Toward a science of metapatterns: building upon Bateson's foundation

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Abstract

Purpose – Gregory Bateson defined a metapattern as a "pattern of patterns." But, what did he mean by metapattern (which he used only once)? Can there be a meta-science, in which metapatterns are its objects or principles? The authors explore these issues.

Design/methodology/approach – The authors review examples of Bateson's "great pattern" of "combination," which the authors call the binary. Bateson showed that binary is the minimal solution to the problem of gaining new characteristics by combining parts into a larger whole. Thus, binary is clearly a metapattern, a discipline-transcending structural and functional principle. The authors select parts of Bateson's writings to highlight his search for other great patterns, some of which correspond with those developed by T. Volk.

Findings – The authors suggest that the basis for a science of metapatterns is the following: functional patterns that confer advantages on the systems that possess those patterns can converge, in a meta-realm that includes all of what Bateson termed stochastic sequences, namely, in biological, cultural, and cognitive realms. The convergences are common solutions to the same functional problems that span a wide variety of systems. Other general principles in the organization of systems, such as borders, arrows, cycles, centers, and networks, constitute members of a system of metapatterns, the objects in a Batesonian metascience. The authors show that the metapatterns have implications for research in the humanities and social sciences, as well as for dynamic learning along the lines of Bateson's broadly-extended concept of epistemology.

Originality/value – As nearly universal functional patterns, metapatterns could serve to create a scale-bridging form of descriptive scholarship and thus contribute to the quest for a unified body of knowledge, which E.O. Wilson termed *Consilience*.

Keywords Cybernetics, Sciences, Systems theory

Paper type Conceptual paper

Introduction

Gregory Bateson was one of the most innovative thinkers of the twentieth century. Born in 1904 to a prominent British family that included his father William Bateson, a renowned geneticist, he spent the majority of his most productive working life in the USA until his death in California in 1980. Bateson's work is difficult to categorize because it ranged so widely, across anthropology, ethology, cybernetics, and philosophy.

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In short, he was a systems thinker who simply refused to confine his investigations to disciplinary boundaries.

Bateson's final book for which he was solely responsible was *Mind and Nature* (Bateson, 1979). In the work's preface, he coined an enigmatic word: metapatterns. As far as we know, Bateson used the term in only a single written paragraph, in which, he (loosely) defined metapattern as a "pattern of patterns," which characterized a "vast generalization that, indeed, *it is patterns which connect*." (Italics in original).

Even though the term metapattern was used so sparingly by Bateson, it is clear from his writings that his central quest was very much related to metapatterns, because he explored large-ranging, overarching patterns exhibited by systems on a number of scales. He discussed, for instance, the non-evolutionary nature of physics and chemistry, in which information does not matter, in comparison to the evolutionary systems of biology and culture, in which "differences make a difference," to use a favorite phrase. In the pages leading up to his paragraph on metapatterns, Bateson described how one could compare, in turn, the right and left forelimbs of a crab, then the appendages of a crab to those of a lobster, and then the results from the crab-lobster comparison to those from a man-horse comparison. With interests thus spanning the essential nature of systems from physics to psychology, and by indicating how to sequentially expand the ranges of comparative generalizations, Bateson, according to our thesis, was seeking a science of pattern, in other words, a science of metapatterns.

At least once, Bateson explicitly indicated that a broad new science was possible. He wrote (Bateson, 1979, p. 93):

> It is the Platonic thesis of [this] book that epistemology is an indivisible, integrated meta-science whose subject matter is the world of evolution, thought, adaptation, embryology, and genetics – the science of mind in the widest sense of the word.

His use of the word epistemology is non-standard, because it is usually restricted to the study of knowledge. As is well known by Bateson aficionados, Bateson saw "knowledge" as extending beyond its usual meaning, and perhaps, as the current field of systems biology increasingly becomes the study of biochemical signaling networks and transfers of information, Bateson's usage will prove prescient. But, here we wish only to focus on and support Bateson's general idea that there is an integrated meta-science worth investigating.

