John McWhirter

Differential Information and the Emergence of Mind : Developing Bateson's Ideas on Difference, Mind, and Epistemology

John McWhirter
SENSORY SYSTEMS TRAINING, GLASGOW & VALENCIA

DIFFERENTIAL INFORMATION AND THE EMERGENCE OF MIND: DEVELOPING BATESON'S IDEAS ON DIFFERENCE, MIND, AND EPISTEMOLOGY

METALOGUE

Daughter: Daddy, how exactly does a "difference make a difference"? How does it do it?

Father: Well, it is not the difference that is doing something. We do it. But without the difference we can't make a new difference. There is a problem with the word "makes". There is a difference between "making" a cup of tea, the tea "makes" me happy, one and one "makes" two. These are different "makes".

D: Well, what kind of "makes" does the difference make?

F: Difference makes all of them. It is just that there are very different things happening that our language doesn't distinguish clearly. You know that an apple is different than an orange but it is very difficult to describe what the difference is.

D: The orange is orange and the apple is red!

F: Yes, we use that, but that is not the difference. What if it were two oranges? They are the same color, but you still know that they are different.

D: I could put one in one hand and the other in my other hand. I could see that I had two oranges; I could see that they are different.

F: So, it helps to separate them and look at them?

D: Yes, then I can see that they are different.

F: If I took them away and then showed you one at a time how would you know that it wasn't the same one that I was showing you?

D: I wouldn't, I'd need to see them together.

F: If there is not enough difference then you would see it as the same orange?

D: Yes.

F: That is one of the ways that a difference makes a difference; it is a different difference!

D: But how does it do it, daddy?

F: You know what an orange is of course and when I say orange you know what I mean don't you?

D: Yes, of course!

F: If I say "differential information" what do you think about?

D: That daddy uses big words!

F: Yes, but does anything come to mind like the orange?

D: No!

F: That makes it harder for me to explain. If you had never seen and touched and tasted an orange, it would be the same. You would not know what to think about when I said orange.

D: So, tell me what it is, daddy!

F: That will take some time. I will try and then we can see I can "make a difference that makes a difference" and that we can understand how it makes a difference, OK?

D: O.K.

F: Well, hold this book in one hand and this other book in your other hand. Now notice that they are different.

D: Yes, one is bigger that the other, and heavier, it is a different color as well.

F: OK, there are a number of differences. Some wise men once said that this was a ratio, like the ones you do in school, you know the relationship between two lots of things.

D: I don't see any numbers ... well, OK one book and one other book ..., but there are no numbers to make a ratio. In school, we had numbers; one chicken laid three eggs and another four eggs, so their laying was in a ratio of 3:4.

F: Yes, that is how their egg laying compares, how it was different. Ratio is one way of describing the difference.

D: But with the books I don't see how a ratio can describe the difference, I feel that they are different, I see that they are different, where are the numbers? One book and one book is 1:1, no difference!!!!!

F: No, it is not just about numbers.

D: Is ratio the only way to explain the difference? How can heavier or a different color be a ratio Daddy. One of the chickens might have been bigger and that is why it could lay more eggs. So, size for size they might have produced a similar weight of eggs, could that be right?

F: Yes, there are other ways of comparing them, by proportion or weight. You could still make a ratio. Although that would miss the fact that there was a different kind of difference happening ... .mmm, I need to think about this.

D: Does that mean that you don't know daddy?

F: Yes … and no! It means that what I knew is not all that there is to it. There is more going on here that I had previously thought about.

D: Does that mean that you were wrong?

F: Yes and no, again! I was right but I had not considered other things. Now that I know more I would be wrong to think that this is all there is to it. But this is how we improve, grow up what we know. When you were smaller last year, were you wrong because you are bigger this year?

D: No, of course not! Do ideas grow up, daddy?

F: Not on their own, we need to do it for them.

D: So, we can make this idea grow up?

F: Well, let's see if we can!

BATESON'S INFLUENCE ON MY WORK

Gregory Bateson covered many disciplines and many ideas. In this paper, I will be limiting my attention to developing some of his work on difference, mind, and epistemology. The style will be more subjective in places than is usual for a scientific paper. All experience is subjective and describing some of the thinking that led to new ideas is easier to test if it describes what is changing in the world directly and not one or two steps back from it.

One of the aims of the paper is to use a 'Batesonian' type methodology, that is, to use a similar way of exploring ideas and developing new understandings that Bateson used, especially in his book *Mind and nature* (1979) This style includes some of the reasoning, especially questions and abductions on the part of the writer. In addition, my aim is to use the same tools and distinctions that he used, in order to develop them further. I will also be utilizing a few modelling models that I developed, that were greatly influenced by his work, to organize the results of my exploring.

Gregory Bateson is a great example of a scientist who continually went "beyond" in his work. He went beyond his original discipline, he went beyond the existing paradigms and he went way beyond the norm in the scope of his interests.

My work as a behavioral modeler has been greatly influenced by the work of Gregory Bateson. Since I first came across his work, around 1979, I have been fascinated by his breadth and depth of thinking, especially about mind. Initially I worked hard to understand the different way he thought, appreciat-

ed the emphasis on pattern, epistemology, cybernetics and ecological thinking and the ideas of difference and context. It has been a natural step for me to not just understand his work but to also build on it and extend it. In the following paper, I will outline some new developments that I have made in the areas of Difference and Mind, and introduce a new type of information that I have created / discovered, one that Bateson must have been very close to discovering. His constantly going beyond has been a great influence on my own work. As I developed the universal modelling methodology of DBM®, I constantly applied back to his work any new distinctions and models that I developed, which would often result in new insights and then further new developments. This recursion is very much in the form of developing through recursive calibration and feedback.

Beginning in the mid 1980's, I began to create a universal descriptive modelling methodology, now called "Developmental Behavioral Modelling" (DBM®) (McWhirter 2014). My aim was to create the tools to model human mind and behavior. One of my main inspirations was the work of Gregory Bateson. Bateson appreciated the importance of formal models.

