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Context Changes Everything

How Constraints Create Coherence

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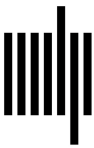

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The Backstory, Today

When we last left the backstory, Descartes had proposed the theory known as dualism, the sundering of reality into two domains, mind and body. As we saw, dualism could not account for top-down causes without violating physical closure or espousing overdetermination. Neither could it explain coherent wholes or intentional, purposive action.

The early twentieth century witnessed the apogee of Skinnerian behaviorism, a reaction to dualism which I will not discuss since it is so well known. By midcentury, however, objections to behaviorism were strong and numerous. Empirical research cast doubts on the idea of mind as the impenetrable and/or unnecessary content of a Skinnerian black box. Attempts to blackbox cognitive processes and reduce sensations like phenomenal feels to operant conditioning floundered (Rosenblueth, Wiener, and Bigelow 1943; Putnam 1967, 1975; Wright 1976; Goldman 1970; Roque 1987). By the mid-1970s, a new academic discipline called *cognitive neuroscience* turned to computer technology and brain imaging, especially attempts at brain mapping, for inspiration on the relations between mind and body.

Formulated by British philosopher J. J. C. Smart (1959) and Austrian American philosopher Herbert Feigl (1958), the *psychoneural identity theory* (also called identity theory) set the stage for this new approach by proposing the reductionist thesis that mental events and processes are identical to—nothing but—brain events. U. T. Place's (1970) seminal article was titled "Is Consciousness a Brain Process?" In language typical of its day, the theory proposed that, for example, "mental event or process Ψ is identical to C-fibers firing."[1] An inadequate understanding of identity, informed by the standard understanding of causality as energetic transfer, was to plague the identity theory as well as the two that followed, functionalism and the supervenience thesis. Let us see how.

The earliest version of the identity theory proposed that mental events generally—my thoughts now about my grandmother, for instance—are identical with a certain neuronal firing pattern. The identity theory allegedly applied to phenomenal feels as well. Pain—my headache now—is also identical to (nothing but) a certain neuronal firing pattern.

Type identity theory held that types of cognitive and sensory processes (such as thoughts, beliefs, pains) are identical to certain types of brain events. Headaches are identical to a type of brain event—say, a C-fibers-type brain process. Type identity would be falsified if two tokens of the same mental event (two instances of headaches) correlate with distinct types of neural or physical events—for example, if my headache now correlates to certain C-fibers firing but your headache yesterday correlated with a different type of brain event, such as a neurotransmitter-release-type event. Since C-fibers firing and neurotransmitter releases are distinct types of brain processes, pain as a type of event (headaches, in this case) could not be identical to C-fibers firing type events.

Evidence to that effect quickly appeared. Degeneracy popped up everywhere (Mason et al. 2014). Dramatic cases of patients with congenital hemibrain but who showed no obvious evidence of cognitive impairment raised serious doubts about any simple one-to-one identity between types of mental events and types of physical events such as brain processes. Neurological studies establishing the indubitable plasticity of the brain put paid to any claims to identity.

To circumvent this objection, the *token identity theory* replaced type identity. This weaker version of identity maintained that actual instances (tokens) of pain are identical with actual neural events. On a token-identity version of psycho-neural identity, my particular headache today might be identical with a certain instance of C-fibers firing, even if your particular headache yesterday was identical with a given neurotransmitter process. There is nothing to an actual experience of pain over and above the token brain event with which it is identical.

Retreating to token identity lost the theory its credibility. Token identity could not explain why instances of the same type of pain, say headaches, might be identical with C-fibers firing in one case but neurotransmitters in another. The alleged identity became even more questionable if those correlations (my pain with C-fibers firing; yours with a neurotransmitter release) were not regular and lawlike.

To make matters worse, empirical results coming out of neuroscience at the time raised additional doubts about universal *unipotentiality*, the one-to-one identity between one brain and one mental event on which

the identity was based. Brain mapping of amputees revealed that the region of the brain usually associated with the amputated limb could be coopted by a different function. Areas in the brain corresponding to one faculty can be taken over by another faculty if necessary and put to a different use. Regions of the brain dedicated to vision could be taken over by hearing or touch, for example. The identity theory could not account for such widespread plasticity.

