

Analysis Tool or Design Methodology? Is there an epistemological basis for patterns?

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Intuition and pattern recognition is, consciously or unconsciously, used across all realms of rigorous inquiry, from both hard and soft sciences, the humanities, especially in mathematics, as well as in more applied disciplines. In fact, it could almost be said to be the one common factor in all their approaches to knowledge generation. However pattern recognition is often dismissed along the route of inquiry as merely a means of achieving inspiration or getting that first hunch. It is strange that given our human propensity for pattern recognition, and the continual reliance on the concept across all disciplines that we have not developed a deeper philosophical investigation of patterns themselves.

This position paper seeks to outline some of the issues around using patterns as an epistemological construct. I am very aware in writing this that I am skating on very thin ice; I do not have the background in epistemology, the philosophy of science or the constructivist schools of knowledge. There is also a massive body of work across the 20th century that is either explicitly or implicitly based on the idea of structure, relations and patterns. This paper is not intended to do more than scratch the surface in a pragmatic attempt to raise some of the questions that would allow the use of patterns as a justifiable knowledge generation and validation technique. However many of these issues are very substantive or reach further into old questions in epistemology than even the concept of patterns necessarily do by themselves.

The main argument in this paper is that the study and use of patterns has had much success in interventionist or normative types of inquiry, namely design and action research. In these situations, due to the contextual nature of the knowledge, value judgements in relationship to their utility can be made rather than truth judgements on the nature of the patterns. Based on this theoretical background, patterns can be justified as part of the process of inquiry in any type of research, but not by themselves as an ends; they are process not product.

During the course of this there are four main issues outlined and left open to discussion. First, what are patterns? Next the issue of the normative and instrumental nature of patterns. The relationship between abduction and apophenia. Finally, a possible epistemology, based on a comparison and contrast of action research and positivist science.

Whilst not wanting to take sides in the Science Wars, my allegiances tend to lie with the Science and Technologies Studies camp. This paper is developed from a point of view that we can have practical knowledge about objective reality, but not in a purely vanilla realist sense. There are many different flavours of realism and I am yet to develop a discerning enough palette to pick a favourite.

What are patterns?

The concept of patterns is not a new one and appears to pop up in a number of different fields, especially, across the second half of the 20th century. Most of these seem to go hand-in-hand with the development of systems theory and one of the earliest discussions of them in this light appears to be from Gregory Bateson (Bateson, 2000)¹. Earlier structuralist and formalist work could also be contextualized in a study of patterns and systems.

Bateson's concept of culture was as a structure of relationships between "bits of culture" and he was looking for patterns in these structures of relationship. The patterns he would spot were commonalities in relationship structures within a culture or across different cultures. Later in his multidisciplinary career he would start to look for common patterns across wildly different systems, i.e. between zoology and psychology (Bateson, 1988). These patterns are common structures that occur in the human and natural world, and are represented in various forms that cut across, or transcend academic disciplines. Bateson called for a meta-science of these meta-patterns; a multi-disciplinary approach to looking at common patterns wherever they occurred.

Bateson's meta-patterns have recently been resurrected recently by the ecologist Tyler Volk, and he intends them to be a way of unifying knowledge and inquiry in science and humanities (Volk, 1996; Volk et al., 2007). Examples of these Bateson/Volk meta-patterns are universal concepts, for example *Spheres*² such as stars, fruit and skulls ; *Binaries* such as electrical charge, bilateral symmetry and structural linguistics; and *Sheets*³ like leaves, flatworms and wings.

Patterns, rather than the objects in the system would seem to be of importance to ecologist, wherever the principles of ecology are being applied.

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1. *Steps to an Ecology of Mind* was first published in 1972, but includes essays written over his lifetime. The chapter, "Experiments in Thinking About Observed Ethnological Material", originally a paper presented in 1940 is the first place to outline his pattern-influenced thinking.
 2. Spheres are meta-patterns that balance forces and are the minima for the surface area to volume ratio.
 3. Sheets maximise surface area, can be flexible, and can 'capture' other matter.

Ecologists focus more on dynamic systems in which one part is always multiply connected, acting by virtue of those connections, and always variable, such that it can be regarded as a pattern rather than simply as object.

(Fuller, 2005)

Most recently a thread of pattern thinking has been popularised via Software Engineering and Interface Design. This can be traced back to Christopher Alexander's *Timeless Way of Building* (Alexander, 1979), which uses patterns as a design methodology for democratising architecture⁴. Contemporary uses of patterns in this tradition cover fields such as pedagogy, ubiquitous computing, mobile social software, moderation, wiki creation, computer supported co-operative work and game design (Dixon, 2009).

