Are the Universal Patterns of Systems Thinking Embodied in Physical Form?

by Derek Cabrera

Abstract

Historically, because systems thinking is at its core about the relationship between ontological and epistemological phenomena, one of the fundamental problems of systems thinking has been the perceived dualism between mind and body. Any universal theory of systems thinking, therefore, must demonstrate a resolution to this problem. This paper provides the formal logic for the embodied basis for the four universal patterns of systems thinking.

Aligning how we know with what is real

At its core, systems thinking attempts to align the real-world in which we exist (systems) with our human cognition (thinking) about it. For a moment, entertain the idea that if our thinking was in perfect harmony and alignment with the real-world (e.g., our mental models always worked) then there would be no call to action nor field of study called systems thinking. In other words, when our mental models (our thinking) are out of alignment with the real-world our solutions to problems fall short, unintended consequences occur, problems persist, and we are dissatisfied. Therefore, we should be clear that any study of systems thinking, or call for more of it, is an overt statement that we are "out of alignment" and need a different way of thinking about real-world systems.

If our thinking is to truly align with real-world systems, our best bet for identifying such patterns of thinking is to look at how real-world systems have become embodied in our thinking over evolutionary time through physical, chemical, biological, and eventually neurological processes.

One interesting thing to note then is that ensuring that societies have more systems thinkers requires two activities which may not be immediately obvious: (1) because systems thinking is already embodied in us, is not something we need to "teach" but something we need to bring into student's awareness (metacognition), and (2) the reason people are not systems thinkers is because we trained them out of it, not because they needed training in it. That is, the lack of systems thinking is really more of an abundance in socialization and training toward a mindset of oversimplified reductionism, hierarchic and categorical thinking, and linear causality.

Embodied cognition and systems thinking

Two concepts, embodied cognition and evolutionary epistemology, offer deep insights into systems thinking theory. The the workings of the human mind are embodied in physical form and have evolved from physical form. Our understanding of the mind is limited if we think of it in a brain-centric way. We must think systemically about the mind as integrated in the body. Scientists call this "embodied cognition". As we look deeper into what it means to be embodied, we will discover four simple but sublime patterns that provide a more accurate basis for understanding the mind.

What do we mean when we say that "cognition is embodied". Let's take this step by step to reveal several different levels of understanding. At the most basic level, the brain is integrated with the body through circuitry and sensation. The body is not merely a vehicle for carrying the brain from place to place, the two are integrated in what we call, the mind.

At a deeper level, it is easy to see that the physical state of the body can effect our thoughts. For example, when we reject what someone is saying, we are prone to cross our arms or legs. Likewise, when we cross our arms and legs, we are more prone to reject what someone is saying.

At yet another level of depth, embodied cognition is more nuanced. Abstract concepts are also embodied. For example, when we say that an idea is "hard to grasp", hard is a physical metaphor for difficult and grasping is a physically embodied metaphor for understanding. In fact, the way that we learn or understand any new idea or word is through the process of grounding it in a physical embodiment (this is sometimes referred to as "reification" which means to make something abstract concrete).

To truly understand the mind we need to go one step deeper into what is meant by embodiment. For this exercise, I want you to travel back in time before brains and even before complex organisms. I want you to think of those little amoebic things you might have seen under a microscope in high school. Little squiggling bodies. It makes no difference what kind of bodies (e.g., cells, dogs, popcorn, organisms, organizations, etc). What we want to explore is the essential patterns of embodiment—through a simple example of bodies.

Distinctions (D): identity and other

Let's start with a few of these bodies in Figure 1. We'll call them Things. In this new world there are four things: Thing1, Thing2, Thing3, and Thing4. Each is defined not only by what it is (Thing1), but also by the other things that it is not (Thing1 is the same as Not-Thing234).

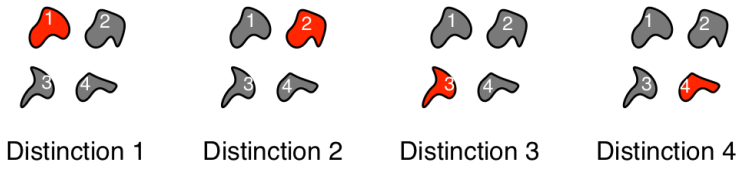

Figure 1: Distinctions: identity and other

Note, in Figure 1, that there are four things as well as four distinctions. For a distinction to form, it requires the interaction of a thing and other things. If there is no distinction, then there is no thingness and therefore no body. So distinctions are a requirement of embodiment. Every thing—in a way that parallels the sophistication of that thing—knows what is and is not itself. You know when your chewing on yourself because it hurts. You might not know much about the other, but you do know that it is not you. Distinction (thing-other) is one of the universal patterns of embodiment. For the human mind to learn or understand any new idea or word, it must distinguish it from others.