3 USES OF MODELS

A model of the interaction between structure and process underlies much of the argument of this book, and it will be critical to understand the relationship between these notions and the problem of knowledge or description.

A model has several uses: first, to provide a language sufficiently schematic and precise so that the relations within the subject that is being modelled can be examined by comparing them with relations within the model. Occidental languages, in general, do not lend themselves to the discussion of relations. We start by naming the parts and after that the discussion of relations between the parts appear as predicates attached usually to a single part – not to the two or more parts among which the relation existed. What is required is precise talk about relation, and a model will sometimes facilitate this. That is the first purpose of a model.

A second purpose of a model appears when we have a vocabulary of relations, for then the model will generate questions. One can then look at the subject which is being modelled with these specific questions in mind – and perhaps find answer to them.

> Finally, a model becomes a tool for comparative study of different fields of phenomena. Itis above all the tool of abduction, drawing from phenomena in different fields that which is shared among them.
>
> (Bateson & Bateson, 1987, p. 37)

Bateson was also very appreciative of the natural modelling that every human necessarily uses to make sense of their world. He explored many examples of our modelling working positively, style, grace, and aesthetic, as well as and many of the difficulties that arise when the modelling does not work well, schizophrenia, double bind, and alcoholism.

All of the models in DBM° were developed with an extended model for a scientific methodology. This is the "verify – falsify – beyonding" model. Rather than giving up on verification and moving to falsification, as recommended by Karl Popper (1959, p. 19), I have found that for practical modelling both work well together for new ideas. Firstly, verification checks that the new idea is worth pursuing (do the details exist), then falsification checks its limits (scoping). I also added "beyonding" as the developmental step that keeps us open and connected to the larger whole in our exploring. Beyonding is how we keep science developing. The richness of beyonding is evident in the life of Bateson.

A number of the modelling tools that I created were influenced greatly by Bateson's ideas about mind and levels of organization. One of the earliest models was influenced by Bateson's work on levels and epistemology. I created a model for modelling (describing) any behavior or content at all levels of detail. The basic model is a triad of "what–how–why". These are used as an integrated triad and not three separate elements. The next part of the model involves fractal modelling.

DBM® FRACTAL MODELLING

DBM° fractal modelling allows us to describe how similar structures and functions operate at different levels of content without disconnecting the levels. This enables us to maintain the wholeness of our epistemology and move smoothly up and down through levels of content. The key elements in the fractal modelling is to maintain the unity of each triad at each level. If the triad is fragmented, then the fractal modelling breaks down.

DBM® EPISTEMOLOGY MODEL: "WHAT–HOW–WHY"

In investigating any phenomena, we can organize our knowledge into three integrated levels. What is there? How does it work? Why does it work?

Table 1. What–how–why

why
how
what

To connect to the next level of detail we use DBM® fractal modelling to each of these three again. If we want to move up to the next level. we will move up to a larger "what", "how", or "why". This is a modelling tool that can be applied to describe all levels of content as an integrated whole rather than the traditional jumping from one level to another, physics, chemistry, biology, psychology, and so on. The fractal modelling works as an integrated whole.

Table 2. Fractal levels of what–how–why

Up a level	Starting level	Down a level
To a larger: why, how, or what.	why	why
		how
		what
	how	why
		how
		what
	what	why
		how
		what

After creating this investigation model, I noticed a clear link with Bateson's description of how description, explanation, and tautology work together.

> A pure description would include all the facts (i.e., all the effective differences) immanent in the phenomena to be described but would indicate no kind of connection among the phenomena that might make them more understandable. [1]) and

---

[1]   Retrieved from http://www.oikos.org/m&nmultiple.htm

On the other hand, an explanation can be total without being descriptive. "God made everything there is" is totally explanatory but does not tell you anything about any of the things or their relations.

In science, these two types of organization of data (description and explanation) are connected by what is technically called tautology. Examples of tautology range from the simplest case, the assertion that "If P is true, then P is true," to such elaborate structures as the geometry of Euclid, where "If the axioms and postulates are true, then Pythagoras' theorem is true."[2]

and

Tautology contains no information whatsoever, and explanation (the mapping of description onto tautology) contains only the information that was present in the description. The "mapping" asserts implicitly that the links which hold the tautology together correspond to relations which obtain in the description. Description, on the other hand, contains information but no logic and no explanation. For some reason, human beings enormously value this combining of ways of organizing information or material.[3]

I realized that this was a special case of "what", "how", and "why" for a direct description of a phenomenon with tautology operating as a special example of a "how" level description.

Table 3. Direct description

	direct description	
why	explanation (why)	↑
how	tautology (how)	
what	description (what)	↓

I also knew from teaching "what–how–why" model that students would, if they did not maintain the unity of the "what–how–why", mix up different descriptions. Indeed, this happened naturally in creating metaphors where the "how" and "why" are the same and the content ("what") changes.

---

2   Ibidem.

3   Ibidem.

Table 4. Metaphoric description

	direct description	metaphoric description
why		explanation (why) ↑
how	→	tautology (how)
what	description (what) ←	↓

After identifying this, on one of my many readings of Bateson's work, I recognized this pattern in his description of "ratio" being the explanation for how difference is created.

"In fact, difference is dimensionless because it tends to be a ratio between two similars of some kind; and ratios between similars have no dimensions because the dimensional aspect "cancels out"". (Bateson, 1991, pp. 152–153)

For ratio, there is a mathematical "what" that does not involve the basic "news of difference" but a mathematical operation of bringing two numbered entities together. This is a different direct description. This is a combination of two kinds of description and operates as a metaphoric description. While a metaphoric description can give some insights into how things work it is also limiting if it is considered to be a direct description; we will stop trying to find an accurate description. Further difficulties will arise if we try to use the metaphoric description to develop the phenomena we are exploring.