Bateson was in many ways an enigma. His writings were often unsupported by the usual academic references, and his logical leaps and out-of-the-blue assertions can leave a reader exasperated while at the same time in awe at the possibilities laid forth. Consider the use of the term metapattern in only a single paragraph from a man whose quest was obviously totally involved with metapatterns, and the idiosyncratic definition of epistemology as a meta-science that included genetics. Nevertheless, Bateson did, as we will suggest, lay down a foundation for a science of metapatterns.

In this paper, we employ the term metapattern, following Volk's (1995) expansion on Bateson's term, to refer to a pattern whose generality derives from a universal function that often applies to scales across biology, culture, and cognition. Metapatterns, we propose, are the "objects" or principles of a Batesonian meta-science. We will show how Bateson sought such a science, even when not actually using the term metapattern or without even directly referring to such a science, specifically by reviewing his work on what we will call "binary systems." We will then discuss the basis for metapatterns as convergences across biological and cultural evolution, and their application for studies in the humanities and for education. We will conclude by offering some directions for the future development of the science.

Bateson's great pattern: two-part systems

One clear example in which to see how Bateson's approach can serve as a foundation for a science of metapatterns comes from his book chapter called "Multiple versions of the world" (Bateson, 1979). That chapter looked at the metapattern of the minimal relationship necessary to form a higher order system, in other words, what we prefer to call a *binary*. Here is a brief summary of Bateson's examples.

(1) *The case of difference*. As the 0's and 1's in the electronic codes of computers show, "it takes at least two somethings to create a difference." Thus, anywhere that difference could be useful to some system, in the most general sense, two is the minimal number of parts necessary to generate it.

(2) *The case of binocular vision*. Two forward-aimed eyes of mammals can focus on the same object, but because they provide different angles of view upon that object, the two eyes function as a system to create depth perception for the animal.

(3) *The case of the Pluto*. The discovery of the astronomical object Pluto (we dare not anymore call it a planet!) depended on at least two pictures from the same region of the night sky, which astronomers then compared to discern Pluto as the sole object that changed position relative to the other fixed stars.

(4) *The case of synaptic summation*. A single nerve cell requires at least two other nerve cells feeding signals into it in order to make it fire.

(5) *The case of the hallucinated dagger*. In Shakespeare's play *Macbeth*, Macbeth questions the veracity of a dagger that he sees before him, because his hands cannot simultaneously grasp it. Macbeth not only required that at least two senses give the same result in order to believe his perception, but he was able to consciously ruminate on the fact that his two senses – sight and touch, in this case – contradicted each other.

(6) *The case of synonymous languages*. A number of proofs in mathematics can be given algebraically or geometrically, for example, in the demonstration that $a^2 + b^2 = c^2$. The learner gains a more profound understanding by seeing a proof reached by two different modes of analysis, because the proof is then truly independent of the mode.

(7) *The case of the two sexes*. Sexual reproduction using two sexes is the minimal way of mixing the genes to ensure genetic variation in the offspring of the parents. Most biologists now believe that this mixing confers a key advantage to sexual organisms, namely, that more variable offspring are better protected from fast-evolving parasites.

(8) *The case of beats and moiré phenomena*. Musicians who manually tune a string instrument, such as a guitar, can use the slow oscillating beats generated by the difference between two nearly identical notes. Moiré patterns are a type of visual illusion generated when two similar patterns are juxtaposed, such as two

window screens. Bateson offered the intriguing suggestion that these binary phenomena might be analogous to a brain's creation of time through memory or an organism's testing of a new ecological niche by contrasting it to a former, known one.

(9) *The case of "description," "tautology," and "explanation."* An explanation, according to Bateson, is achieved by mapping a mere description of a phenomenon onto a tautology, which is a set of rules about parts and relationships that have already been separately established to be a valid dynamical system of such parts and relationships. Thus, explanation is born from the combination of new description and old tautology.

Bateson claimed that these examples showed an overall theme of "combination," which he called a "great pattern" (Bateson, 1979, p. 71). Another word to describe this pattern is the binary system (Volk, 1995). Whatever word is used, it is clear that the binary as minimal system to generate a new level of organization does span across biological and cognitive contexts.

