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Rethinking Technology & Creativity in the 21st Century

Making Sense of What You See: Patterning as a Trans-disciplinary Habit of Mind

by Danah Henriksen, William Cain, Punya Mishra, & the Deep-Play Research Group[1*], Michigan State University

> There are only patterns, patterns on top of patterns, patterns that affect other patterns. Patterns hidden by patterns. Patterns within patterns… What we call chaos is just patterns we haven't recognized. What we call random is just patterns we can't decipher.
>
> —*Chuck Palahniuk*

> Humans are pattern-seeking story-telling animals, and we are quite adept at telling stories about patterns, whether they exist or not.
>
> — *Michael Shermer*

> Rhythm. Life is full of it; words should have it, too. But you have to train your ear. Listen to the waves on a quiet night; you'll pick up the cadence. Look at the patterns the wind makes in dry sand and you'll see how syllables in a sentence should fall.
>
> — *Arthur Gordon*

We have argued previously for seven "tools for thinking" that underlie trans-disciplinary thinking and creativity (Mishra, Koehler & Henriksen, 2011). Inspired in part by the Root-Bernstein's (1999) work in this area, we argue that these skills encapsulate the ways in which creative people think. These seven skills are: Perceiving, Patterning, Abstracting, Embodied Thinking, Modeling, Play, and Synthesizing. Our last article (Henriksen et al, in press) was on the skill of Perceiving, while this one focuses on Patterning. We argue that patterning as a trans-disciplinary skill goes beyond our senses – it is a habit of mind, a reflexive way of thinking that seeks to uncover relations and connections that may not be immediately apparent, as well as to create new ones.

1* The Deep-Play Research group at the college of education at Michigan State University includes: Punya Mishra, Danah Henriksen, Laura Terry, Chris Fahnoe, William Cain, Colin Terry, Jon Good, & Rohit Mehta. Address all communication to Punya Mishra: <punya@msu.edu>.

Temple Grandin is an engineer, a doctor of animal science, and a professor at Colorado State University. She has achieved all this even while having been diagnosed as autistic when she was two years old. In her recent book, *The Autistic Brain: Thinking Across the Spectrum*, she discusses her efforts to understand how humans develop and use different ways of thinking through interviewing autistic individuals in different fields and disciplines. Through this she has identified three different ways people organize, process, remember, and use new information: thinking in words, thinking in pictures, and thinking in patterns or structures.

Pattern thinking, unlike thinking with words or pictures, involves the organization of new data, ideas, and concepts in terms of structures and regularities. In this paper, we look at pattern thinking broadly, not just as a tendency that develops for a specific area but, more importantly, as a skill that cuts across disciplines. In the sections below we describe patterning as a trans-disciplinary skill, which consists not just of recognizing and selecting patterns, but also the ability to create new ones.

Pattern recognition

As Mishra, Koehler, and Henriksen (2011) note, "Recognizing patterns involves identifying a repeating form or a plan in a seemingly arbitrary arrangement of things or processes" (Mishra, Koehler, & Henriksen, 2011, pg. 25). Indeed, the human experience can be described as a pattern experience – we can perceive them everywhere. As Shermer writes, in the quote above, "Humans are pattern seeking animals." The first and most obvious patterns we can perceive are natural: heartbeats, snowflakes, the tides, the seasons, the rising and setting of the sun – they all exhibit regularities of one kind or another (or even several at the same time). We can see, hear, and feel regularities emanating from natural objects and phenomena, and as we do so, we internalize the features of those regularities as learned structures, i.e. patterns.

One can argue that science and mathematics, art, and literature are at some level all about seeing and breaking patterns. Biology, astronomy, physical sciences, and others are all based in some way on our ability to recognize symmetries and/or regularities in essential processes and characteristics. From the celestial bodies that orbit one another like clockwork, to atomic combinations that conform throughout the known universe, patterns seem to surround us in a ways that are ultimately knowable through our ability to recognize structures and combine our perceptions of things over time. This is true of art as well, in examples such as the Op-Art of Bridget Riley, the symmetric visual play of Escher, or the syncopation of African drum music or the cadence of a poem.