WEBER–FECHNER AND RATIO

Applying this model to Bateson's ratio explanation, we can see how the metaphoric shift leaves intact the mystery of how and why difference functions (1 and 2). It also leaves non-described what actually happens when we create a ratio (3).

Table 5. Metaphoric description of ratio

	direct description	metaphoric description
why	2) ?	explanation (why) mathematics
how	1) ?	tautology (how) "ratio" ↑
what	description (what) "difference" ← →	3) ?

From his description of Ernst Heinrich Weber and Gustav Theodor Fechner,[4]

---

[4]   Worth noting is that the so called "Weber–Fechner law" pertaining to psychophysics

he adopts the explanatory term of "ratio" to clarify what is happening when a difference is created. At this point, I realized that I didn't know how it worked and directed my attention back to basics.

I then began to create multiple descriptions to explore other similar distinctions to ratio and others that seemed to be closely related to difference. My hope was that from a multiple description some new insights would emerge. It will be now be useful to quote extensively from Bateson to establish how he settled on "ratio" as the basis for explanation and then how I developed his ideas from there.

Bateson appreciated the work of Weber and Fechner and its implications for science.

> I think the history of formal behavioral science begins with Fechner and Weber in Leipzig, about 1840. Weber had made the discovery that ratio is what makes a difference, and Fechner saw that this was important. So Fechner gets the credit, though the first step was Weber's. That discovery, of course, puts the whole of the hard sciences out of the realm of what we are interested in. In the hard sciences it has always been assumed that causes have real dimensions of Length, Mass, Time, or some combination of these; e.g., Energy has dimension, $ML2/T2$ (Mass x Velocity squared). But the Weber–Fechner generalization implied that stimulus as a "cause" of sensation or behavior was of zero dimensions – a "ratio between similar dimensions (or a difference between dimensionally incomparable complexes or gestalten). This made the whole methodology of the hard sciences irrelevant to any consideration of behavior or psychic science – a clean sweep! After that there was no point in fussing with quantitative experiments. Altogether, an extraordinary feat.

> (Bateson, 1991, p. 152)

And then...

> I do not know whether Fechner knew quite how important his laws, but he did know that the discovery about ratios – which was an empirical and (surprisingly) an experimental discovery – was outstandingly im-

---

of human sensory perception, has been formulated by G. T. Fechner in recognition of the achievements of his professor E. H. Weber in the German work *Elemente der Psychophysik* of 1860. Cf. the following statement popularized from the English translation: "Simple differential sensitivity is inversely proportional to the size of the components of the difference; relative differential sensitivity remains the same regardless of size." (1966 [1860], p. 19). Editors' note.

portant. He went a little insane with it, I think, and wrote a very curious book about life after death (Fechner, 1836/1943). He realized, of course, that difference is not located in either space or time. Where is the difference between this paper and that desk top? Obviously not in the paper; obviously not in the wood. It certainly is not in the space between them, and it is a little hard to say that it is in your senses and my senses.

In fact, difference is dimensionless because it tends to be a ratio between two similars of some kind; and ratios between similars have no dimensions because the dimensional aspect "cancels out." The difference between these things is still the difference between these things after I mail this thing to Alaska or to any other place. We deal with something that is not localized and that is, in a certain sense, not physical. On the other hand, it can trigger a sense organ.

What you do as a perceiver, always, is to compare. If you do not have in external event to trigger you, you make an event by a scanning process so that the yellow of the paper against the brown of the table can be perceived by micronystagmus. The difference becomes an event in time.

Perception of states is always very poor, or zero (I am never quite sure which, but certainly very poor). It must be clear that you would not know when to respond, if you did not have an event structure. A state gives you no "when." Put a frog in a saucepan of cold water and have him settle down comfortably; then very slowly raise the temperature. It is said that if you raise the temperature slowly enough, the frog will not jump, and ends up boiled; there is no "when" for him to perceive. Always, perception depends on change or gradient[1] (a statement that follows from Fechner's contribution).

(Note 1. It is probably not correct to say that perception depends upon "gradient," which has always real dimensions. Rather, it must depend upon difference so set in time or space as to be perceptible.) (Bateson, 1991, pp. 152–153)

This footnote is very important. It is a different description than that given through "ratio". The description through ratio does not describe the process. It represents a content combination and not the experience or the process through which it is produced. Ratio then is not an explanation of the process. So, what could explanation how we create difference? To answer this, we will begin with the distinction of "difference" and use multiple descriptions to explore different possibilities. Understanding how different explanations don't work can help us get closer to what does work.

DIFFERENCE

It is fair to say that Bateson was fascinated by the phenomena and idea of difference and its relation to mind. The idea of difference is both simple and challenging to a materialistic mind set.

It is worth quoting at length:

> Now, let me leave evolution for a moment to consider what is the unit of mind. Let us go back to the map and the territory and ask: 'What is it in the territory that gets on to the map?' We know the territory does not get on to the map. That is the central point about which we are all here agreed. Now, if the territory were uniform, nothing would get on to the map except its boundaries, which are the points at which it ceases to be uniform against some larger matrix. What gets on to the map, in fact, is difference, be it a difference in altitude, a difference in vegetation, a difference in population structure, difference in surface, or whatever. Differences are the things that get on the map.

> But what is a difference? A difference is a very peculiar and obscure concept. It is certainly not a thing or an event. This piece of paper is different from the wood of this lectern. There are many differences between them – of color, texture, shape, etc. But if we start to ask about the location of the differences, we get into trouble. Obviously the difference between the paper and the wood is not in the paper; it is obviously not in the wood; it is obviously not in the space in between them, and it is obviously not in the time in between them. (Difference which occurs across time is what we call 'change').

> A difference, then, is an abstract matter.