Bateson's examples 2 and 7, for instance, occur in biological systems, and presumably came into being through the process of evolution because of the fact that both binocular vision and sex gave survival advantages to the species that bore those patterns.

Depth perception requires a minimum of two eyes, and sexual mixing of genes requires a minimum of two sexes. In both these cases, the big leap in organization comes in going from one to two. More than two eyes would not add anything new to the depth perception. Yes, spiders do possess multiple eyes, but not for creating depth perception. Were mammals to add another forward-facing eye, there would be some improvement in depth perception from the additional viewpoint, but the big step that produced the new functional effect of depth perception came from having two rather than one. Going from two to three would only be an incremental improvement and not a qualitatively new level of function.

The general function of binary is similar with sex. Having three or more sexes rather than just two would provide some additional mixing of genes, but the big functional step came in the change from clonal reproduction with no mixing to two sexes with mixing. The complicated genetic dynamics of fungi that possess more than two mating types notwithstanding, it a pair of parents that creates a genetically new organism and that is what the vast majority of the world's sexual organisms use. In other words, the minimal number of parts – two – to achieve a new functional characteristic is the pattern that was fixed by biological evolution.

Example 5, with Macbeth, is both a biological and a metacognitive binary. Examples 1, 3, 6, and 9 are binary systems in human thinking, with number 1 being general enough to apply to computer machine language. (Though example 4, with synaptic summation, is logically true, we are not sure if it has relevance to the brain, because most nerve cells receive signals from tens to hundreds of other nerve cells.) After the examples, Bateson pointed out that:

> The aggregate is greater than the sum of its parts because the combining of the parts is not a simple adding, but is of the nature of a multiplication or fractionation, or the creation of a logical product.

He was trying different words to get at the point that the binary combination is not a mere addition, not a mere linking of parts, but a new level of logical type (we suggest the term "functional type") that is generated when the two parts work together to form a single system, which, in Bateson's cases, generates depth perception, computer code, gene mixing, discovery of planets, verification of sensed reality, explanations, and various other forms of understanding.

Thus, in his analysis of the great pattern of combination, Bateson pointed out a pattern whose universal characteristics apply across various scales of phenomena. He did not specifically use the term metapattern in his examples of the binary combination, but clearly the pattern fits the term. Twoness as the minimal system that functionally combines parts to form a high-order entity with new characteristics is a very widespread pattern of patterns. The binary could be considered one elemental pattern in a meta-science of metapatterns. Space prevents us from reviewing other examples of binary, but see Volk (1995).

Further potential metapatterns from Bateson

The binary was not the only pattern pointed out by Bateson that could be called a metapattern. We here list a few of these without discussing their varying degrees of validity but only to demonstrate the common theme of the metapattern that coursed throughout much of Bateson's own extensive analysis. In Bateson (1979), he offered the metapatterns of form-and-process, and calibration-and-feedback. Bateson and Bateson (1987) discussed a pattern they called the "syllogism in grass," which used the following logic: grass dies, men die, therefore men are grass. They suggested that this type of syllogism could be the logic of religion, poetry, and the pre-linguistic biologic world. Continuing, Bateson in numerous places cited the concept of feedback in cybernetic systems, and Bateson (1972) explicitly noted three great cybernetic, homeostatic systems: the individual, society, and the ecosystem, an analysis that in many ways preceded similar attention to the metapattern of the complex adaptive system so dear to those involved in what, after Bateson's death, became known as complexity science (Waldrop, 1992; Johnson, 2001).

Two metapatterns developed further by Volk (1995) were important to Bateson: the cycle as a pattern of both ecosystems and minds, and the arrow, which Bateson pointed out was cognitive pattern inherent in "conscious purpose," and which was often in conflict with the true, cyclic nature of minds (Bateson, 1972, pp. 440-7). Bateson was also interested in the transfer of large-scale patterns from one realm to another. For instance, he wrote that "Consciousness and the 'self' are closely related ideas, but the ideas (possibly related to genotypically premises of territory) are crystallized by that more or less arbitrary line which delimits the individual and defines a logical difference between 'reward' and 'punishment.'" (Bateson, 1972, p. 442). Here, Bateson indicated that the mental pattern of the self might be related to the more ancient biological pattern of animal territory, both examples of the metapattern of the border (described by Volk, 1995). This transference of pattern from the physical or biological realm to the more abstract realm of concepts is the key theme of cognitive linguists who work with the deep structure of metaphors (Lakoff and Johnson, 2003), another marvel of the mind to which Bateson paid significant attention.