Mathematics has sometimes been called the science of patterns, however in general practice lacks a formal method for recognising their impact. Following on from pattern inspired hunches, mathematical proofs are usually arrived at either deductively or inductively. Michael Resnik presents an ontology and epistemology of mathematics, using patterns in the overall fabric of relationships in maths as the process and knowledge objects of the subject. (Resnik, 1981; Resnik, 1982; Resnik, 1999)

At the heart of it, all these pattern based approaches is a systems view of the world, and in particular, a complex systems approach. These complex systems of culture, mathematics or physics are inherently difficult to understand and any attempt to rigourously describe or model them will fail to capture the completeness of the system. This raises many problems for academic inquiry into these areas, and especially when study of these systems is intended for normative purposes and some form of timely intervention is the desired outcome.

All of the systems above have historicity and change over time. When we are discussing patterns we are looking to systems that can evolve or self-organise in some manner. Patterns are then the common structural forms that emerge from this natural, and non-natural, evolutionary complexity. They are the shapes that repeat themselves because they are, as Alexander would say, optimal solutions to common problems. (Alexander, 1979).

The study of patterns is therefore a morphology of these structures, but not just for their own sake, but to analyse the underlying forces, the network structure or the system that is actually of primary concern. They are a means of gaining a useful, and timely understanding of a complex system through examining the evolutionary balancing of the forces that created the patterns without having to have a complete, and fundamentally impossible, understanding of the systems that self-balance those forces (Dixon, 2009).

4. Alexander is a self-professed systems thinker and architect, it is reasonable to assume that he was aware of Bateson and also Buckminster Fuller's discussion of patterns (Fuller et al., 1975).

These patterns may be multiple steps removed. Alexander catalogues the patterns of buildings to get at the systems of human habitation. The common structures of 'undesigned' houses show the physical systems of building, which reveal the social systems of human habitation.

The main benefit of using patterns as a method for system understanding is that one does not have to model the overall system in any way, or create abstract interpretations. The patterns provide an intermediary stage for analysis, as well as signposted routes into the most important parts of the system.

Based on this patterns are an abstraction, but are they a different sort of abstraction to a model? Are they different in some manner from modelling, or is this just positing a new form of modelling?

Having outlined what patterns are, here are some things they are not. They are not models of the system, they are structural representations of elements within them. They are not metaphors or analogies for emergent properties of a system, they are physically present and not re-interpreted. Neither are they maps, graphs or diagrams of an entire system. They are not created, they are documented and described.

Based on this description of patterns, designed artefacts themselves are not patterns, which creates a conundrum and methodological problem for information visualisation. Do the visualisations create patterns in the data or do they merely reveal?

Given that patterns are common structural elements that identify localised evolutionary sweet spots, how do we go about identifying what these structural elements should look like in new fields of study? This is easy when we think about architecture, or the physical world, but what about history, culture studies or politics? What are the tell-tale structures for those systems? Who makes these decisions and how does one justify the choices for identifying patterns?

A final question. Is there a fundamental difference between these patterns above? Alexander is looking at the emergent physical excrescence from systems. Bateson/Volk, in most cases, the physical instantiation of systems. Structuralism seeks the connections and relationships. The same could be said of mathematics. Are these patterns all the same? Are they all patterns of process or at any point do they become product?

Instrumentality, normativity and contextuality

The typical relationship between the forms of rigorous inquiry is outlined in Figure 1. At one end of the spectrum the traditional sciences attempt to take a detached position to inquiry and are seeking universal facts or truths. At the other end of the spectrum are interventionist projects, where the knowledge generated can only be assumed to work in the context in which it was discovered and on the project that it is being used. With action research and design generalisations beyond the project are difficult and dangerous, and knowledge may only be valid at that point in time, as the researchers will be actively effecting change. Interpretative inquiry sits

somewhere in the middle, trying to make generalisable knowledge claims based on context and relativity, but always being in a position of having to make value judgements based on subjective relationship to the area of study. (Aakhus and Jackson, 2005; Mathews, 2009)

Positivist/Empiricist science	Describe	Detached	Universal
Humanities	Critique	Normative & involved	Contextual
Action research Design as research	Design	Intervention	Situated

Figure 1. Continuum of knowledge from applied to abstract

Patterns work very well at the bottom level of this diagram, in the fields of Action Research and Intervention. Patterns identified and used can be judged on their effectiveness in making actual change, rather than needing to be generalised and tested for validity on a more universal scale. The correctness of patterns is therefore within the scope of the project or activity, and needs only be valid for the participants.