> In the hard sciences, effects are, in general, caused by rather concrete conditions or events – impacts, forces and so forth. But when you enter the world of communication, organization, etc., you leave behind that whole world in which effects are brought about by forces and impacts and energy exchange. You enter a world in which 'effects' – and I am not sure one should still use the same word – are brought about by *differences*. That is, they are brought about by the sort of 'thing' that gets on to the map of the territory. This is different.

Difference travels form the wood and paper into my retina. It then gets picked up and worked on by this fancy piece of computing machinery in my head.

The whole energy relation is different. In the world of mind, nothing – that which is *not – can* be a cause. In the hard sciences, we ask for causes and we expect them to exist and be 'real'. But remember that zero is different from one, and because zero is different from one, zero can be a cause in the psychological world, the world of communication. The letter which you do not write can get an angry reply; and the income tax form which you do not fill in can trigger the Internal Revenue boys into energetic action, because they, too, have their breakfast, lunch, tea and dinner and can react with energy which they derive from their metabolism. The letter which never existed is no source of energy.

It follows, of course, that we must change our whole way of thinking about mental and communicational processes. The ordinary analogies of energy theory which people borrow from the hard sciences to provide a conceptual frame upon which they try to build theories about psychology and behavior – that entire Procrustean structure – is non-sense. It is an error.

I suggest to you, now that they word 'idea', in its most elementary sense, is synonymous with 'difference'. Kant in the *Critique of Judgement* – if I understand him correctly – asserts that the most elementary aesthetic act is the selection of a fact.

<div align="right">(Bateson, 1987 /1972/, pp. 458–459)</div>

When investigating how exactly difference works, I realized that It was very important, as in all modelling, to attend to what is actually happening and to try to make as few assumptions as possible.

Starting with the stimuli from the world our nerves are irritated and fire. The analogue world is changed to a digital response. What Weber and Fechner identified was that this is not an absolute response but a relative one, the sensitivity working, as Bateson described, as a ratio. Difficulties arise with this description as we progress through the nervous system to the sensory system and our experience of mind. We do not experience a digital world, we experience a continuous three-dimensional world, a four-dimensional world. How does the digital and ratio become a four-dimensional experience?

Examples of different types of experiences that become increasingly difficult to explain are: (1) sensations, (2) senses, seeing, hearing, physical feelings, etc., (3) thoughts, (4) ideas, (5) emotions and higher level emotions, (6) identity, and (7) mind

We experience differences in all of these even if they are very different content. In exploring them a number of questions arise. Are the same kind of differences? How do we develop / create them? If they are the same difference how come the content is very different? How do the relate together? And more deeply: Are they merely differences or differences that make a difference? How does a difference make a difference?

To take these ideas further it is useful to identify where Bateson got to in his thinking and to start from there to develop it further. We can note that Bateson identifies different types of difference. Also, that he does not describe how exactly a difference comes to be a difference nor how exactly one difference "makes" another difference.

As previously stated, "ratio" is a tautology from mathematics that is used to explain the "difference". Through the first scientific test of verification, this piece of abduction certainly gives an explanation that seems to "fits" the experience. It does not, however, actually describe the difference. It offers a representation and a meaning from mathematics, but it is not what we experience when we experience a "difference". When we taste, for example, two different coffees and the second tastes different from the first we do not experience a ratio, we experience a "sense of difference". When we taste two coffees, the second can be experienced as hotter, colder, sweeter, more bitter, smoother, nicer, more satisfying and so on. The underlying process may be created by ratio but this is clearly an abductive leap to a tautology that seems similar, two numbers side by side representing a difference.

Using "falsification", I explored more thoroughly searching for other plausible tautologies that could be substituted for "ratio". This generating of multiple descriptions was very useful in deepening my understanding of different examples of difference. The following are a selection of the main ones I identified: "proportion", "summation", "position", "sequence", "function", "quantity", "quality", "value", and "contrast".

If ratio is our first example, we can explore other possibilities and compare how they work as descriptions and explanations. We will briefly describe three more examples, 3-D vision, proportion, and comparison. I will leave it to the diligent reader to explore the others for further "differences".

EXAMPLE 2: PROPORTION

If we take the case of proportion and apply it to two lines, one two centimeters long and the other three centimeters long we can create a sense of difference in at least seven different ways, resulting in seven different difference! Six of which can be represented like ratio.

(1) 2:3 from proportion "more"

(2) 3:2 from proportion "less"

(3) 1/2 bigger from proportion "bigger"

(4) 1/3 smaller from proportion "smaller"

(5) 1:2 from proportion "added"

(6) 3:1 from proportion "subtracted"

(7)   ------   ---------   proportion "contrasted"

It is very interesting to note that with the proportions, "bigger" and "smaller", as well as "added" and "subtracted", which are usually considered to be reversible they are not simply the numbers reversed as they would be in ratio but very different proportional experiences. There are clearly different processes taking place.

With the seventh, we experience a singular experience, the two lines together as one experience. There is not the comparison of two things but a single experience. Contrast also works in a similar way. There are no numbers are involved, indeed numbers, two and three centimeters, are the contents that cancel out as Bateson described above, and we experience a difference that has no number and therefore no ratio.

The other examples also work in different ways. How are these different differences being created? we are no further forward in understanding HOW the differences are created. We are no further forward in understanding what exactly a difference created from a difference is. We are building immanence though and at this stage further examples from Bateson's work will be useful, creating additional multiple types of examples to extend our exploring.

EXAMPLE 3: COMPARISON

Comparison is another way of creating a new experience.

> In fact, whenever information – or comparison – is of the essence of
> our explanation, there, for me, is mental process. Information can be

defined as a difference that makes a difference. A sensory end organ is a comparator, a device which responds to difference. Of course, the sensory end organ is material, but it is this responsiveness to difference that we shall use to distinguish its functioning as "mental". Similarly, the ink on this page is material, but the ink is not my thought. Even at the most elementary level, the ink is not signal or message. The difference between paper and ink is the signal.