How metapatterns come into being

Bateson emphasized the importance of stochastic systems, which he defined as a sequence of events that "combines a random component with a selective process so that only certain outcomes of the random are allowed to endure" (Bateson and Bateson, 1987, glossary). He saw that such a system was not confined to the example of biological evolution, but was itself a kind of metapattern that applies to other scales as well. For example, mental processes, such as thinking, can be stochastic (Bateson and Bateson, 1987, Chapter 2; Bickhard and Campbell, 2003).

Daniel Dennett (1995) noted that a general "algorithm" for evolution can apply to both the realms of biology and culture. This is certainly true. By means of the algorithm's components of replication, variation, and selection, it generates great blue herons, mosquitoes, gorillas, and Pseudomonas bacteria in its biological manifestation, and automobiles, symphonies, and publishing genres in the cultural and cognitive manifestations of the algorithm. Blackmore (1999), among others, developed this second manifestation into a theory of cultural and mental "memes," for comparison and contrast to biological genes. Thus, Gregory Bateson was a forerunner in this field of universal evolutionary analysis.

Though Bateson did not use, as far as we know, the term "convergence," we submit that this concept will be crucial in providing the explanatory mechanism for the existence of metapatterns. Convergence in biological evolution occurs when two or more lineages of organisms arrive at the same solution through independent phylogenetic pathways. Thus, the wings of birds, bats, and butterflies are all flat not because these creatures shared a common ancestor that had flat wings, but because they independently evolved similar engineering solutions to the challenge of achieving airborne lift, which required large surfaces to be in contact with the air. Examples of biological convergences span from functional biochemical molecules used by organisms to their social behaviors. The number of examples is huge (Conway, 2004), with new instances constantly appearing in the literature.

Because the evolutionary algorithm (or Bateson's metapattern of a stochastic system) appears on several levels, from biology to culture (following Bateson, one might want to include "thought" as a level to itself, and not just lump it into the category of "culture"), it seems reasonable that the great meta-realm made up of all stochastic systems could exhibit convergences within it. Thus, there will be functional patterns that are similar in biology, culture, and cognition – for example, the binary. Such convergences would be the objects of a science of metapatterns.

Metapatterns in the humanities and social sciences

Consequently, convergences that exhibit fundamental functional patterns that occur many times would be expected in the pattern-generating disciplines of the social sciences and the humanities, and evaluating their metapatterns could have serious implications for all fields within them. Binaries, for one, are particularly evident. From the classroom to the news, and to our daily experiences we are confronted with social, political, religious, and psychological binaries. Binary classifications such as majority/minority, rural/urban, rich/poor, young/elderly, straight/gay, traditional/modern, educated/undereducated, liberal/conservative, right-wing/left-wing, Christian/non-Christian, mainstream/fundamentalist, spiritual/material, nature/nurture, anxiety/depression, conscious/unconscious, have become embedded in our language and greatly influence the ways we perceive the world and ourselves.

On the one hand, these binary classifications can be indispensable for celebrating human diversity and identity, while on the other, they can lead to the rigid mind that abhors ambiguity and result in stereotypes, prejudice, discrimination, and exclusion. As Zerubaval (1993) pointed out, people compartmentalize reality into discrete mental boxes, "islands of meaning," in which they classify, categorize, and label themselves and each other. The fact that "two" is the minimal classification that generates a system of discourse is the likely reason why binary is so prevalent. Because the binary classification is often one of inclusion and exclusion, it is closely related to the metapattern of the border already noted. These "great patterns," using Bateson's term, not only reveal the ways that people relate to their large society, but they also have consequences for the ways that people think about themselves, as for example, in Bateson's analysis of conflict between the arrow metapattern of conscious purpose and the cybernetic, cycle metapattern of ecological and cognitive systems.