As such there has been a recent growth in pattern based inquiry based on the Alexandrian thread. His use of patterns is intentionally grounded in design and although he did publish a collection of his patterns, he claimed that they were not complete and not necessarily right⁵. His process of using patterns was to identify a new pattern language for each project, including patterns that might be very particular for the type of building project he was working on. So a psychiatric hospital would draw on a different set of patterns than a college campus. There might be some in common, but there would be many special cases that would apply only to that type of project. Additionally, as the process is participant driven, they were expected to research, document, analyse and use new patterns. (Alexander, 1979)

5. In publishing his list of patterns, and also publishing it before his process, he created a de facto standard for an architectural pattern language. It would probably have been better to communicate the process by keeping them secret and making other practitioners go through the hard work of documenting and understanding the patterns.

This tends to be the problem with pattern collections, that they end up being treated as merely collections of best practice or rules for practitioners in the discipline, rather than a living, dynamic language to be consciously re-interpreted by lay participants on each new project.

The other aspect of the Alexandrian method is that the patterns are not intended to be considered or used separately, they are, as he describes them, a language. Patterns in this sense are not a static set of knowledge, but instead a process; a design tool, not a design (Dixon, 2009). In this sense it is worth noting that there seem to be parallels to explore in the relationship between structuralist linguistics and Alexander's approach. However one of the key differences is that Alexandrian patterns are cataloguing the emergent physical patterns and structuralism is looking at the repetition of the underlying relationships in language.

Abduction and apophenia

Pattern recognition as a process exists within the context of any form of inquiry even without foregrounding the notion of patterns. Abductive reasoning is a necessary part of the scientific or critical process and used across all disciplines. Abductive reasoning is, simply put, the spotting of patterns and relationships in sets of data. However by itself it is not valid, and patterns spotted by hunches and intuition need to be validated or the process become one of mere apophenia.

The principle of abduction was proposed by Charles Sanders Peirce, the founder of Pragmatism, as a formalisation of hunches, guesses and intuition. He discussed it as a third, necessary, part of the logical scientific process, along with deduction and induction (Burch, 2010). It was the method by which hypotheses were created or discovered.

In deduction a premise is reached by purely logical, *a priori* reasoning, *A* therefore *B*, and *B* therefore *C*, leading to *A* therefore *C*. Induction is the principle of repeated testing. If *B* follows from *A* in all observed cases, then that would be a good theory for all cases in the future.

Abductive reasoning is different in that no logical or empirical connection is required, merely spotting patterns in the data. The results of abduction however are not necessarily logically or scientifically coherent, they need to be tested either deductively or inductively, or both. This three step process of abductive hypothesis forming, deductive theory forming and inductive empirical testing was the basis of Peirce's three part iterative scientific process. This process has been actively adopted by many interventionist processes of inquiry, which I will come to in the next section.

Apophenia is the natural foil to abduction. Apophenia is the experience of seeing connections and patterns where there are none and ascribing excessive meaning to these situations. This is the experience that leads to such things as conspiracy theory and numerology⁶. The concept, first put forward by Klaus Conrad (Dansey, 2008) as a description of psychosis has become a broader description of the same experience in sane individuals. Although working from the same principles as

6. These cultural practices based on apophenia assume the mantle of science or pseudo-science to be self-affirming and self-justifying.

abduction, in that it is fitting a pattern of connections to a random set of data, the experience is one that is not validated through either deductive or inductive reasoning. In fact, in cases of mental illness the individual must stick purely to their abductive reasoning and will remain unconvinced by deductive or inductive reasoning. It is pattern recognition gone wrong, seeing only the pattern expected, no matter what data leads to it. In using patterns as a tool, or form of inquiry, it becomes the opposite of abduction. It is false hypotheses based on incorrect patterns.⁷

Another aspect of pattern recognition is the difference between natural, evolutionary patterns and designed patterns. When I say natural and evolutionary, I am getting at processes that may be, solely or in a mix, physical, biological, social, psychological, technical and political, of sufficient complexity and occurring over a long period of time. Compare these to designed situations, and structures created with conscious agency and we get very different types of patterns. Additionally, if the process of identifying the patterns is one where the data is significantly changed and, consciously or unconsciously, agency is effected on that data, then the resulting patterns also show the effects of that agency. The patterns will now be designed, not discovered. Whereas apophenia discovers anti-patterns with no validation, design can retro-engineer patterns into an pre-selected normative model.