(Bateson & Bateson, 1987, p. 17)

When exploring comparison, the sequence becomes very interesting. For example, if we compare the overlapping circles below (cf. Figure 1 with Figure 2), A and B. If we ask "how is B different from A?" we get 1. As the answer. If we ask "how is A different from B?" we get 2. As the answer. These are different differences. Unlike ratio, which is reversible, this kind of comparison is not reversible. Also, while we have created differences, the comparison does not describe exactly how this creates differences.
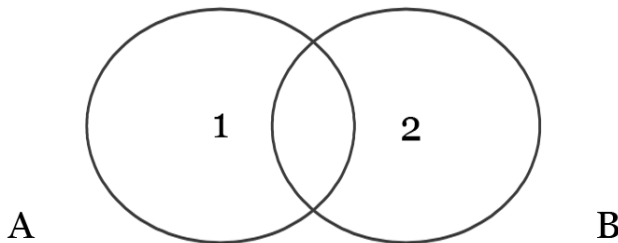
Figure 1. Comparing two "things"

EXAMPLE 4: THE MYSTERY OF 3-D VISION

Our three-dimensional experience is created from two two-dimensional experiences, one from each eye. This is one of the most significant examples of "a difference making a difference".

A fun game we used to play as children is relevant here. We would take two cardboard tubes and use them to look through. A very interesting experience could be created by randomly moving them; it disrupted the sense of three dimension, and indeed the sense of unity in the visual experience. The two experiences could be attended to but often they would seem like two independent experiences (more often as a "weird" experience that could become

unpleasant). This highlights the inter-related aspect even in the two-dimensional experiences.

Another point is that when we look through one eye alone, we continue to experience a three-dimensional experience. There is no summation as there is only one two-dimensional experience.
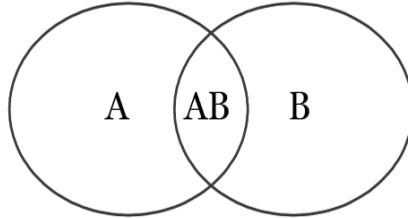

Figure 2. 3-D Vision: From *Mind and nature* (1979, p. 70, Figure 4)

Bateson used the example of 3-D vision in *Mind and nature* (1979, p. 70, Figure 4) as the second order of intersecting circles. There is a limitation in the representation of 3-D in the diagram. (Cf. Figure 2, above). Bringing together or comparing cannot be how it works; AB remains a combination of only A and B. This cannot be how it works. Nor can it be a ration as a ratio as it would remain as two related 2-D experiences. A 3-D experience is a singular experience.

Whatever way the two 2-D experiences are combined the result is different experience, a singular experience. How they are combined remains a mystery, the central mystery of how a "difference makes a difference". How we create a new single 3-D experience from our two 2-D experiences remains a mystery.

SUMMARY

(1) "Ratio" does not describe difference, even in the examples where it can be applied.

(2) Proportion, which offers an explanation at a higher level, cannot be applied at yet higher levels and again does not describe directly "difference"

(3) Summation, again while interesting does not in itself create difference, it builds on differences already created.

(4) Comparison, again interesting and again depends on differences already existing.

(5) 3-D vision, again no clear description of how a new single 3-D experi-

ence comes from two 2-D experiences. A key feature here is the singularity of the created 3-D experience, it is no longer two things.

I explored all the other distinctions on the list above with similar results, very interesting but no nearer a description of how difference is created. At this stage I thought that a different type description may add something. I chose Bateson's example of calibration and feedback.

EXPLORING "CALIBRATION" AND "FEEDBACK"

As shown in Figure 2, Bateson organizes the working of a house heating system in terms of calibration and feedback (arrows mark the direction of control):

CALIBRATION   FEEDBACK

personal
status   genetics and
                                    training of
personal   person
threshold
                                    'to cold' or
                                    'too hot'
bias
                                    osciliating
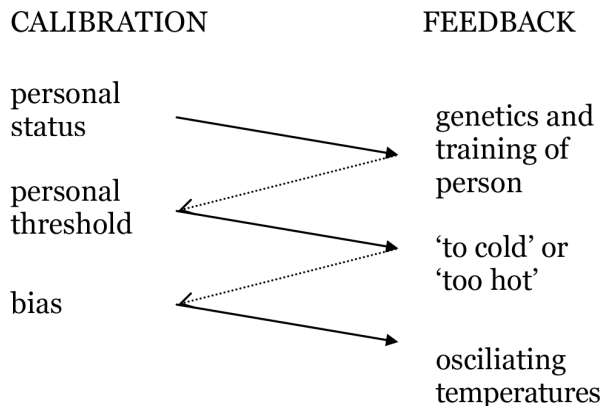   temperatures

Figure 3. Calibration–feedback: House temperature (Bateson, 1979, p. 214)

Modelling a real situation, we get an expanded model of setting a thermostat. When setting a real house thermostat, the sequence is more complicated.

In exploring this model, I expanded the description for the as follows:

(1) Setting "comfort" level, calibration

(2) Feedforward "comfort" level" on thermostat

(3) Set thermostat, calibration

(4) Feedback from house temperature

(5) Calibrate difference between feedforward and feedback

(6) Identify where on range "Too cold -----OK-------Too hot"

(7) Decision to keep or change "setting" (feedforward)

Unlike Bateson's example, the calibrating (digital information) and the feedback (analogue information) do not describe all the steps involved. Iden-

tifying "too" hot / "too" cold is a different kind of response, it is not exactly a digital or an analogue type of information and yet it is central to the control of the system. Through this expanded description we have identified a third element, a new difference.

A more accurate representation creates a gap (one of the great benefits of formal modelling is to create gaps, for example the original periodic table was as important for the gaps as for the formal relations between known elements. These gaps are new knowledge, we now know that there are definite specific things that we don't yet know and that we know something about the kind or type of thing that it must be.