Although some localization was discovered, clinical research soon focused on this dramatic plasticity, its *pluripotentiality*, and its often distributed architecture. Multiple realizability also appeared to be a common characteristic of biological organization. Certain neurotransmitter molecules have a particular effect in the digestive tract but an entirely different effect in the brain. Also, complex neural networks were discovered to be widely distributed throughout the brain.[2] Thoughts and beliefs—mental events generally—could not be easily and unequivocally identified one to one with local physical structures or processes.

Combined, these observations prompted the fundamental question, "What justifies identifying token mental events with a diverse array of brain events that seem to share no common or general feature with each other (other than being brain events)?"[3] Since neither brain imaging nor other probes at the time had sufficient resolution to identify microneural processes exactly, both versions of the identity theory were left with the following unpalatable choice: either a *double aspect theory*, for which mental events are ontologically identical to physical events, but physical stuff has two qualitatively distinct aspects, physical and mental,[4] or what might be called *promissory physicalism*, the pledge that once brain imaging techniques improved, the exact correlation between thoughts, intentions, or sensations and neural patterns would be elucidated. In recent years, the explosive power and granularity of brain mapping technology continued to up the ante on that pledge (but see Mitchell 2021).

And so, the themes presented in our introductory chapter reappear in the twentieth century in the guise of the philosophy of mind's theories about *type identity* and *token individuation* (the identity theory called it token identity theory, not token individuation theory). What makes a particular event or process a token of a given type? And how can actual instances or specimens become increasingly individuated and therefore uniquely themselves, all the while continuing to belong to the same type? What constitutes and holds together a type of mental event like an intention, and how is it biologically realized, one to one? How is that even possible in cases of intentions like running for office, which take years

if not decades to be realized? The standard assumption that universal and unchanging primary properties confer type identity makes this question a critical one. Lacking an account of coherence that binds distinct individual and previously separate neurons into a unitary network with emergent properties while simultaneously allowing that network to individuate and differentiate over time as distinct tokens, both versions of the identity theory failed to account for emergent properties of interdependencies even among physical (neural) processes.

Like behaviorism before it, the token identity theory also egregiously failed to explain the emergent content of thoughts and intentions and the qualitative feel of sensations like a searing pain, a vivid color, or a haunting fragrance. As noted earlier, the subjectively felt properties of the latter were labeled qualia. Even if one-to-one correlation was established between actual neural processes and particular qualitative feels such as the experience of seeing the vivid crimson of Don Juan roses, correlation alone would not explain what it is about those neural events that produces that qualitative experience of color—or of a searing pain. It would fail to account for qualia. As formulated in a commonly used example, a blind neuroscientist who knew everything about the physical substrate that correlates with the color red would still not fully grasp everything about the experience of perceiving a Don Juan rose. Finally, the purported identity between neural processes and mental events also failed egregiously to account for subjective experience (the hard problem of conscious awareness in general and self-consciousness in particular). Neither version of the identity theory could *explain* why certain neural patterns turned on the light of awareness nor account for how brain events can be about facts in the world. Much less could it explain recursive self-awareness.

Functionalism

Inspired by the work of British mathematician Alan Turing on universal computing machines (Turing 1936), the burgeoning fields of computational devices and information theory transformed Anglo American philosophy of mind. Specifically, the fact that devices can carry out the same information processing on different hardware suggested to philosophers that the multiple realizability of mental events might be reconceptualized on the analogy between a computer's hardware and its software—in particular, on the fact that software can be instantiated in a variety of hardware. This theory came to be known as *functionalism*.

According to functionalism, what makes an experience a mental state is not its internal and material substrate (its primary properties) but its function. On the analogy of software, function is realized as a series of if–then relations (algorithms) that link physical inputs to outputs such as behavior. Functionalism thus updated behaviorism's ideas about conditioning with conceptual tools borrowed from information-processing: mental events just are the algorithms running on a brain.