Time plays an important role in our recognition of patterns, primarily because the mind needs time to recognize the regularities and similarities of the patterns it encounters. Some patterns are easily recognized and take very little time – a chessboard is at first glance a simple square with alternating black and white squares within it, and as players develop expertise they begin to understand, choose and create more elaborate patterns in how the pieces are played on the board. Likewise, a metronome aids beginning musicians with a simple rhythmic pattern, and as musicians develop more fluency with musical patterns they can recognize, replicate, and create more complex patterns with notes, tones, tempo, volume and sound. More complex patterns in nature can take a long time to recognize and appreciate, such as the spawning pattern of certain species of cicadas, which can take years between events and shift in intervals to confuse predators.

Humans are well adapted to notice patterns and to make use of them in daily life. As Michele and Robert Root-Bernstein note:

People are, in fact, pattern-recognizing and pattern-forming creatures. In order to make sense of the world, we look for repeating qualities in phenomena around us; we try to discern the reasons behind repeating events and processes. (Root-Bernstein and Root-Bernstein, 2013)

Our human senses help us to perceive the outside world around us, but recognizing patterns requires more than just perception. With so many patterns surrounding us, pattern recognition is not just a case of recognizing one pattern that may be present in a jumble of sensory data. Pattern recognition, particularly the recognition that takes place in specific disciplines such as mathematics or music, may be just as much a matter of *pattern selection*.

Pattern Selection

To see how pattern selection works, let us consider an example from fiction. In the book (and the film) *Contact,* by Carl Sagan, the central character Ellie Arroway is a scientist leading a search for evidence of extraterrestrial life. She uses a telescope array designed for capturing sound/radio transmissions to listen for intelligent patterns in the background of cosmic noise and radiation that fills the universe. More than once, she hears the regular beats of quasars and pulsars, objects that give off regular bursts of energy and radiation that can be heard across space. Those naturally occurring patterns, however, are not the patterns she is listening for. It is only when she hears a pulsating systematic rhythm, set to prime numbers, does she recognize the pattern she has been seeking. This is an example of not just pattern recognition, but pattern selection – the ability to discern a specific pattern, among a cacophony of unrelated patterns, that is a hallmark of the prepared mind. While some people do seem to have an innate preference for pattern thinking (as Temple Grandin notes in her book) this is a skill that can also certainly be developed with practice, training and patience.

So far we have argued that people can recognize patterns using their senses to perceive regularities and structures within an object or

phenomenon. Pattern recognition, in turn, leads to pattern selection – the skill of honing in on meaningful patterns that achieve a particular need or objective, helps to uncover structures and relationships that improve understanding of particular phenomena. This brings us to a final aspect of pattern thinking which is the key to creativity: *pattern formation*.

Pattern Formation

Nature creates what we perceive to be structural patterns. We can recognize such patterns at work, and even select the ones that will help us to achieve an objective. Pattern forming, on the other hand, is a creative move, requiring us to create new patterns. As a cognitive skill pattern forming is a little more challenging than pattern recognition and selection combining as it does both pattern recognition and pattern selection with creative drive and purpose. People can form their own patterns of behavior unconsciously, without realizing they are doing it (from behavioral tendencies, to interpersonal patterns, to basic life routines), but purposeful pattern forming is a skill that builds upon the strengths of recognition and selection in order to create something new – to generate a new rhythm or regularity that serves a desired purpose.