With these examples in mind, I will return to coffee.

If we taste three hot coffees and three iced coffees, we can again identify that we can experience different kinds of experiences of difference. For the hot coffees, one may be too hot, one too cold and one "just right". The same for the three iced coffees. If we now bring together the two lots of three experiences, we can notice that the experiences of too hot and too cold are subtly different. The too cold for the hot coffee is concerning in the same way as the too hot for the cold coffee (they will continue to get worse). And the too hot for the hot coffee and too cold for the cold coffee can have a similar assurance (they will get better with time). The experience of just right highlights that there must be other influences operating. Clearly if we are expecting a hot coffee and get an iced coffee it will not be just right, the difference then would be in the type of coffee, we have the wrong coffee. This is a higher level sense of difference. For our human experience our expectations preferences and values combine to create a real sense of difference.

DBM® LEVELS OF DIFFERENCE AND COFFEE

(1) Taste drink, flavor of coffee

(2) Taste a second coffee (compare with memory of another), one hotter than the other (one cooler that the other!)

(2) Next level difference: One too hot / cold

(4) Next level difference: Good coffee / bad coffee

(5) Next level difference: Not good enough to be called a coffee

These different levels fit with the different levels of information: emit, transmit, communicate, relate, and identify, which I will detail below.

DIFFERENTIAL INFORMATION AND MIND

Contemplating the different questions and gaps resulted in my abductive leap "beyond" my previous thinking. Rather than use pre-existing distinctions, I stayed with the experience and realized that this was a new type of information, not just a new comparison of analogue or digital information. Immediately, I sensed that the questions could be answered and the gaps filled.

I begin with the statement that there are two traditional types of information: analogue and digital (as illustrated visually in the first part of Figure 3). From my exploring the different limitations in using existing distinctions and ideas to explain how we create three dimensions, ideas and mind, I made the abductive conclusion that it must work differently and be created directly by an, as yet, undiscovered process. In further developing this idea, I created a new distinction for a new type of information and a new process to produce it.

The new type of information I named "differential information". Differential information is the product of differentialating (a new word to distinguish it from differentiating). A simple example of differential information is the consequently visualized in Figure 3 and Figure 4.

ANALOGUE INFORMATION: CONTINUOUS

DIGITAL INFORMATION: SEPARATED UNITS

• •

Figure 3. Differentialating analogue and digital information

DIFFERENTIAL INFORMATION: The "square" is an example of the next level of informational structure; it is "there" and not really "there", as described above. It is the result of our "differentialating" the digital information.
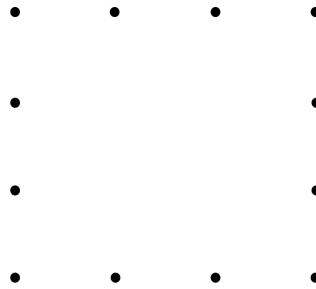
Figure 4. Differentialating the digital information

A simple exercise in creating a differential also highlights how it is not a ratio.

Differential information: Pen exercise:

(1) Hold a pen horizontally in the air in front of you with your left hand.

(2) Touch the top side of the pen with your right-hand forefinger, notice the pressure on your finger, then remove it.

(3) Next touch the underside of the pen with your right-hand thumb, notice the feeling and then remove.

(4) Next use both fore-finger and thumb at the same time.

(5) Notice that you can now feel the width and solidity of the pen rather than just the two feelings, in the thumb and fore-finger. This feeling of width and solidity is the result of "differentialating" the two feelings. It is not a ratio, nor a product, nor a comparison. You can if you are careful also notice the individual feelings in the thumb and fore-finger. The feeling of width is a totally different product, as is the feeling of solidity.

The ubiquity of this distinction is evident in that immediately many anomalies and gaps identified above, ideas, concepts, 3-D vision, can be described with this distinction as well as directing our attention toward how they are formed rather that a metaphoric explanation.

Ideas were differentials. Like difference they have no location, or substance but are real. Love and depression, are also differentials. Our identity, again, a differential structure. Mind itself, I suggest, is a differential structure, no substance but experientially real like the square from the dots.

It is important to note other things that it is not. It is not an emergent structure as it requires the specific processing of differentialating to create it, though it is dependent on the sensory processing. Just like the square we experience ideas and mind as solid and real even though they are not physical.

With this new type of information all of the difficulties and questions above can be answered.

A FEW APPLICATIONS OF DIFFERENTIAL INFORMATION

This new type of information creates a new paradigm for:

(1) How mind works: Mind is an on-going differential process and product.

(2) How ideas and concepts work: ideas and concepts are differential products.

(3) Plato's difficulty with ideals is solved, they are very much of this world.

(4) How higher emotions work: wonder, love, some forms of depression, moods, for example, are all differential and once formed they no longer require the content used in their formation.

(5) How patterns and patterning works: a differential of differential.

(6) How our sense of self is a differential from all our experience. This is why our deepest sense of self is the same throughout life; when we think back to childhood we still feel that it is the same me as now. The differential sense of self is independent of the content of specific life experiences.

(7) How our nervous system processes information, not through analogue nor digital but differential.

(8) How we can understand that some forms of problems; fears and depressions, and "differential" dynamics and not content based. In the square form dots example we can still sense the square even if all the dots are removed.

(9) An obvious consequence of this new idea is the realization that digital computers can never create a mind like our human mind. A similar mind would require a new type of computer, a differential computer.

THE POWER OF 3

Many philosophers and mathematicians have been fascinated with the number 3. Charles Sanders Pierce, the creator of abduction and many advanced ideas in logic was one example and many of his ideas are organized in 3's. In creating DBM® models I have found that many models end up being organized in 3's and fractals of 3.

One reason for this may be in how 3 relates to differential information. If we have one "thing", we can experience one "difference". If we have two things, we can experience each of them and the difference, a total of three.

