

Emergence Revealed: Where the Whole is Always Equal, Never Greater, than the Parts

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ABSTRACT: Emergence, the enigma that captures the essence of system behavior, often leaves us marveling over its surprising outcomes.

Emergence takes place when the dynamic interactions among the parts of a system give rise to properties or outcomes that would be absent if the parts acted in isolation. The idea of emergence is often summarized in the misleading trope that, “the whole is greater than its parts.” But let’s set the record straight and debunk this popular myth: the whole is always equal, never greater, than its parts.

Keywords: Emergence | Systems Thinking | Systems Science | DSRP

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Don’t be fooled by this trick of perception, for in reality, the whole is always precisely equal to its parts (a.k.a., the Whole=parts principle or $W=p$). Yes, you heard it right! The allure of emergence lies in its ability to reveal qualities at the level of the whole that may not be immediately obvious when examining the individual parts. But, those emergent properties result from the simple rules governing the interactions between the parts.

Let’s take foraging ant colonies as an example. No single ant possesses intelligence, but collectively, their adherence to one simple rule – “no crossing a pheromone trail” – gives rise to intelligent behavior at the colony level. How do several thousand dumb things get together and suddenly produce intelligent behavior? Here’s where the mystery reveals itself: the whole is dynamically interconnected and multiplicative, rather than simply additive¹. Still, it remains firmly grounded in the fundamental principle that the whole equals the parts that it is made up of, which includes its relationships. Because the relationships are part of the whole they are parts of the whole.

Embracing systems thinking means acknowledging the profound truth that relationships are indeed material things, and therefore

Cite this paper: Derek Cabrera (2023) Emergence Revealed: Where the Whole is Always Equal, Never Greater, than the Parts. *Journal of Systems Thinking*. (23) 8.

¹ Mathematicians will sometimes use this turn of phrase to explain that the whole is not literally the additive sum of its parts, which is in fact often the case, but this is a special case focusing on the mathematical definition of the term “sum.” The typical use of the trope does not make such fine-grain distinctions.



parts of the whole in their own right that are as tangible as its other structural components. By recognizing this, we shatter the illusion that the whole could ever be less than its parts. No more mysticism, no more arbitrary distinctions!

Beware, too, the pitfalls of conflation – emergence is a valid scientific concept, but it has often been used as a backdoor that allows mysticism to creep in. Emergence has nothing to do with the whole being more than its parts. Instead, it calls our attention to behavioral outcomes that reveal themselves at the level of the whole rather than at the level of the parts, but this is not the same as the creation of an inequality of wholes and parts. Don't fall prey to the lure of mystical interpretations, fanciful explanations, or hand-waving. Instead, see emergence for what it truly is – the system's behavior emerging from the interactions of its constituent elements.

Now, dive into the deep waters of quantum realms and microcosms, where the whole is as complex and intricate as its smallest parts. There's no room for the fallacy that the whole could ever be less than its parts. When faced with perplexing results or puzzling behavior, remember this: the whole always equals its parts, every bit as much as one side of an equation always equals the other side. If your conclusion points elsewhere, keep looking, because you're missing something (usually relationships). Think of the $W=p$ principle much like the guidance provided by the conservation of energy law. You may recall Richard Feynman's parable of the conservation of energy, where a child and a set of 28 indestructible wooden blocks, where no matter what the child does with them, the mother always finds 28 blocks at the end of the day. The $W=p$ principle reminds us that if we seem to miss a connection in a system, it's akin to the missing block – it's there, waiting to be discovered, and we must search for it with curiosity and diligence. In practice, we often take the cognitively lazy path and simply decide that because we missed a part of the whole, the whole must simply be greater.

So, let us embrace the brilliance of $W=p$ and break free from the shackles of misperception. Emergence is a fascinating journey, but it doesn't call for mystical explanations or divine intervention. It beckons us to understand the simple interaction rules –the relationships–that orchestrate the dance of complexity. And, when we cannot yet “figure it out” it emboldens us to have the courage to say, “we don't know” – one of the most courageous acts a scientist can take. The $W=p$ principle provides us with the mental fitness to accept that “we don't know” for an answer.

Stand firm in the truth that the whole is never more than its parts. Be the seeker of understanding and dispel the allure of mysticism. Let us celebrate emergence as a genuine scientific phenomenon,



grounded in the beauty of interactions and the interconnectedness of things – because in this wondrous universe of systems, the whole is forever equal to its parts.