An impressive example of trans-disciplinary pattern forming comes from the earliest days of modern astronomy, detailed in Richard Holmes book The Age of Reason: The Romantic Generation and the Discovery of the Beauty and Terror of Science. In the late 1700s, William Herschel was already an accomplished musician, when he began pursuing his true passion of stargazing. At the time, experienced astronomers were still in the habit of looking at celestial objects on a case-by-case basis – they would point telescopes in the direction of a planet or star and move them to keep the object in view as long as they could. Herschel at first did the same, but he soon developed a different pattern of star gazing all together. He discovered he could read the night sky the same way he read sheet music – by moving his telescope in an up and down pattern, letting the stars pass by as the earth's rotation brought them into view. In this way, Herschel introduced what is now a standard method for conducting stellar "sweeps" – letting the earth's rotation carry objects into proper viewing position without interruption. (It should be noted that Herschel also designed and built his own telescopes, constructing some of the largest and most precise telescopes of his era, pairing his technological and content knowledge in creative ways).

Herschel formed a new pattern to fulfill an objective – his own physical observation of the heavens – that also took into account the natural patterns that were already present. He was able to recognize a pattern – how stars seem to move across the night sky is relation to his "fixed" position. Herschel was able to recognize this by identifying with his existing approach to reading patterns in sheet music. He then selected that pattern as meaningful to his own studies but he went one step further. He altered his own physical pattern of star gazing – moving the telescope up and down in a linear sweeping motion – to create a new rhythm of observation and study, one that took advantage of the natural rhythm of the earth's rotation. Similarly, artists, musicians, and poets often engage in developing new patterns by mixing and remixing older patterns.

Patterning in the Classroom

We have covered some core aspects of pattern thinking as it relates to real-world disciplines. Given the value of this habit of mind across art, science, mathematics, and other such areas, it is clear that this is a trans-disciplinary skill with relevance in the classroom. Our Master of Arts in Educational Technology program at Michigan State University includes a course about creativity in teaching that helps participants (who are also classroom teachers teaching a variety of different subject matters, topics, and age levels) learn how to develop lessons or teaching ideas based on trans-disciplinary thinking skills. In the previous article in this series (Henriksen et al., in press), we noted a few examples of how the skill of perceiving can be developed in teaching settings. Here, we offer some examples from our teachers relating to how they develop their pedagogy around the skill of patterning.

For example, one of our recent students was a high school English teacher in an urban school. She described how, in covering Shakespeare, many of her students struggled with the text, due to the complexity and unfamiliarity of the lines and patterns of speech. Because patterns are so critical with this content, the teacher made the rhythm and patterns into a "full body" pattern experience by having her students stand up and "walk out" the beat of the Iambic Pentameter so that they could feel and recognize the pattern. She noted that giving them a sense of the pattern was critical because, "once they learn the pattern, the content can be discussed." Once her students had learned the poetic patterns, she had them go through the text of Hamlet and highlight the text portions that struck them with a strong emotional connotation – for example, any words or phrases that bring up negative thoughts or feelings, or a sense that "something evil is going on." Students then moved on to creating a new pattern, by taking this new jumble of strong thematic words/phrases and developing them into a new poem (a "found poem"). This teacher noted the importance of patterning skills because, in having students learn the original Hamlet text, she reflected that:

While a given passage may seem to have an ominous tone to some, it may seem like a random jumble of words to other students. But once the pattern is discovered and understood, the loathsome nature of what has occurred in the play will begin to come alive, and the evil of what has occurred can be fully realized.