So the process of spotting, discovering or finding patterns requires both care to not break them by moulding the data to fit pre-conceptions as well as not being over-zealous in finding meaning where there is none. And in all cases being able to perform some type of deductive or inductive reasoning to validate the pattern's existence. Rather than a theory for what patterns are then, a methodology for using patterns, that fits with Peirce's three part method is what is needed.

An interventionist epistemological basis

If a robust methodology for the use of patterns in any discipline is required, and patterns have been used effectively in interventionist methodologies, then it would be sensible to examine the theory behind an established field like action research. Action research is an area where there has been a great deal of work on justifying the techniques, results and knowledge generated. As a practice is far removed from positivist science and has had to justify its practices constantly against often antagonistic opposition.

7. The relationship between apophenia and the posthuman binary of pattern/randomness (Hayles, 1999) raises many interesting points. Flickering meanings in the constant information overload of the posthuman age means we are all too often experiencing apophenia and never getting the chance to validate our patterns. We never necessarily know if our pattern is "right" and all too often the conspiracy theories and the paranoid delusions invade our interpretation, lending a madness to the everyday.

Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable framework. (Rapoport, 1970)

Design research is a much more recent discipline and doesn't have the tradition of justifying itself using this kind of theoretical approach, but all forms of interventionist research could be justified using the theoretical background of action research.

From examining something like action research and contrasting it with traditional science, a starting point for an epistemology of patterns could be extrapolated and applied to both interpretative and scientific endeavours.

Action research favours:

- Understanding over explanation
- Making things happen over Prediction
- Conjecture over deduction/induction
- Engagement over detachment
- Action over contemplation

According to action research, positivist science has many deficiencies in generating knowledge for solving problems. Action research however is intended to be a problem solving methodology. It can also base its legitimacy as a science on strong philosophical traditions that are different from traditional positivist science. The viewpoints of the following interconnected philosophies are core: Marx's praxis, hermeneutics, existentialism, pragmatism, process philosophy and phenomenology (Susman and Evered, 1978).

Through Marx's praxis, philosophy is intended to change the world, and one is personally changed whilst doing it. The idea of the hermeneutic circle is that there is no knowledge without presuppositions and that different interpretations can co-exist. Existentialism gives individual choice, empowerment and action. Phenomenology brings with it the importance of immediate subjective experience rather than distant objective science.

Possibly most relevant for this discussion though are the historically interlinked traditions of pragmatism and process philosophy. These both present non-traditional epistemologies.

Process philosophy puts *things* in the background and focuses on process. Doing this brings in three factors. First that processes are complex and made up of stages or phases, that they have a temporal element and that there is a structure or shape to them. So it is an underlying philosophy for dynamic systems, naturally supporting change over time and the concept of evolution (Rescher, 2008). Via pragmatic philosophy, Pierce, James and Dewey, we get the iterative learning/research cycle and the idea that there is no ultimate positivist truth, that the truth of anything can only be judged in how useful it is contextually to the individual (Hookway, 2008).

Most of these underlying assumptions are contrary to traditional science, which assumes its methods are value neutral, people are only ever objects of inquiry, eliminates the role of history in the knowledge generation process and assumes that there can be a denotative language to describe it (Susman and Evered, 1978).

However, in a wider context the practice of science and technology does function like instrumental inquiry (Stephens et al., 2009). At the micro level science uses traditional scientific technique, but on the grand scale, good science is wrapped in action research. Iterative cycles of abductive reasoning followed by deductive or inductive thinking. The cycles continue with the abductive reasoning informed by previous cycles of inquiry.

What this means is that patterns can be used as part of the scientific process, but not necessarily as a scientific product. Within the grand scale scientific practice. In this case it is easy to justify the use of patterns as part of the process rather than a product of the process, as say, a scientific fact is. They have a validity and a usefulness within the context of the scientific inquiry but cannot through that be justified outside that process.

It is in the middle ground of interpretative research, history, media studies or linguistics, where this style of pattern use gets fuzzy. Can we make claims for patterns being valid knowledge, or should they be only used as a route to traditional discussion and critique?