By decoupling the informational and functional aspect of mental events from its material realization—in transistors, solid state chips, or organic matter—functionalism decoupled feelings, emotions, thoughts and intentions—mental processing generally—from biological wetware. Whereas the identity theory's emphasis on organic stuff had left no room for artificial intelligence, functionalism also pleased science fiction buffs: if the same software happens to be running on silicon chips instead of organic matter, we can conclude that the silicon device feels pain. Artificial Intelligence as a serious field of research was born.

Claiming that the functional order and organization according to which actions are governed is more significant than the stuff the organization arranges conferred an unavoidably dualist tint to the theory. As a result, functionalism came to be referred to as *property dualism* by advocates and detractors alike. It is noteworthy for our purposes, however, that one early critique of functionalism pointed out that it made no room for context (Dreyfus 1972).

Chinese Room Objection

The idea that input–output relations can fully account for all higher-level mental capacities, including emergent properties such as qualia, consciousness, understanding, and so on, was soon challenged. The so-called Chinese room argument of American philosopher John Searle (Searle 1980) is often considered the metaphorical coup de grâce to functionalism. Suppose you are locked in a room, and a sheet of paper with a question written in Chinese characters is passed to you under the door. By consulting a Mandarin-English dictionary (which serves as an algorithm-like lookup table), you respond with other characters. Searle's point is that there is no reason to suppose that by enacting what is in effect a software program in this manner you understand the meanings of the interlocutor's squiggles, or that your own squiggles convey an intended reply.

In short, functionalism's failure to address understanding, meaning, the intensional and intentional content of mental events, qualia, and the

hard problem of consciousness was as egregious as its predecessors', the identity theory and behaviorism.

Intentional content with a *t* is what a mental event such as a thought or belief is about. But what is intens*i*onality with an *s* with respect to mental events? In addition to qualia, among the novel properties of mental events is *intensionality*. As noted in the previous chapter, intensional concepts and properties like *here* and *now* are those whose character is inherently context dependent. As an example of intensionality in belief statements, consider the following: Ann believes that John's wife is cheating on him. Ann does not know that Mary is John's wife. Under these circumstances, the term *Mary* cannot be substituted for *John's wife* in the statement "Ann believes that John's wife is cheating on him"—because Ann does not believe that it is Mary who is cheating on John.

And yet intensional content of mental events, such as Ann's belief above, is at the heart of how intentions cause actions. Add a premise to the above case: suppose Ann believes that John is also cheating on his wife, and Ann tells Mary that. Since Ann did not intend to tell John's wife that he is cheating on her, the two terms cannot be substituted salva veritate in these sentences either. Ann's comment was informed by the intensional content of her beliefs, which, in this case, do not link Mary with John's wife.

The implications for functionalism were clear: any functionalist account of intentional action must account for how purposive behavior is directed by mental content as conceived by the agent. Ann's beliefs and intentions, and her comments, are conditional on her mindset, that is, on her conceiving of the person as John's wife, not as Mary. Despite referring to the same individual, the terms cannot be substituted for one another without loss of truth value in sentences where these appear as the intensional content of mental events.

Intensional content of mental events must be indexically defined because beliefs, thoughts, and intentions as generated by contextual constraints are perspectival. They are products of context-dependent constraints. Any account of *intentional* causation must therefore account for the role of *intensional* content in purposive action.

Principle of Supervenience

Aiming for a *nonreductive physicalism* that could account for emergent mental properties like meaningful and intensional content as well as qualia, the Principle of Supervenience was formulated to buttress functionalism and, in passing, further refute the identity theory.

Advocates of the supervenience thesis acknowledged that mental events have remainder properties that do not match neuronal patterns defined extensionally. The intensional content of thoughts, beliefs, and the felt experience of color and pain cannot therefore be identical to either neuronal events or software packages.

Advocates of the new theory proposed instead that mental events supervene on brain events.

The *supervenience thesis* claimed to offer a nonreductive yet fully naturalist approach that avoids the pitfalls of both the prevalent psychophysical identity theory and Cartesian dualism. Korean American philosopher Jaegwon Kim, who had earlier espoused the identity theory, was its best-known advocate. Because of the subjective, qualitative character of some mental events as well as their intensional content, mental events could no longer be considered identical to either dematerialized syntactical relations or neural processes tout court. Kim proposed instead that mental events are in an asymmetric relation of supervenience with brain events.

