

A Proposal for the Definition of Emergence

Benjamin T. Solomon¹

¹Xodus One Management

Publication Date: 2026/03/14

Abstract: This paper lays out a new definition for what Emergence is. Emergence is something new that is able to manifest itself from something that was previously not present. There are 7 properties that constraint the definition of Emergence, New, Stimulus, Resemblance, External Factor, Form, Inheritance and Reversion. Backed by mathematical formalism, these constraints eliminate inconsistencies and provide repeatable interpretation for Emergence. Three examples are provided.

How to Cite: Benjamin T. Solomon (2026) A Proposal for the Definition of Emergence. *International Journal of Innovative Science and Research Technology*, 11(3), 632-635. <https://doi.org/10.38124/ijisrt/26mar451>

I. INTRODUCTION

Lichtenstein [1] provides an excellent in-depth cross-disciplinary analysis of emergence and its emergent and identifies 8 core qualities, 9 emergence Prototypes and 4 Principles. Lichtenstein's [1] 4 principles are,

- Principle 1. Generative Emergence is in disequilibrium i.e. an emergence process will commence only when the system is in dis-equilibrium.
- Principle 2. Generative Emergence Increases Capacity i.e. increases the capacity of the system and it's agents.
- Principle 3. Successful Generative Emergence requires strong containers i.e. constraints are important for Emergence to be expressed.
- Principle 4. Emergence of Emergents: Complementarity of process and outcome i.e. the complementarity of emergence process and emergent outcomes.

One interpretation is that these describe the "how" of Emergence. This paper is concerned with the "what" or definition of Emergence without consideration for how it happens.

The classical definition of synergy is that the "whole that is greater than the sum of its parts". Given the Parts P_i , the Synergistic Whole W_S , Synergy is,

$$W_S > \sum_i P_i \text{ Synergy} \quad (1)$$

If (1) is not true, i.e. (2), then there is no synergy. For example, (2) is Group Activity not Teamwork.

$$W_S = \sum_i P_i \text{ No Synergy i.e. Group Activity} \quad (2)$$

If (1) is not true, i.e. (3) is true, then a Burden is present,

$$W_S < \sum_i P_i \text{ No Synergy i.e. Burden} \quad (3)$$

This paper proposes (i) that Emergence is evident when whole W_E is *different* from the sum of its parts [4],

$$W_E \neq \sum_i P_i \text{ Emergence} \quad (4)$$

and if

If (4) is not true, i.e. (5), then there is no emergence. It is a normal summation process,

$$W_E = \sum_i P_i \text{ No Emergence i.e. Summation} \quad (5)$$

(ii) that the emergent does not have to be better or worse (like Lichtenstein) than what was previously there, but it is noticed when the emergent is better.

➤ *The Emergence Thesis:*

Lee Smolin [2] describes Emergence as something new that is able to manifest itself from something that was previously not present. For example, the mind emerges from the brain, however, this may not be a good example [5 & 6] because,

- If one assumes that animal live forms do not have a spirit or soul, i.e. they are biological automatons or "biotons", then it would seem that the mind does emerge from the brain.
- If one assumes that animal live forms do have a spirit or soul, i.e. non-biotons, then it would seem that the mind does not emerge from the brain but is a pre-existing condition of the spirit or soul.

In physics, it has been contended that since something cannot come out of nothing, Emergence, therefore, requires that all emerging properties must come from a medium that is complex, else it is magic. And we definitely cannot have that in physics, can we? This is a paradox. How can something new emerge when it already exists?

For example, mobility is emergent when all the individual mechanical and electrical components are assembled *in a specific manner* to produce a car. When the car breaks down and is no longer drivable, mobility emergence is cancelled. Our civilization emerges from caves to mega cities.