Relationships (R): action and reaction

Let's look, in Figure 2, at another universal pattern of embodiment: relationships. It turns out that although thing-hood involves being distinctly different from other things, evolution has ensured that its also important to interact with other things. So, its part of life that when you're a thing, you have ways of relating to other things. The number of ways that you can relate is as plentiful as the number of things that exist. You might have some little cilia or hairs; you might emit some chemicals; you might create sounds or guttural utterances; you might have a binding agent or grabbing apparatus. In any case, the second pattern of embodiment is action-reaction relationships. It tells us that to understand new things we must relate them with other things.

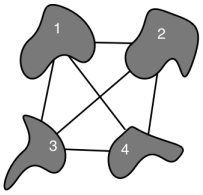

Figure 2: Relationships: action and reaction

Systems (S): part and whole

Let's zoom in, in Figure 3, on our four things to see what's going on inside. What we see is that every thing is made up of parts. Isn't that remarkable? Every little thing is actually made up of other parts to form a whole. We can

call these part-whole systems, which is the third pattern of embodiment. In other words, the human mind understands things by constructing (lumping) or deconstructing (splitting) ideas into part-whole systems.

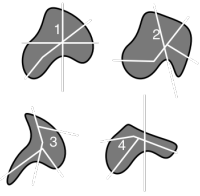

Figure 3: Systems: part and whole

Perspectives (P): point and view

Let's take a look, in Figure 4, at the fourth and final pattern of embodiment: point-view perspectives. On the face of it, to think that some little amoeba-like thing could have a perspective seems ludicrous, but take a closer look. Let's say that our group of four things are aware of (related to) each other in the ways shown in the image labeled "group". If we take the perspective of Thing1, we see that Thing3 is not part of their point-of-view. Similarly, from Thing2's point-of-view, Thing4 doesn't exist. Thing3 and Thing4 also have their unique viewpoints on the world. This is an example of a rudimentary thing taking a crude perspective. You can understand this in the real world if you think of Things 1, 2, 3, and 4 as people in a social network. As you can imagine, Person1 is not aware of Person3 and therefore does not consider them in their perspective of the network. Of course, as things increase in their complexity, the sophistication of the perspective also increases.

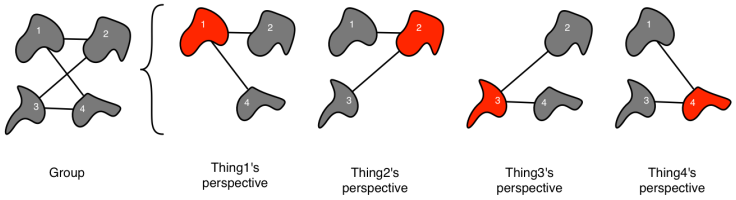

Figure 4: Perspectives: point and view

DSRP is embodied cognition

Little amoeba-like things are good for establishing the basics, but what we care about is understanding our own brains and minds. These four patterns of embodiment help us ground abstract ideas by making distinctions, recognizing relationships, organizing ideas into part-whole systems, and taking multiple perspectives on ideas.

Overtime, individual bodies relate so strongly and continuously that they become systems of related individuals. For example, in Figure 5, our group of 4 things started to relate and they continued on relating to such a deep and significant degree that over time they began to go everywhere together. In fact, what these four things have done is quite remarkable! Through continuously relating, they have transformed themselves from things into parts of a new thing we can call, Thing1234.

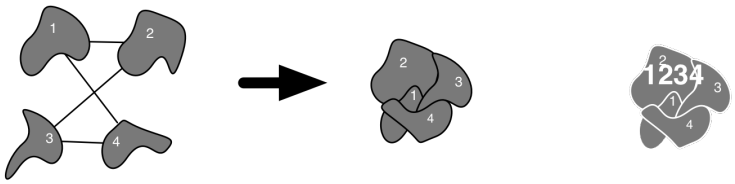

Figure 5: Higher-order part-whole systems become new distinctions with collective identities

Amazingly, it doesn't stop there, because Thing1234 now has its own unique perspective that is different than Thing1's, Thing2's, Thing3's, or Thing4's (who maintain their perspectives). And, get this..Thing1234 might wander into a new environment (Figure 6) and meet some other things such as Thingabcd and Thing#$%@. They could begin relating and in time form a new more complex Thing.

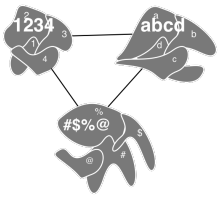

Figure 6: New [systemic] identities form relationships and maintain perspectives with other similar systemic idenitites

This embodiment and evolution goes on for several billion years. Various parts specialize to form wholes that can do interesting new tasks. These part-whole systems made up of part-whole systems, become complex multicellular organisms. In essence, we fast forward in evolution a bit and see how organisms have formed based on iterations of this same process over and over again. Each iteration has the same general outcomes: new things (distinctions), new systems, new relating abilities, and new perspectives. Note too, in reality there would be differentiation between cells, thereby forming new systems with increasingly distinct form and function.