As American philosopher Donald Davidson first used the term in 1970, the supervenience thesis held that when one type of properties (Ψ)—those that define mental events—supervenes on another type of events and properties (Φ)—physical ones—there can be no changes in Ψ without a corresponding change in Φ. No two events can be alike in all underlying or subvening (physical) properties while at the same time differing in their emergent or supervening (mental) properties. An event "cannot change in some mental respects without a corresponding alteration in some physical respects." Resolutely naturalist, the supervenience thesis held that mental processes are not identical to but depend on physical ones.

Davidson argued, however, that on pain of turning into another version of the identity theory, that dependence relation must be causal. Subvening neurological events must actively cause supervening mental properties (Davidson 1980). Suddenly, the problems of mereology reappeared. How do different subvening physical (brain) processes cause supervening thoughts and beliefs with intensional content, for example (Juarrero 1999)? And especially, what role does the intensional content of those mental events play with respect to causing purposive action? Can intentions cause actions in virtue of their supervening properties, their intensional content in this case? The problem of top-down causation thus returned as well.

Recall that the received understanding of causal relations to this day maintains that causal power goes only one way, bottom-up. Davidson and Kim took for granted that proper causes only operate as efficient causes, that cause and effect must be spatiotemporally distinct, and that

causal power goes only from subvening properties to supervening ones. As merely aggregative sums of subvening brain events, moreover, mental events must be causally powerless because if the emergent properties of mental events as mental could bring about changes in the physical world, this top-down causal influence would violate physical closure and overdetermine the universe.

The only acceptable conclusion for the supervenience thesis was that the supervening properties of mental events might be real, but they are epiphenomenal, that is, impotent.

In a scathing critique, Kim (1989, 1998) labeled this crushing implication of the supervenience thesis "Descartes' Revenge" because of its analogy with the fatal flaw of Descartes' dualism described at the beginning of this book. Supervenience's dirty little secret was that avoiding overdetermination and violating causal closure unavoidably commits its advocates to epiphenomenalism and the disavowal of top-down causality. Supervenience cannot explain acting purposively—*because* of the context-dependent intensional content (much less qualia) of an intention—without committing the same errors as substance dualism. Qualia and the intensional content of intentions can only be the impotent effluvia of physical—in this case neuronal—processes.

In the end, Kim concluded that, pace purported claims of supervenience, mind and body are in fact identical after all (despite their distinct properties). To accentuate the pertinence of the supervenience debate for this work, I reiterate that the impasse between emergent properties and causality arises in the first place because philosophy has no general understanding either of the origin of mereological coherence or of top-down causation from wholes to parts, or other than in terms of efficient causes.

Multiple Realizability

The plausibility of both functionalism and the supervenience thesis vis-à-vis the token identity theory nevertheless rested as strongly on the fact of degeneracy as did the initial attempt to formulate the identity theory in terms of types, not tokens. Understanding coordination dynamics and hierarchies as constraint regimes generated by their constituents, each multiply realizable by the relata that comprise them is key to rethinking these problems.[5] Multiple realization is not limited to neurological and information-processing dynamics. As we have seen throughout this work, it is not even limited to living things, where it is called degeneracy.

Multiple realizability appears to increase throughout the universe alongside complexification. In a wide variety of fields in addition to the computational and cognitive neurosciences, including empirical neuroscience, we have presented evidence that emergent properties such as autocatalytic cycles and convection cells can be variously realized. Phenotypes can vary, sometimes quite dramatically, depending on the context in which gene expression occurs. This provides evidence that realizations of a genome's information content in a particular phenotype are not one to one. This is also clearly so with respect to the intensional content of beliefs and intentions. Even assuming schizophrenia has a strongly genetic component, for example, paranoid schizophrenic patients in medieval times were not fearful of the CIA. The role of context in multiple realizability and intensional content must be accounted for. Furthermore, higher-level (supervening) properties can persist despite dramatic changes in the underlying neurological realizations. Different neural patterns can realize the same thought; the same neural pattern can subtend different emotions—depending on context. As noted earlier, persistence is grounded in the lack of one-to-one correspondence between changes in lower-level events and particular functions or properties. Plasticity, degeneracy, and pluripotency are typical of the relations between types and tokens.