We create more than the sum of the "things". If we have three things, we can experience the three of them and the three differences between the three of them, six things. We can also experience the three differences between the three differences, and then again the differences between these three differences, and again, and again, theoretically forever.

We can also experience the differences between groups of three differences and between different levels of detail. The potential differences are infinite! Of course, in practical applications we will never make anywhere near this amount but the huge increase in creating new information once we have three things is incredible. Interestingly adding a fourth does not greatly add to the potential for new differences.

Table 6. Quantification of things and differences

number of things	1	2	3
number of potential differences	1	3	infinite

It should be noted here that when Bateson wrote that two somethings were required to create difference he is referring to, for example, a person and the thing that they are observing (the 1, 2 or 3 things above.

> Of all these examples, the simplest but the most profound is the fact that it takes at least two somethings to create a difference. To produce news of a difference, i.e., information, there must be two entities (real or imagined) such that the difference between them can be immanent in their mutual relationship; and the whole affair must be such that news of their difference can be represented as a difference inside some information-processing entity, such as a brain or, perhaps, a computer.
>
> (Bateson 1979, p. 76)

CREATING A META PATTERN FOR AN ECOLOGY OF MIND

Having a clearer understanding of how difference and mind are created the next step is to connect this with the larger perspective, how does all of this fit with an ecology of mind. How are the higher structures of mind created? How do higher levels emerge from lower levels? How do the different levels integrate and relate? Are there patterns that connect? If we are to work practically with an ecology of mind we need to address these questions.

Information for humans is not the same as the neutral information in non-living systems, it is part of our living experience and as such is influenced by us as we receive it and process it.

How we manage ourselves, our processing of the information changes the information.

> It is, of course, true that our explanations, our textbooks dealing with non-living matter, are full of information. But this information is al ours; it is part of our life processes. The world of non-living matter, the Pleroma, which is described by the laws of physics and chemistry, itself contains no description. A stone does not respond to information and does not use injunctions or information or trial and error in its internal organization. To respond in a behavioral sense, the stone would have to use energy contained within itself, as organisms do. It would cease to be a stone. The stone is affected by "forces" and "impacts", but not by differences.
>
> I can describe the stone, but it can describe nothing. I can use the stone as a signal – perhaps as a landmark. But it is not the landmark.
>
> I can give the stone a name; I can distinguish it from other stones. But it is not its name, and it cannot distinguish.
>
> It uses and contains no information.
>
> "It" is not even an it, except insofar as I distinguish it from the remainder of inanimate matter.
>
> What happens to the stone and what it does when nobody is around is not part of the mental process of any living thing. For that it must somehow make and receive news."
>
> (Bateson & Bateson, 1987, p. 17)

LEVELS OF INFORMATION

Difference allows us to make distinctions in the world. While difference is the basis of all our distinctions and information, information in turn is the basis for what is meaningful and personally significant. We can relate these different levels of information as follows:

Table 7. Levels of information

significance
meaning
information
distinction
difference

How we receive information and what sense it makes is not a simple matter of receiving information. I have identified five levels of information that we can "receive" from "news of a difference".

(1) *Emit*: Information is given OFF: The range of "non-verbal" behaviors and activities; tensions, skin color changes, tone of voice, etc. No intentional communicating is involved;

(2) *Transmit*: Information the is given OUT: Information that is intentionally given out to the world but not to anyone in particular (although it also can influence ourselves – act confidently and you may become more confident); dressing formally, informally, the style of the clothes, etc.;

(3) *Communicate*: Information is given TO and WITH an expected response: Information is intentionally given to someone (or to ourselves) and a response expected as part of a communicational interaction;

(4) *Relate*: Information is given WITH another and FROM how we communicate as to the basis of our relationship with the other person (and with ourselves); for example, we can notice how people are relating, the level of intimacy, bonding, concern, etc.;

(5) *Identify***:** Information is organized AS an us, them, these, those. We relate differently to those people we identify with, family colleagues, friends, because the identity can change the information. The same words from a family member are usually richer in meaning than a stranger because of all the connections involved.

Table 8. Levels of information

identify
relate
communicate
transmit
emit

As well as differential information being the basis of our epistemology model (what-how-why), it is also the basis for different levels of our managing ourselves and a number of other models. When we interact with the environment there is a relationship from our self-performing and a specific world content. If there are now changes then this is a simple interaction that we can repeat, eat the same fruit from the same tree, etc. When the fruit runs out we have a disruption to this simple performing, we need to "step back" and think about what to do next, this is a different level of attending. No longer is it attending from ourselves to the world, we are now attending from our self to our self-performing. We need to manage our self. This is our self-managing. To decide how best to manage we connect to our reasons and values for doing what we are doing, this is another level of attending from our self to our self-directing. As we do all of this we are unconsciously, and sometimes consciously, checking our well-being and if things are OK or not. This is our self-supervising.

When we combine these levels with the epistemology levels of what-how-why, two new distinctions emerge. The first one is that we are aware "that" something is happening in the world before we know "what" it is. The second one is related to our self-supervising; we are constantly checking "that" things are OK or not. The two new distinctions are two content poor "that's". Both need to be investigated before we know "what" is happening.

Table 9. Managing ourselves

self-supervising	that
self-directing	why
self-managing	how
self-performing	what
content	that

Bateson's fascination with epistemology is important to include in the meta-pattern. One of the main DBM® models is the DBM® Field model which is used to model fields of study and individual applications with the field. A core idea in this model is an integration of all the main formal structures in human epistemology and follows the same pattern.

Epistemology in its broadest sense includes all our knowledge. In DBM® we have identified that for any complete field of study there is always a specific content area, a specific technology, methodology, epistemology, and ontology.

These are formal extensions of our individual self-managing and operate in the same patterned way. They develop as differentials of differentials, the same process as our emerging mind.