In effect, the teacher introduced her students to the idea that

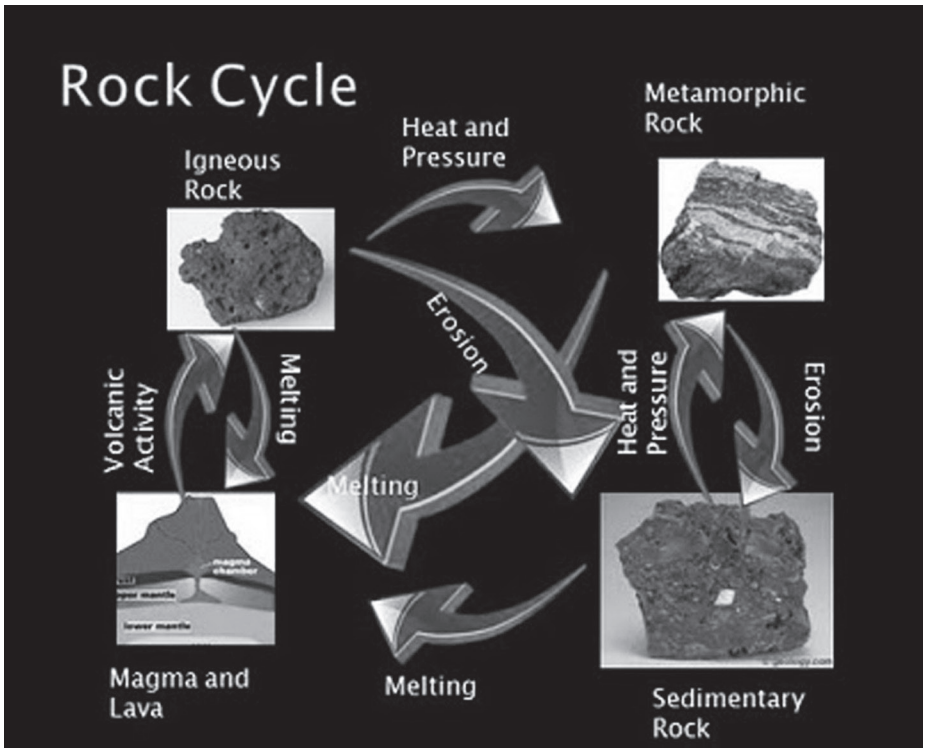

Figure 1: Convention Diagram of the Rock Cycle

Shakespeare approached his work with patterns in mind – and she helped them internalize that pattern for their own use in interpreting his work. So in this sense, the skill of pattern thinking becomes critical to understanding a piece of text – both in reading it and finding the meaning, while also being able to write and construct new work out of it.

In another example, a science teacher working with the rock cycle had her students begin learning the cyclical pattern by studying a fairly conventional representation of it (shown on the next page in Figure 1):