To keep things clear, I will use the term “medium” to describe “what was there”. I have placed some updated conceptual restrains [3 & 4] on Emergence to eliminate potential inconsistencies and to formulate repeatable definitions for Emergence. These are:

- New: New properties $P_{new,i}$ emerge from the medium M_k which consists of a set of existing properties $\{P_{exist,j}\}$.

$$M_k = \{P_{exist,j}\} \text{ Medium's Property} \quad (6)$$

$$P_{new,i} \notin \{P_{exist,j}\} | M_k \text{ New Property} \quad (7)$$

For example, Mobility is emergent when all the individual mechanical and electrical components are assembled *in a specific manner* to produce a car.

- Stimulus: A stimulus Δ_m is required to bring about a new property. Stimulus is a neutral description for a trigger, a signal or event, etc. For example, the stimulus is *assembled in a specific manner*. Using (6),

$$P_{new,i} = (\Delta_m \{P_{exist,j}\}) | M_k \text{ Stimulus Property} \quad (8)$$

(8) show that the stimulus Δ_m acts on the existing properties $\{P_{exist,j}\}$ of the medium M_k to create a new property $P_{new,i}$. The stimulus property Δ_m has the advantage of postponing the discussion that “something cannot come out of nothing” until one has a better understanding of the phenomenon, while enabling the research to continue.

(8) enables one to define Serendipity S_p ,

$$S_p = (\Delta_m \{P_{exist,j}\} | M_A) | M_T \text{ Serendipity Property} \quad (9)$$

Using the rainbow example [1], Serendipity S_p occurs when the Emergence of a rainbow $\Delta_m \{P_{exist,j}\}$ in one medium M_A the atmosphere is seen while sitting in another medium M_T , the traffic where,

$$M_A \not\subset M_T \text{ AND } M_T \not\subset M_A \text{ Different Mediums Property} \quad (10)$$

That is, one can observe an Emergence from a non-emergent position.

- Resemblance: The new property cannot resemble the stimulus else it is not new, e.g. mobility is not the same as *assembled in a specific manner*. From (8),

$$P_{new,i} \not\subset \Delta_m \text{ Resemblance Property} \quad (11)$$

- External Factor: The new property is not dependent on external factors F_E , e.g. mobility is not dependent on the existence or lack of roads.

- Form: The stimulus alters the form F of the medium and constrained by Resemblance. Form F is a neutral description for structure, shape or composition of the medium M . For example, the form of space time is 4-dimensional x, y, z, t and in the absence gravity, it is linear. Another example, mobility form $F(M_{new})$ is not the same as the sum of mechanical and electrical parts $F(M_{old})$.

$$F(M_{new}) \neq F(M_{old}) \text{ Form Property} \quad (12)$$

- Inheritance: The new Emergent set of properties $\{P_{new}\}$ inherits the properties of the medium $\{P_{old}\}$ that it emerged from, e.g. with mobility $\{P_{new,i}\}$, tires roll, engine converts chemical energy into mechanical energy, etc,

$$\{P_{new}\} = P_{new,i} \cup \{P_{old}\} \text{ Inheritance Property} \quad (13)$$

- Reversion: Given a reverse stimulus transformation Δ_R objects can exhibit a reversion to the properties they inherited, e.g. a breakdown reverts to sum of mechanical and electrical parts.

$$\Delta_R = \{P_{new}\} \cap \{P_{old}\} \text{ Revision Property} \quad (14)$$

These seven rules provide a structured formalism to dealing with Emergence. Of course, the Stimulus Property postpones the discussion of whether Emergence is derived from magic or not, as we don't know how it originated. For now, we have a working framework for Emergence, and can wait on that answer. Lichtenstein's [1] cross-disciplinary analysis of Emergence suggests that several scientists may have identified possible Stimuli.

➤ *Discussion: Investigate Further Using Multiple Sclerosis as an Example*

With Multiple Sclerosis (MS) [7 & 8], the presence of the Epstein-Barr Virus (EBV) has been strongly associated certain genes. Thus, there are four questions that need to be answered.

