GST 109 — Emergence and Physical Transfers

Formal Description

Emergence occurs when the maintained causal organisation of participating components establishes a capability to produce or accept physical transfers unavailable to those components acting independently. The transferred entity need not be novel: the new capability may concern its causal role as a transfer that is produced or accepted.

A physical transfer involves matter, energy or physically embodied information. Information is carried in physical states, configurations or patterns of transfer; it does not move independently of a physical substrate comprising matter or energy. Transfers may occur between components within an assembly or across the boundary of an assembly.

The source of a transfer possesses a capability to produce an output, while its destination possesses a capability to accept it as an input. Whether a transfer is internal or external depends on the assembly boundary chosen for investigation.

Plain English Explanation

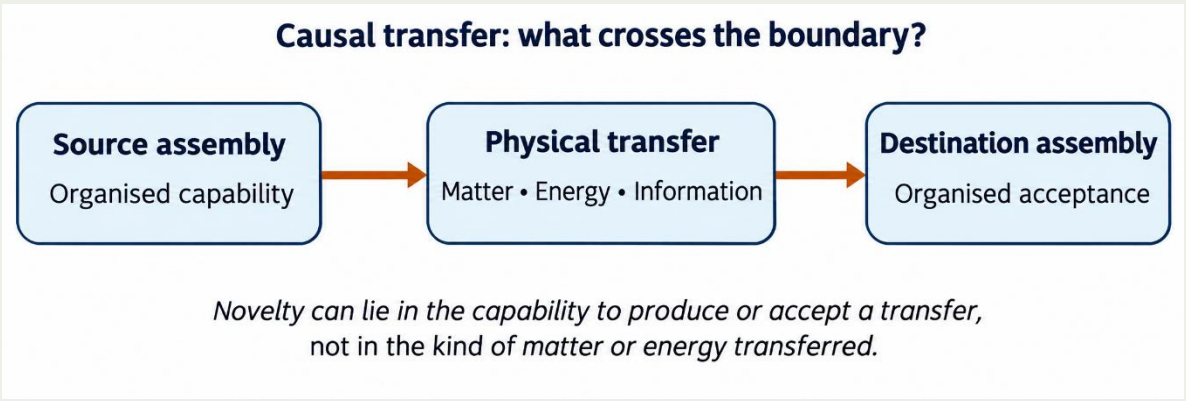
Imagine a generator supplying a lamp. Mechanical energy enters the generator; organised interactions between its components enable electrical energy to leave it; the lamp accepts that electrical energy and produces light and heat. The energy is not a new kind of substance. What matters is the generator's organised capability to make that conversion and deliver the output.

Now look inside the generator. Its shaft transfers mechanical energy to the rotor. The rotor and stator interact electromagnetically. These are internal interactions when the generator is treated as one assembly. The mechanical input and electrical output cross its boundary. If we consider the generator and lamp together as a larger assembly, the electrical transfer to the lamp becomes internal to that larger assembly.

Not all transfers are flows of a material object from one place to another. Energy can pass through mechanical forces or electromagnetic interactions. Information, meanwhile, can be conveyed by a physical pattern: for example, changing electrical signals can carry a message. The pattern may matter to what a receiving system can do, but its causal effects still depend on physical interactions.

An emergent capability may involve producing a familiar transfer in a new way, accepting it under new circumstances or enabling a new effect at its destination. Simply observing a transfer is not enough to establish emergence: we must also investigate what the participating components can do independently.

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Schematic: a source assembly produces a physical transfer accepted by a destination assembly. The diagram is intentionally general; it does not assert that every such transfer is emergent.

Examples

Generator and lamp. Mechanical work is supplied to the generator; electromagnetic interactions within it enable an electrical output; the lamp accepts electrical energy. The generator's overall conversion capability depends on its maintained organisation.

Enzyme and substrate. A substrate interacts with an enzyme at its active site. Physical interactions facilitate a reaction and the products are released. The enzyme does not create new kinds of matter; its organisation enables a particular catalytic capability.

Radio communication. A transmitter produces an organised electromagnetic signal, and a receiver accepts it. The physical signal may embody information in its changing pattern. A receiver's capability to respond to that pattern depends upon its organisation; interpretation is not necessary for the signal to have physical causal effects.

Provenance and Links

This account builds on *Causal Assembly Theory and A Causal Account of Emergence* (Challonr, 2026). It draws on established physical explanations of mechanical and electromagnetic energy transfer, enzyme catalysis and signal transmission.

Related course topics: Understanding Emergence; How an Emergent Capability Works; Causal Integration; Recognising Genuine Emergence; Investigating Emergence.

Practical Exercise

Choose either a generator supplying a lamp or a radio transmitter communicating with a receiver. Draw a boundary around the source assembly and identify at least one internal transfer and one transfer crossing its boundary. For each transfer, name the source, the destination and what is physically transferred.

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Now draw a larger boundary enclosing both source and destination. Which transfer changes from external to internal? Does the transfer itself change?

Finally, identify one capability that might be emergent. Explain what evidence you would need about the independent components before concluding that emergence has occurred.

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