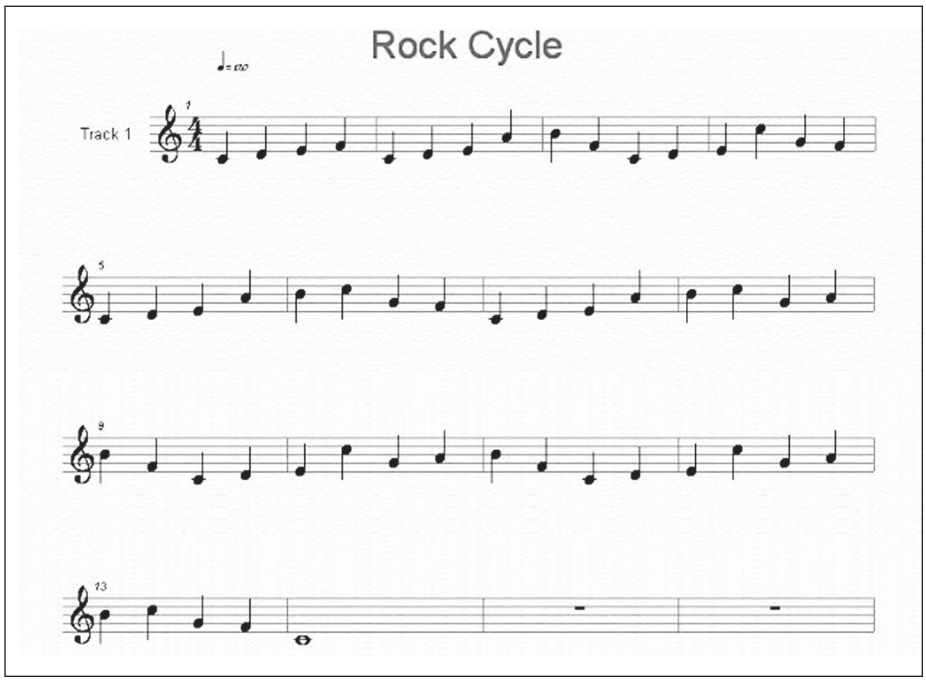

Figure 2: Interpretation of the Rock Cycle Processes through Musical Notes

This image of the repeating cycle helps students understand how all types of rock are interrelated, showing the three main rock types, and the kinds of dynamic transition processes (such as erosion, melting, volcanic activity) that link them. But, although this visual pattern gives a good surface level understanding, the teacher noted how it was important to have students internalize the natural cycle by representing the pattern in a different way. In one of her examples she used a musical approach, by giving each part of the rock cycle a music note. She then worked with students to use combinatory processes to find the different transition processes a rock can go through and the different musical possibilities this might create (this is shown in Figure 2 below, followed by a key to show which musical notes correlate with which processes):

Magma and Lava = C (low); Volcanic Activity = D; Igneous = E; Melting = F; Sedimentary = G; Heat and Pressure = A; Metamorphic = B; Erosion = C (high)

Using very basic music-reading knowledge, new patterns emerge that would be difficult to otherwise find in the rock cycle, by showing how they might be arranged into different tunes and note combinations. This new pattern of the cycle allows students to see the continuous formation of rocks, while still showing the variations and repetitions. Additionally, her students not only learn the immediate science content, but also strengthen some basic music knowledge along the way, making it truly trans-disciplinary in nature.

The teacher suggested that this could also be patterned as claps, stomps, and beats acted out by the students instead of notes; or could be performed in a round format to allow students a deeper under standing of the fact that rocks do not just follow the pattern one at a time, but continuously and at different times. In developing activities such as this that focus on pattern thinking, the students are not only able to hone in on the content at hand, but also learn tangential content that connects the

patterns (in this case between science and music); and more importantly, to expand on habits of mind that enhance thinking across disciplines.

These are just a couple of brief examples of the ways that some of our students have applied the skill of patterning to their own teaching. This skill occurs across a range of disciplines (sciences, music, art, English literature, and others), and in our courses we often see a wide range of ways that teachers can bring trans-disciplinary skills (in this case patterning) into their teaching. Like all habits of mind and cognitive skills, pattern thinking is one that can be developed and enhanced over time, by learning and practicing the components of pattern recognition, selection, and formation, which help to take disciplinary knowledge and expand it further into deeply creative realms of thinking.

Pattern Thinking Across Disciplines

Temple Grandin, in her book mentioned above, notes that she became convinced of the natural occurrence of pattern thinking through her conversations with a number of autistic programmers to ask how they visualized their work. They said that not only could they see the structure of code architectures in their mind, programming was, for them, a matter of filling in the appropriate code in a fully formed mental structure they recognized as fulfilling a purpose.

Patterning as a cognitive tool is not just a mechanism for making sense of large and complex terrains of sensory data. It is one of the brain's evolutionary strategies for survival in a sensory-rich world that is at once chaotic and coherent. We can appreciate the patterns that occur naturally across our domains of knowledge, and make use of their regularities and structures. This is true of both sciences and the arts. For instance, referring to the structural aspect of good writing, Robert Louis Stevenson wrote:

The web, then, or the *pattern*, a web at once sensuous and logical, an elegant and pregnant texture: that is style – that is the foundation of the art of literature. (Kindle location 76)

Stevenson recognized that the pattern thinking within great literature contain qualities that are pleasing to both our logic and our senses. And pattern thinking – recognizing, selecting, and forming – can be meaningfully applied to create powerful learning experiences that connect domains of knowledge and invite more creative thinking and new possibilities into our lives.

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