- Hypothesis: How does the Epstein-Barr Virus (EBV) that has infected 95% of the world's population, in some way cause Multiple Sclerosis (MS) that only affects 2% of the world's population? Statistical analysis would negate the hypothesis.
- Intention: What was the intention of the immune system, destroy or heal?
- Mistaken Identity: Did the immune system mistake the neurons for foreign cells?
- Emergence: Is MS an emergent disease? Does it exhibit emergence?

With respect to the Hypothesis question, Solomon [9] proposed the Stress-Disease Meta Model (SDMM) consisting of 8 parts,

- **Susceptibility:** An indication of how likely the underlying tissue is likely to suffer injury in the presence of stress responses and/or effectors.
- **Stressors:** Cause the disease to be exposed or made visible in susceptible patients when these stressors produce harmful stress responses.
- **Stress Response:** Indicates how the biochemistry responds to stressors.
- **Effectors:** The mechanism (toxins, virus, etc.) by which stress response leads to susceptible tissue injury.
- **Injury:** Damage done to susceptible tissue, including both temporary and permanent damages.
- **Disease:** A state of being in injury.
- **Disease Response:** The statistical behavior of injured tissue exhibiting as a disease.
- **Disease Processes:** The pathogenesis and biochemistry that describe individual, connected sequences to injure or heal the affected tissue. There are two classes of Disease Processes,
 - ✓ **Regeneration Process:** A group of subprocesses that heal the injured tissue.
 - ✓ **Degeneration Process:** A group of subprocesses that cause injury to tissue.

From this SDMM one infers that with MS (the Disease) that the Degeneration Process is substantially stronger than the Regeneration Process as the Central Nervous System (CNS) continues to degenerate. This Disease Response has been documented [9] and has led to the obvious secondary injury of the myelin sheath protecting the neurons. Since this disease is not fully understood, the Effectors are not known. In MS the Stressors are emotional distress [9]. From [7 & 8] Susceptibility is the gene variant present in MS patients. That is, there was an earlier, hidden primary Injury, possibly inherited, that led to this genetic disposition of MS Susceptibility.

➤ *Addressing the Four Questions,*

- **Hypothesis:** EBV is not the cause of MS. However, if the Hypothesis is, “in the presence of the EBV does the gene variation lead to MS?”, this hypothesis would be correct.
- **Intention:** There needs to be a mechanism to determine intention, i.e. whether the immune system is attacking or healing. A change in the distribution of white blood cells does not answer this question, only pathogenesis can answer this question.
- **Mistaken Identity:** In the case of MS, [7] suggest that this is the case.
- **Emergence:** The Medium is the host body with the presence of EBV. The Stimulus is the genetic variant. The New property is the MS disease which does not resemble the Stimulus. There are no known External Factors present. The Form has changed from a healthy body to a diseased one while Inheritance of existing properties are present in living tissue i.e. a cure will revert the injured tissue to a healthy one. With potentially, a yet to be discovered correct treatment, Reversion is possible. Yes, MS the Disease, is Emergent.

➤ *Discussion: Different Perspectives Using General Relativity as an Example*

In General Relativity, a gravitational field is a structure of spacetime that is shaped like a funnel in the presence of the mass source. One could propose a different perspective, each object falling in a gravitational field experiences its own funnel. As an object moves down this funnel, it accelerates towards the mass source. However, if the mass source is negative i.e. negative mass, a form of exotic matter, the spacetime funnel structure is inverted. Thus, when an object moves down this inverted funnel it accelerates away from this negative mass source.

The trajectory of the object moving in this funnel can be split into a horizontal component and a vertical component. The horizontal component is the acceleration relative to the mass source. The vertical component is the downward motion within the funnel, in effect causing the horizontal component, acceleration, per the funnel structure.

From an Emergence perspective the Medium, is the spacetime. The mass source is the Stimulus that causes the New Property of acceleration by way of the shape of the funnel. Acceleration, the New Property, towards or away from the mass source (the Stimulus) does not Resemble the Stimulus. However, the vertical downward motion along the funnel, of the accelerating object is an External Factor. Thus, General Relativity, even though it is correct, is Emergence Non-Compliant. There is an Emergence Compliant version for gravitational acceleration [3] but this is beyond the scope of this paper.