When we examine some of the other major influences and forces which shape society, such as globalization, population and economic trends, social movements, environmental concerns, political and religious ideologies, and technological developments, we discover other great patterns that deserve recognition as metapatterns, which have relevance for our understanding of culture and society. One such pattern is the organizational center (Volk, 1995; Bloom, 2006). Interestingly, thinkers who have dealt with the great pattern of binary have also noted the center. Levi-Strauss (1973) and Derrida (1973), for example, stressed the roles of both binaries and centers in the cognitive aspect of pattern-making. Using mythology and philosophy, both Levi-Strauss and Derrida essentially argued that binaries and centers function in the way we perceive and organize the data of the universe. Likewise, Shils (1975) proposed the binary classification of "center-periphery" as being fundamental to understanding society. According to Greenfeld and Martin (1988), the center carries a twofold meaning when used as a concept. First, it is a synonym for "central value system," referring to irreducible values and beliefs that establish the identity of individuals and bind them into a common universe. Secondly, the center refers to "central institutional system," the authoritative institutions and persons who often express or embody the central value system. Both meanings imply a corresponding idea of "periphery," referring both to the elements of society that need to be integrated and to institutions and persons who lack authority.

Aside from the metapatterns mentioned above, Simon (1973) and others (Chase, 1980; Gurrslin and Richards, 1988) examined the various structures and characteristics of social hierarchies, some of which have been analyzed mathematically to reveal a common pattern of power-law networks (Barabási, 2003). Gebser (1986) also identified a number of social and cultural patterns of space and time. Lamont and Molnár (2002) discussed how the concept of boundaries, already noted as the metapattern of borders, has been at the "center" of influential research agendas in anthropology, history, political science, social psychology, and sociology. Although there has been on-going research on patterns in the social sciences and humanities, the essential problem is that this research has been somewhat disjointed in that it lacks a shared theoretical and methodological approach, which can pull it together into a coherent body of knowledge. We propose that a science of metapatterns could offer such an approach.

Metapatterns in education

Bateson was interested in the application of his ideas to learning and education, as evidenced in his discussion of "deutero-learning" (learning to learn) and other educational issues (Bateson, 1972, 1979; Bateson and Donaldson, 1991). For Bateson, learning was grounded in cybernetic cycles of feedback (i.e. recursive feedback loops), as well as in his unique notion of epistemology and emphasis on "differences that make a difference." In contrast to the standard philosophical notion of epistemology already noted, Bateson's epistemology was dynamic (Harries-Jones, 1995). He was concerned with the processes of knowing and of decision-making about how we view the world, where "…epistemology is that science whose subject matter is itself" (Bateson and Donaldson, 1991, p. 231). From this point, Bateson contended that "epistemology is the great bridge between all branches of the world of experience – intellectual, emotion, observational, theoretical, verbal, and wordless. Knowledge, wisdom, art, religion, sport, and science are bridged from the stance of epistemology… Epistemology is inductive and experimental, and like any true science, it is deductive and, above all, abductive, seeking to put side by side similar chunks of phenomena" (Bateson and Donaldson, 1991, p. 232). From this perspective, we can see that his concern for learning permeated much of his work, and that his definition of abduction is closely related to the quest for metapatterns.

Bateson's view of epistemology as a dynamic process of knowing is key to applying a "science of metapatterns" to the field of education, which will involve an active process of inquiry and of making sense of phenomena. Whether conducting formal research as a scholar of education or practicing as a teacher, the same pattern of learning as epistemological inquiry and sense-making is central. This view of learning begins by examining some topic or phenomenon in recursively greater detail and depth. At the same time, the student, teacher, or researcher can begin to develop abstractions (e.g. explanatory models and principles, etc.), while recursively "testing" these explanatory models and principles to other contexts, along the lines of Bateson's concept of abduction. Such a model of learning results in more complex and interconnected understandings across science, mathematics, art, literature, social sciences, and all aspects of culture that even include craft skills and sports.