Remarkably, however, the most trenchant objections to the supervenience hypothesis initially challenged the claim that mental properties are degenerate at all (that is, multiply realizable). Of those questioning the multiple realizability premise itself, American philosophers Thomas Polger and Lawrence Shapiro (Polger and Shapiro 2016) are among the best known. Those arguments are discussed in detail in the next chapter, where the tendency to question anything but the underlying framework about causality and the reality of mereological relations is highlighted.

Before that, however, let us close this chapter by bringing the backstory up to date with the 4E approach.

The 4E Approach Today

In 1975, Hilary Putnam published "The Meaning of 'Meaning,'" where he argued that "the mind ain't just in the head"; it is extended and distributed throughout the body. This take on the mind and cognition contrasted vividly at the time with the approach that held that the mind is entirely located inside the brain, where it mysteriously processes contentful representations and produces intentional actions.

Clark and Chalmers's (1998) article directly addressed the question, "Where does the mind stop and the rest of the world begin?" by introducing the philosophical thesis of *active externalism*: it is not that the mind ain't just in the head and extends to the rest of the body. In fact, no principled separation can be drawn between mind, body, and environment. Human activities incorporate objects in the environment into cognitive and affective processes; these, in turn, extrude into the devices and tools they design and deploy.

Earlier, *Origins of the Modern Mind* (Donald 1991) had presented evidence that cognition and consciousness actively involve tool and technology use. From paper and pencil to handheld calculators, such devices at first glance seem only to store and execute the products of the mind. In fact, Donald argued, a wide range of tools must be considered co-creators and co-implementers of mental activity. Our mind extrudes into the world through its embodiment in a panoply of devices; conversely, those devices become integrated into our cognitive and affective framework. It is evident that this idea is congruent with the one presented in this book.

In the past twenty-plus years, this approach has grown into a movement. Often labeled the *4E approach*, it draws from complexity science and dynamical systems theory to describe cognition not only as embodied throughout the human anatomy and physiology (Thelen and Smith 1994) and extended into technology, tools, and other devices (Chemero 2009). Ontically, it defines mental events as enactments of social practices and activities (De Jaegher and Di Paolo 2007, Noe 2010).

Sensorimotor Life (Di Paolo, Buhrmann, and Barandiaran 2017) explicitly refers to recursivity, reciprocal causality, and dynamics as central to the enacted mind. The authors note that human activities are "highly context-sensitive and full of constraints of all kinds, including, but not limited to time pressures at multiple scales, context-sensitive manipulation of tools and artifacts, the need to coordinate actions with variable objects and other people . . . constraints on the capabilities and demands of the body" (Di Paolo, Buhrmann, and Barandiaran 2017, 4). Slaby and Gallagher (2014), too, extend the idea of enacted minds to institutions and organizations. They consider science, for example, to be a cognitive institution that "shapes our cognitive activity so as to constitute a certain type of knowledge, packaged with relevant skills and techniques" (33). One can consider the elaborate social practices of cassava and nardoo preparation to be instances of enactivist practices.

Radical enactivism goes even further: it posits that mental, cognitive, and affective processes are constituted in and through sense-making

activities. This version of the 4E approach conceptualizes cognitive and sensory processes as radically context dependent on activities: cognitive processes are nothing but the enactment of social practices. Specifically, this radical version casts doubt on the reality of mental representation and intensional content as such. From this perspective, the human self (Kyselo 2014) in its entirety is also constituted as (nothing but) a "social existence" organized as self-other activities "represented by a phase space . . . whose attractors can be defined" (Kyselo and Tschacher 2014, 1).

There is significant agreement between the ideas developed here and 4E's insight that embedded and embodied human practices and activities provide the right framework for understanding minds and mental processes. However, although the role of constraint in generating and preserving structured self-other possibility spaces (such as sensorimotor habits, social practices, and schemes) is implied in most of the 4E publications, when constraint is mentioned at all, it is used almost exclusively in the stabilizing and restricting sense of constraint.

