had, or developed, negative views towards the subject of mathematics. In most classes I taught there were recurrent refrains; "I can't do this", "I hate maths", "I can't do algebra", "Why will I need to know this when I am older?". All these comments suggest a way of relating to messages in mathematics classrooms (or perhaps just my mathematics classroom), which primarily is to ignore them.

I took from the two stories that if students' views of mathematics are to alter in my classroom there must be communication at a meta-level to these views and that I could consciously engage in such meta-communication. The vehicle I have ended up using in most classes I teach is to promote the idea of each student 'becoming a mathematician'. I offer this as the purpose of the year and, in the early weeks particularly, every time I observe a student exhibiting 'mathematical' behaviour I will comment on it to the whole class, *e.g.*, "Josie has just tried out an idea, found it didn't work and then altered her idea to make a new prediction – that's an example of how mathematicians work, making predictions, testing them and then modifying their ideas." (See Brown and Coles, 2000, for a fuller discussion of these ideas in practice.) Each class I teach reflects back to me – in their writing, comments and actions – different aspects of 'becoming a mathematician' and so a unique classroom culture is always established. Recently students 'asking their own questions' has become part of that culture in most classes.

Circular causality

The next aspect of Bateson's thinking to affect my practice was his writing about causality. Put briefly, Bateson viewed humans and the world we live in as complex, adapting systems. Systems interact and 'co-evolve' as each one responds to the responses of the others.

> "Tell me, papa, why are the palm trees so tall?"
>
> "It's so that the giraffes may be able to eat them, my child, for if the palm trees were quite small, the giraffes would be in trouble."
>
> "But then, papa, why do giraffes have such long necks?"
>
> "Yes. It's so as to be able to eat the palm tree, my child, for if the giraffes had short necks, they would be still more troubled." (Bateson, 2002, p. 146, from an undated cartoon by Caron d'Ache)

Patterns emerge comprising circles of causation – one system's actions leading to a response in its environment, leading to a response in the system and so on.

A simple mechanical example Bateson uses to illustrate this idea is a thermostat. A cold room means the thermostat switches on the heating. Some time later the room reaches a heat that means the thermostat cuts off the heating. A while later the room is cold which means the thermostat switches on and so on. In order to assign cause and effect to such patterns the chain must be broken somewhere and what follows be labelled effect and what precedes the break labelled cause. Bateson points out that it is arbitrary where such a cut off is made. The cold room causes the thermostat to turn the heating on, but the cold room was an effect of the thermostat having turned the heating off. A linear description of these events leads to what appear to be logical contradictions; the temperature dropping causes the temperature to rise, which cause the temperature to drop.

What relevance this idea has for my classroom is perhaps best illustrated with a story, in Bateson's sense that:

> [a] story is a little knot or complex of that species of connectedness which we call *relevance* [...] if the world be connected [...] then *thinking in terms of stories* must be shared by all mind or minds. (Bateson, 2002, p. 12)

Danielle's story

I taught Danielle mathematics for an academic year when she was 11 years old, at the start of her secondary level schooling. With the class she was in, the notions of 'asking questions' and in particular 'asking why' became central to what individuals did, wrote about and talked about when invited to "think mathematically".

My memories of Danielle are of an un-confident student, who frequently stated things like 'I can't do this', but someone who, over the course of the year, was increasingly able to ask questions within the mathematics and let go of debilitating self-perceptions.

At the end of that year I knew I would not be teaching Danielle again and I said to her something along the lines of "whoever is teaching you next year, keep asking questions". I bumped in to Danielle's mother at a parents' evening the following year and she came up to me and commented that Danielle had been doing what I had told her. Danielle remembered my advice (when I asked her, aged 16) as me telling her to "keep being argumentative".

I next taught Danielle again, aged 16, when she turned up in a philosophy class that I taught. At the start of the first class I invited everyone to comment on why they wanted to study philosophy and she mentioned the reason being that she is always asking questions. I was so struck by her answer that I interviewed her on her own some days later to ask for more detail.

> Alf Coles: Why did you want to study philosophy?
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> Danielle: I have to know why everything is like it is... I have to keep asking questions ... I need to know why otherwise I don't understand... I have been like this for a while... it is something that started at secondary school. (extract from interview with Danielle, October, 2003)

Danielle could not pin-point exactly when or why she had begun needing to ask questions or find out why things are as they are, but she was clear this was something that had happened to her at secondary school.

Reflections

It would perhaps be easy to interpret this story as being an example of straightforward (linear) cause and effect – I make a big thing of asking questions within mathematics to a student and this *causes* her to take that attitude into other areas of her life.

Bateson, I am sure, would see it differently. Every student in Danielle's class was exposed to similar messages about asking questions – by no means every student internalised this attitude. The fact that Danielle did says something about her, not about me. If a linear cause has to be assigned then *she* is the one who 'caused' the change in herself.

An analogy might help. Imagine you are speeding in a car in a limited speed zone and pass sign after sign telling you the speed limit. After passing the tenth sign you slow down to the speed limit. Has that sign caused the drop in speed? (You may want to consider your own answer for a moment.) I would say no – otherwise the drop in speed would have happened after passing the first sign. Something is clearly different in the context of you passing the tenth sign compared to the other nine. If a lineal cause must be assigned, it is you taking your foot off the pedal that caused the drop in speed.

Bateson uses the examples of kicking a stone and kicking a dog as a way of highlighting the difference here. The stone's immediate trajectory will be caused by my kicking it – the stone is not a complex system. The dog's trajectory will be caused by its own metabolism – the dog is a complex system. The change in Danielle is one part of an on-going dialogue of *responses* and *responses to responses* between her and her environment.