We propose that the "subject matter" focus of such a model of learning could be greatly enhanced by a science of metapatterns and related concepts that share with metapatterns the sense of applicability and meaning across contexts. In other words, if a researcher or child were inquiring into some specific cycle, whether biological, cultural, or cognitive, that person may uncover specific functional characteristics of the cycle. At the same time, this information can be used to begin to develop explanatory models of this cycle, while recursively testing this model on cycles in other contexts. As this testing proceeds, differences among cycles are found, along with certain functional similarities. The recursive process continues with further investigations of cycles in other contexts and the development of additional explanatory models. As the process progresses, two basic types of explanatory models are developed:

(1) context specific models; and

(2) generalized models.

It is at the most generalized scale where one would expect to find metapatterns-based explanations, and these can interact with the more context-specific models in a situation of dynamical learning, which seeks to foster the active inquiry across a range of nested contexts.

A focus on metapatterns as subject matter provides opportunities for complex learning. The major concepts in most, if not all, subject matter disciplines involve one of the metapatterns or an interactive set of metapatterns (Bloom, 2006). Because metapatterns share fundamental functional meanings across contexts and subject matter disciplines, the learning that results in a Batesonian, dynamic epistemology is one with inherent connectedness across contexts. Not only is learning more complexly interconnected, but the entire process of learning as a recursive process of inquiring into depth, abducting across contexts, and generating abstractions is one that could better facilitate the transfer of learning. At this point in time, little or no evidence for "transfer of learning" exists beyond the simplest levels. From an educational point of view, a science of metapatterns could provide for not only more complex learning, but also higher degrees of transfer across levels, contexts, and subject matter disciplines.

Conclusion: the future of the meta-science of metapatterns

Following the initial steps laid down by Gregory Bateson throughout his writings, and from the analysis above, the basis for a science of metapatterns might start with the following concept: functional patterns that confer advantages on the systems that possess them can converge, in a meta-realm that includes all of what Bateson called stochastic sequences, namely, in biological, cultural, and cognitive realms. The convergences are common solutions to the same functional problems that span a wide variety of systems. For example, as Bateson showed, binary is the minimal solution to the problem of gaining new characteristics by combining parts in a larger whole. Other general principles in the organization of systems, discussed here using the terms borders, arrows, cycles, centers, and networks constitute members of a set of metapatterns, which serve as the objects in a Batesonian metascience.

One future task for the science of metapatterns is to survey the realm of all evolutionary systems noted above for more patterns, for example, some of Bateson's other patterns or the additional ones in Volk (1995) and Bloom (2006). There is also a need to formalize the means to identify new metapatterns. Furthermore, because mathematics is already a kind of meta-science that uses scale-independent patterns, we suggest that a complementary binary might someday be formed by combining the mathematics from such disciplines as complexity theory and classical control-theory cybernetics with the more qualitative, topological, and functional approach of metapatterns. We leave the issue for the future, having concentrated here on:

- what Gregory Bateson, no stranger to mathematics and himself a pioneer at the original conferences on cybernetics, wrote about several functional, descriptive metapatterns; and
- our views about additional metapatterns and some sense of the scope of their applications.

Wilson (1998), in his book *Consilience*, envisioned a unification of knowledge across disciplines by seamlessly joining the phenomena of one discipline, say organism biology, with those of others, say molecular biology below and ecology above. We suggest that *Consilience* will require even more than uniting disciplines at their boundaries. It is possible that the project to fill out Wilson's vision will recognize objects and processes akin to the metapatterns discussed here, which, as functional, scale-transcending principles seem to stand outside the specific disciplines. Metapatterns might be considered the discipline-independent rules of functional forms.

Finally, one of Bateson's favorite concepts was the "ecology of mind." He envisioned mental activity as a kind of ecosystem, and an ecosystem as a kind of mental activity. Within these two "ecologies," parts exist in relationships that go beyond, to some extent, the specifics of each type of ecology. We hope that Bateson would have been agreeable to a suggestion that a science of metapatterns will be ecology-like, in consisting of complex relationships of functional patterns in a dynamic logic, still to be elucidated, in which patterns form the subsystems within the larger whole of all of epistemology. There is work to be done.

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