One example of cell differentiation is a neural cell: a cell that has particular chemicals and electrical impulses to cause the first "thought-like" interactions in

the system. As thinking cells begin to evolve, the basis upon which they function is their embodiment. They, like all the cells before them, are an embodied form and, therefore, follow the same four patterns of embodiment. These cells naturally build their processing abilities as extensions of their embodiment. That is, these cognitive cells begin thinking in terms of embodiment: thing-other distinctions, action-reaction relationships, part-whole systems, and point-view perspectives.

Over time, a new complex multicellular organism takes the familiar shape of the human body and brain, forming what we call an embodied mind or embodied cognition. Simply stated, we know that our brain exists throughout our body through a complex of specialized neural cells. The brain forms in sync with the body. As such, our cognition is embodied. Both neural cells and body cells are integrated and exist as perspectival things existing in relational webs and nested in hierarchical part-whole systems.

The neural cells responsible for "thoughts" are embodied. When we see and touch a dog, the abstract concept of dog is generated as a thought. Thus, our conceptual understanding of "dog" is grounded in the touching, seeing, smelling, and real-world experience of interacting with an actual dog. The concept has meaning because it is grounded, embodied, in a sensory experience.

Once we had thoughts, humans began to develop language as a way to better relate to other humans and express our thoughts. The mind uses both phonemic utterances and (eventually) abstract symbols to evolve into a symbol-grounding machine. Go back to our idea of "dog." That thought, "dog", was the result of a physical/sensorial experience with a real dog. In other words, the symbol, in this case, the word d-o-g, is given meaning in relation to an actual experience. So, symbols such as words and numbers, become conceptual thoughts through a grounded, real world experience. For example:

A real-world experience of a sheep grounds the more abstract idea of sheep which in turn is the ground for the word, s-h-e-e-p. A real world experience of counting three fingers or three stones grounds the more abstract idea of the quantity three and these embodied ideas in turn provide the grounding for a squiggle written in the dirt that represents the number '3'. To your mind, the concept of the number 3 is a real thing made up of parts and has relationships to other numbers. Yet, you have never seen the number 3 in real life. It doesn't exist. What exists is 3 pencils, 3 rocks, 3 dogs, 3 people, 3 houses. You've experienced those in real life because they are real, physical entities. But you have never experienced the abstract idea of 3. It is an embodied metaphor which your mind has turned into a thing. If you doubt this, go find the number 3. Point to it. Touch it. Pick it up. Hand it to a friend. You can't. Because it doesn't exist. But your mind, because it is embodied can bring it into existence by making a metaphor to processes that it is most accustomed to seeing, touching. These four processes underlie embodiment itself and allow the mind to handle abstractions: thing-other distinctions, action-reaction relationships, part-whole systems, and point-view perspectives. Embodiment. And, it is this embodiment that provides the foundation grounding that makes the written symbols and verbal utterances that we call language, meaningful.

These four patterns of embodiment are found universally in the physical realities of the world around us: distinctions, systems, relationships, and perspectives. In seeking to understand the world around us, we must seek and see the very way in which the universe is structured and its symmetry to our own bodies. If we know that cognition is embodied, we can therefore understand how we understand things through the four patterns that exist in both the physical, conceptual, and metaphorical realms. Our bodies and our thoughts are no different than one another. As we seek to dissect the brain in left versus right to better understand ourselves, we are missing the very essence of the brain's greatest and most illuminating characteristic - that it is us. In other words, we are distinct, systemic, relational and perspectival beings. Our thoughts are built as our bodies are - we make distinctions, we organize ideas into parts and wholes, we make relationships among ideas, and we take multiple perspectives to deeply understand things. Our whole selves, our whole brains are embodied by these four patterns - and it is these four patterns that provide true insight into how we come to know and into who we are as knowers.

An Embodied, Universal, Systems Thinking Theory of Mind

The story of your mind, of your ideas, your thoughts, feelings, everything that makes up you, can be summed up in four simple patterns. These patterns form your thoughts, your perceptions, the clarity of your speech, the integrity of your character. They make up you. They are you. This is the story of you. These four patterns are also the story of a new and important offshoot of the field of embodied cognition: embodied metacognition.

The four patterns and their complex dynamics form the basis for a new theory of embodied metacognition: Thing-other distinctions, action-reaction relationships, part-whole systems, and point-view perspectives.

Derek Cabrera holds a PhD from Cornell University, is author of seven books and an internationally recognized expert in metacognition and systems thinking. He designed and taught the course on systems thinking as a member of faculty at Cornell University and was a research fellow at the Santa Fe Institute for the Study of Complex Systems. He was a National Science Foundation IGERT Fellow in Nonlinear Systems and a National Science Foundation post doctoral fellow in STEM Systems Evaluation. His theoretical models of systems thinking have made impact worldwide. He is a US patent holder and inventor of the DSRP diagramming method, the VMCL model of organizational design, ThinkBlocks, and MetaMap software, a suite of systems thinking tools used in K-12, higher education, NGOs, government agencies, corporations, and business schools around the world. Currently he is research scientist at Cabrera Research Lab. He lives in Ithaca, New York.