➤ *Discussion: The Same Emergence in Different Situations - Beehive & Capitalism*

Consider a beehive [1] that can host up to 60,000 bees for many generations. Scale economies emerges (New Property) when bees competently and collectively work together (Stimulus) to pollinate fields and produce honey. Making honey is not the New Property as it is an existing property of the bees. The bee organization and structure are the Stimulus that leads to the New Property of Scale Economies. Scale Economies does not Resemble the Stimulus. The new Form of the beehive is the existence of honey within the hive, while both Inheritance and Reversion are true. Honey is the reward for pollinating the fields, and scale economies enable bees to achieve this more efficiently.

Replace bees with humans. In capitalism, scale economies Emerges when organization and structure are enacted competently in a corporate environment. Similarly, cash flow is the reward for better performing corporate structures. Profitability is important but it depends on how one manages the financial structure of the company. American companies are focused on profitability. That is, profitability is the objective, with revenue considered a constraint. From the author’s experience, in the 1970s, Japanese companies and Amazon.com today, were focused on revenue as the objective with profitability as the constraint. The American and the Japanese approaches are in a sense opposite to each other. In both cases, knowingly or unknowingly, cash flow is the reward that enables growth.

II. CONCLUSION

Having laid out the 7 constraints for a New Property to be recognized as Emergence, it is hoped that researchers will, in the future, be more cognitive in recognizing Emergence as an important phenomenon. It is especially important that AI researchers prove Emergence before claiming sentient presence. Alternatively, the definition of Emergence provided in this paper, could lead to new software and hardware designs, that facilitates Emergence.

REFERENCES

- [1]. Lichtenstein B (2025) Emergence as a science. *Front. Complex Syst.* 3:1667670. doi: 10.3389/fcpxs.2025.1667670
- [2]. Lee Smolin, *The Trouble With Physics: The Rise of String Theory, The Fall of a Science, and What Comes Next*, Mariner Books, September 4, 2007, <https://www.amazon.com/The-Trouble-With-Physics-Science/dp/061891868X>
- [3]. Benjamin T Solomon, *An Introduction to Gravity Modification: A guide to using Laithwaite's and Podkletnov's experiments and the physics of forces for empirical results*. Universal Publishers, Boca Raton, 2nd Edition, May 2012. <http://www.universal-publishers.com/book.php?method=ISBN&book=1612330894>
- [4]. Benjamin T Solomon, Emergence: A Powerful but Little Known Notion, *Huffington Post*, December 13, 2016, https://www.huffpost.com/entry/emergence-a-powerful-but_b_8801878
- [5]. Benjamin T Solomon, More Thoughts on Life, *Huffington Post*, January 22, 2017, https://www.huffpost.com/entry/more-thoughts-on-life_b_9032104
- [6]. Benjamin T Solomon, Abortion?, *Huffington Post*, December 21, 2016, https://www.huffpost.com/entry/abortion_2_b_8854782
- [7]. Hayashi, F., Mittl, K., Dandekar, R. *et al.* Antigen specificity of clonally enriched CD8⁺ T cells in multiple sclerosis. *Nat Immunol* 27, 490–502 (2026). <https://doi.org/10.1038/s41590-025-02412-3>
- [8]. Carly Cassella, Scientists discover new evidence a common virus helps trigger MS, *Science Alert*, March 3, 2026, <https://www.msn.com/en-us/health/other/scientists-discover-new-evidence-a-common-virus-helps-trigger-ms/ar-AAIXtguz?ocid=socialshare>
- [9]. Benjamin T Solomon, The Multiple Sclerosis Stress Equation, *Journal of Medical Statistics and Informatics*, Vol 11 Article 1, 2023 https://drive.google.com/file/d/19O_QAG6-Y4J_GputX6lRgpdin0-x7Ode/view with a post-publication page 17 edit.