I see one of my responsibilities as a teacher to be aware of the meta-messages about mathematics I give to a class. What each learner does with those messages is their responsibility.

Levels of learning

An aspect of Bateson's work that I am currently grappling with is 'levels of learning'.

Learning 0: describes any situation in which no change occurs in response to the same context, *e.g*, every time I see my neighbour on the street I say "How are you?" or, a dog salivating every time it hears a bell.

Learning 1: describes any situation in which there is a change in learning 0, *e.g.*, the first time I recognise the man in the funny hat as my neighbour I change from saying nothing on passing him in the street, to saying "How are you?" or, the dog, learning that the bell will shortly be followed by food, starts to salivate before the food arrives. In both these examples the new behaviours become learning 0 as they become fixed.

Learning 2: describes any situation in which there is a change in the process of learning 1. I may have considered myself a shy person and not initiated sequences of interaction with others unless forced to. My experience of getting to know my neighbour leads me to question the self-description of shyness, as I confidently hail him each day. Next time I get to know a neighbour there will be a change in the way I go about it and I could, perhaps, reach the stage of familiarity more quickly. In the case of the dog, she may be subjected to a new experiment in which some event is always preceded by a signal. If she shows evidence of adapting to this new experiment more quickly than she learned to salivate then she shows evidence of change in the process of learning 1, *i.e.* she exhibits learning 2.

The hierarchy continues to learning 3 and 4, but these are beyond me at the moment. Bateson warns that learning 3 "is likely to be difficult and rare even in human beings" (Bateson, 2002, p. 301), and equally so to imagine or describe.

Danielle, in the story above, showed evidence of learning 2 in that she changed the way she approached tasks of learning, *i.e.*, she changed in her approach to learning 1.

In offering my classes the purpose of 'becoming a mathematician' I am trying to provoke learning 2. I am trying to direct students' attention towards a different relationship to messages within a mathematics classroom and into a way of learning 1 in which they develop their own criteria for when something makes sense, expect the feeling of new behaviours making sense and feel able to question until they have this feeling.

There is a link between levels of learning and levels of communication. It is through the meta-communication about what it means to be 'becoming a mathematician' that I believe I can help create the context in my classroom in which learning 2 can occur.

References

Bateson, G. (2000) *Steps to an ecology of mind*, Chicago, IL, University of Chicago Press.

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Brown, L. and Coles, A. (2000) 'Complex decision-making in the classroom: the teacher as an intuitive practitioner', in Atkinson, T. and Claxton, G. (eds), *The intuitive practitioner: on the value of not always knowing what one is doing*, Buckingham, UK, Open University Press, pp.165-181.

The following two communications are reflections after ICME-10, Copenhagen, Denmark, July 4-11, 2004. The task offered was to talk to issues raised from two highlights.

Mathematics knowing as fully embodied

TOM KIEREN

As usual I'll go astray from the request and mention three highlights that are inter-related.

At the first ICME I attended in Karlsruhe in 1976, Micheal Otte made a presentation on the politics of mathematics education. As I remember it, he suggested that to the extent that our work in mathematics education at any level pertained to the service of mathematics knowing in schools at any level, then our work necessarily had a political dimension whether we noticed it or not – he thought we should and provided insights into such noticing.

I was reminded of this by the opening session that was wonderful all around. But I was particularly impressed by the greetings brought to us by the Danish Minister of Education; the Mayor of Lyngby-Taarbæk; as well as the dean from DTU (Technical University of Denmark). They had all thought carefully about what they had to say to the ICME community, at least as represented by those at ICME-10.

Their message was that mathematics knowing was important to the lives of the various communities that they served and for the general public of Denmark. Thus, they suggested that our work individually and as a congress had the potential of serving them and those they served as well. I was reminded of the political significance of our work – deliberately 'small p political' – as well as the ethical responsibility inherent in offering one's ideas to be even considered by others and especially by broader publics beyond those we interact with, say the readers of FLM or our fellow teachers in schools.

This responsibility is evident in a second highlight. This highlight is derived from the presentations of Daniel Ansari and Terezinha Nunes in a session on sources of theoretical (and research) ideas in mathematics education. While Daniel brought to our attention the ways in which the brain and its activity and operations might be seen to be underlying mathematics (at least number) knowing, Terezinha provided us with a view of mathematics knowing which necessarily goes beyond number and particularly beyond brain activity as such. As a community we are left with trying to learn and be aware of how the functioning of the brain might in many different ways impact on how we think about mathematics knowing and how such awareness and learning might help us help individuals engage in such knowing.

In particular, we need to understand such cognitive neuroscience work in order to value it appropriately in the mathematics education responsibilities suggested by my first highlight. On the other hand, Terezinha Nunes pointed to broader, personal mathematical knowing actions and interactions that we also need to understand and appropriately value in new ways. Thus, to responsibly and ethically serve the various communities in which we live we must somehow use theories and ideas that live in the tension of the awarenesses raised by both Daniel Ansari and Terezinha Nunes.

One way to take forward such thinking comes from my third inter-related highlight – Rafael Núñez's presentation. This presentation was a *tour de force* in its use of technology as well as being rich in ideas including:

- the extension of his previous work with Lakoff (2000) and that of others such as Johnson (1987) on embodied metaphors and mathematics knowing to now define and illustrate how *fictive actions* penetrate mathematical thinking at all levels of sophistication from our formation and use of images to the way in which, in arguments in mathematics, for example, when we talk about functions gradually decreasing; monotonically increasing;