Table 10. Modelling the levels of epistemology: DBM® field model

ontology
epistemology
methodology
technology
content

A holistic ecology of mind will include all five levels. Bateson's epistemology will include all five; indeed in this paper I have been using some of his content (difference), technology (multiple-description), Methodology (abduction), Epistemology (ideas), and Ontology (mind).

We need to develop how we use these emerging levels of mind. Our levels of skill and intelligence in using our mind at all these levels is fundamentally important for how we manage ourselves and our planet. The different types of thinking at each self-managing level involves a different type of intelligence. Unfortunately, being good at one level does not guarantee being good at other levels.

Table 11. Levels of intelligence

enlightened	knowing what is REAL
wise	direction, optimal reasons and values
clever	managing optimally
intelligent	performing optimally
present	fully aware of the world as it is

We cannot rely on one level of intelligence if we are to develop as a species. The increasing dominance of clever technology has brought great benefits but also led to pollution and suffering. The increasing pursuit of artificial intelligence with little regard to wisdom will be a challenge for future generations. We need to develop our intelligence at ALL levels if we hope to continue to develop as a species on a planet that is healthy for us at all levels.

We need to manage ourselves in the world as a whole; connecting all the way up from the smallest part of the world to the world as a whole. We need

to be able to work in detail at all levels as an integrated whole. Formal models can help us to identify how the whole works, what we are doing, and what needs to be improved.

These models, and a number of other models, are all related in a meta pattern, a pattern that can connect an ecology of mind that functions at all levels. To create a sense of the pattern a few of the main levels are summarized in Table 12. The reader can sensitise themselves more to the pattern by firstly relating each column and then, keeping each model (column) as a whole, move left and right noticing how the pattern is repeated. In doing this a higher level differential can be created, a meta pattern.

Table 12. DBM® Ecology of mind model: Patterning levels

ontology levels	epistemology levels	performing levels	information levels	communication levels	information level	knowledge level
ontology	ideals	supervising	enlightened	identify	significance	that
epistemology	Principles	directing	wise	relate	meaning	why
methodology	Ethics	managing	clever	communicate	information	how
technology	standards	performing	intelligent	transmit	distinction	what
content	content	content	present	emit	difference	that

METALOGUE 2

F: Well, has that made a difference?

D: Well, it is good to know that I am not a biological computer! And I now know why I always feel that I am me.

F: Yes, you are uniquely you, always!

D: There was a lot to think about. So, it is me that is making the difference make a difference. And I do this by creating what you are calling Differential Information. Is that why when you asked me about the difference between an apple and an orange, I knew there was a difference but I couldn't put into words? Or when I did put them into words I was talking about the orange or the apple not the difference? Is that, right?

F: Yes, exactly!

D: I am not sure that I am clear about some of the other things.

F: Well, I find that I have to keep thinking about them to keep them clear. And many times, as I think about them I have changed my mind about them. That is another way that we develop our ideas, how we grow them up.

D: So ideas are differential information as well. That is why I can never know "where" in my head they are.

F: That's right, they are not actually "in" your head. If you remember playing with your kitten, you see her out here in front of you, just like the real experience, don't you?

D: Yes, so she is not in my head. But do I do it with my head?

F: Yes, but not just your head, you are using your whole body and the world around you, but that is another topic for another day.

D: And every day I am making lots of differences and making other differences with them. I can make new differences between an apple and an orange?

F: That's also right.

D: Great, I am going to have fun playing with that!

FINAL COMMENTS

Inspired by Gregory Bateson's beyonding and searching for patterns that connect I explored over many years many possible explanations of difference. I was also fortunate in being able to explore these distinctions with hundreds of students in our DBM® modelling trainings. While this led me to many new and useful insights and understandings it did not provide a description of how difference and mind worked. From the multiple descriptions, I was eventually able to make the abductive leap and identify a new kind of information, differential information. With this new distinction, many mysteries of difference, ideas, mind, became describable for the first time. Using fractal modelling we can also describe all levels of mind, a continuous whole, enabling us to develop an accurate understanding of how mind and ecology work together. I have laid out some of the many "patterns" that connect at different levels as a basis for further exploration and creating a meta-pattern.

Integrated within this ecological model are integrated levels of intelligence. It is up to us to develop this intelligence and to apply it holistically, instead of the over-emphasis on our clever use of technology. Only with an enlightened wisdom can we develop our technology ecologically in such a way as to continue to go beyond as a species. The planet will continue. If we want to continue with it we must work ecologically with it not against it. If we want to develop fully we must work ecologically with ourselves and not against ourselves. To do this we need all levels of our understanding to be accurate and detailed. For me, developing Bateson's ideas are major steps toward this. I hope that the few steps contained here can help to take us beyond in a positive direction.

REFERENCES

Bateson, G. & Bateson, M. C. (1987). *Angels fear: Towards an epistemology of the sacred.* New York: Macmillan Pub. Co.

Bateson, G. (1979). *Mind and nature: A necessary unity.* New York: E. P. Dutton.

Bateson, G. (1987 /1972/). *Steps to an ecology of mind. Collected essays in anthropology, psychiatry, evolution, and epistemology.* Northvale, London: Jason Aronson /San Francisco: Chandler Publishing Company/.

Bateson, G. (1991). *A sacred unity: Further steps to an ecology of mind.* (R. E. Donaldson, Ed.). New York: HarperCollins.

Fechner, G. T. (1966 [1860]). *Elements of psychophysics* (Vol. 1; E.G. Boring & D. H. Howes, Eds.) (H. E. Adler, Trans.). New York: Holt Rinehart & Winston [Elemente der Psychophysik. Leipzig: Breitkopf und Harterl].

III MULTIPLE VERSIONS OF THE WORLD. http://www.oikos.org/m&nmultiple.htm (Retrieved April 3, 2017).

McWhirter, J. (2014). *Manual, masters in developmental behavioral modelling.* Valencia: University of Valencia.

Popper, K. (1959). *The logic of scientific discovery.* New York: Basic Books.