Conclusion and further questions

Although this paper probably raises more questions than it answers it does outline the basis for justifying the use of patterns as part of a process of inquiry, rather than as a product of a process. The most effective background theory to place them in is pragmatist philosophy, where their overall validity is in their contextual usefulness.

Patterns in their current uses appear to be various types of repeated structural forms. Though this does raise questions about the commonality of these forms and the relationships between them across disciplines. The following questions also remain.

If patterns only indicate certain balances of forces or local structure, are they a useful technique for inquiry if they cannot describe the whole underlying system? Are they merely another form of abstraction or modelling?

Is there a fundamental difference between patterns of connections versus patterns in emergent physical, psychological, social, political, etc., structures? As in the difference between what Alexander or Bateson proposed.

The use of patterns can also be easily framed within an interventionist methodology, where the validity of the process can be internally justified by the results delivered. However this does raise questions about the selection bias and normative effects on the methods themselves.

Given the difference between evolutionary patterns and ones created by design process, are the patterns created by tool such as information visualisation different from patterns that naturally occur? Are we designing patterns in where none existed in the first place? Is there is an unavoidable tendency towards apophenia instead of pattern recognition?

Finally, there is the question that Bateson himself was asking, is there a meta-science of meta-patterns? If all we can say is that these are part of the process, do these patterns stay subject specific and purely localised knowledge? How can we use patterns to further the techniques of critique, interpretation, description and analysis? Is there are meta-disciplinary route to all this?

As said in the introduction, many of these are far ranging questions that concern not only the concept of patterns, but also the interrelated concepts of information, knowledge and all human inquiry. These are not easy questions to answer. However it would seem that, as the study of systems and information has been of steadily increasing importance over the last century, that the study of patterns is going to also be of increasing importance.

References

- Aakhus, M. & Jackson, S. (2005) Technology, interaction, and design. In *Handbook of language and social interaction*, (Eds, Fitch, K.L. & Sanders, R.E.) Psychology Press,
- Alexander, C. (1979) *The Timeless Way of Building*. Oxford University Press,
- Bateson, G. (1988) *Mind and nature: A necessary unity*. Bantam Books New York,
- Bateson, G. (2000) *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution and Epistemology*. Chicago University Press,
- Burch, R. (2010) Charles Sanders Peirce. In *The Stanford Encyclopedia of Philosophy*, (Ed, Zalta, E.N.)
- Dixon, D. (2009) Pattern languages for CMC Design. *Handbook of Research on Socio-Technical Design and Social Networking Systems*, 402.
- Fuller, M. (2005) *Media ecologies: Materialist energies in art and technoculture*. The MIT Press,
- Fuller, R.B., Loeb, A.L. & Applewhite, E.J. (1975) *Synergetics; Explorations in the Geometry of Thinking: Explorations in the Geometry of Thinking*. MacMillan Publishing Company,
- Hayles, N.K. (1999) *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. University Of Chicago Press,
- Hookway, C. (2008) Pragmatism. In *The Stanford Encyclopedia of Philosophy*, (Ed, Zalta, E.N.)
- Dansey, N. (2008) Facilitating Apophenia to Augment the Experience of Pervasive Games. *Breaking the Magic Circle*,
- Mathews, P. (2009) information systems research: describe, critique or design?
- Rapoport, R.N. (1970) Three Dilemmas in Action Research¹. *Human relations*, **23**, 499-513.
- Rescher, N. (2008) Process Philosophy. In *The Stanford Encyclopedia of Philosophy*, (Ed, Zalta, E.N.)

- Resnik, M.D. (1981) Mathematics as a science of patterns: Ontology and reference. *Noûs*, **15**, 529-550.
- Resnik, M.D. (1982) Mathematics as a science of patterns: epistemology. *Noûs*, **16**, 95-105.
- Resnik, M.D. (1999) *Mathematics as a Science of Patterns*. Oxford University Press, USA,
- Stephens, J., Barton, J. & Haslett, T. (2009) Action Research: Its History and Relationship to Scientific Methodology. *Systemic Practice and Action Research*, 1-12.
- Susman, G.I. & Evered, R.D. (1978) An assessment of the scientific merits of action research. *Administrative science quarterly*, 582-603.
- Volk, T., Bloom, J.W. & Richards, J. (2007) Toward a science of metapatterns: building upon Bateson's foundation. *Kybernetes*, **36**, 1070-1080.
- Volk, T. (1996) *Metapatterns: Across Space, Time and Mind*. Columbia University Press,