In contrast, this book has attempted to articulate the manner in which enabling constraints generate those very self-other interdependencies and practices that are at the heart of the 4E approach. Context-dependent constraints create the phase space, attractors, coherences, and mutual dependencies that the 4E approach emphasizes. Constraints are also the source of the emergent properties of those interdependencies, among which, this book has maintained, are intensional content, qualia, and phenomenal awareness, which in turn and acting as governing constraints produce, regulate, and modulate socially required, task-appropriate, and context-sensitive behaviors.

This book has also attempted to explicitly rethink the "[recursive] causality unknown to us" that Kant argued was at the heart of purposive behavior by proposing a general framework of constraints for mereological relations. It has delved deeply into how constraints facilitate and impede information flows between those layers of natural and social hierarchical organization we call individuals, their habitats and worlds, and the social practices in which agents are embedded and which they co-create in their enactments. I have done so by returning to the source of my original interest in complexity theory: the parallels between Kant's understanding of intrinsic teleology as self-organization and the recursive causality at work in Prigogine's dissipative structures (Juarrero-Roque 1985).

Approached with the passkey of constraints and insights from biologically inspired hierarchy theory, far-from-equilibrium thermodynamics show that constraints are not efficient causes; they do not transfer energy

directly and are therefore not vulnerable to charges of overdetermination or violation of causal closure. They are coherence makers and sustainers. Body–social interdependencies, agent–environment couplings, patterns of sensorimotor schemes and habits, and the array of interdependent activities at the center of the 4E approach are therefore best understood as the outcomes of bottom-up enabling and generative constraints. They embody and enact new coherences and as such drive major transformations in evolution. In both the living and the nonliving worlds, constraints generate coordination dynamics with emergent properties. Once coalesced and acting as top-down constitutive/governing constraints, the order parameters of those extended coordination dynamics stabilize, preserve, and realize those interdependencies in the enactment of a variety of activities and practices. In cascades of negative feedback processes thanks to the nonlinearities that characterize far from equilibrium dynamical systems, governing constraints regulate and modulate energetic processes such that individuals can enact those social constraints as socially sanctioned activities and practices.

Without the role of constraints in generating those multiply realizable interdependencies, the self-sustaining mereological relations of "sensorimotor schemes and habits," for example (Di Paolo, Buhrmann, and Barandiaran 2014), would remain unexplained. Accounting for how constraints take conditions away from equilibrium and/or away from independence gathers habits, repetitive drills, sedimentation, self-sustaining interdependencies, and the rest of the conceptual tools of the 4E approach under the general framework of constraints. Without a role for constraints, phase transitions to new possibility spaces with emergent properties would remain unaccounted for. Finally, since as noneconomic entities constraints do not directly transfer energy, it is the conservation of constraints that accounts for the covarying behavior patterns and sensorimotor coordination on which the 4E approach is centered.

In short, *Context Changes Everything* has aimed to explain the sources of the 4Es, embeddedness, embodiment, enaction, and ecological coherence and interdependence. It did so by examining the manner of causality whereby coupling and linkages that generate those 4Es come into being, persist, and even become sedimented and entrenched.

The claims made in this book are therefore more far reaching than those of the 4E approach. Rather than address the topic of mental representation directly, *Context Changes Everything* focused on the role of emergent properties more generally. It proposed that enabling and/or constitutive/governing constraints are in place not only in living things

capable of sensorimotor schemes. Physicochemical convection cells, planetary atmospherics, lasers, and even homeostasis in eukaryotic cells are only a few examples of precursors mentioned in this work. Even prior to the emergence of aquatic life and land-based lichens and mycorrhiza, these constraints continued to complexify in hydrothermal deep-sea ocean vents. Each of these these transitions describes coordination dynamics that are the products of context-independent and context-dependent constraints. A continuum of constraints has evolved, beginning in the Big Bang and the creation of elementary particles, through galactic formations and planetary atmospherics, to the emergence of increasingly symbiotic life and conscious awareness, and finally to the myriad social practices and activities that characterize the Anthropocene and which the 4E authors highlight. Well before the origin of life, that is, constraints at work in the abiotic domain generated and governed precursors of the human self-social dynamics described as the 4Es.

Since embeddedness, sensorimotor habits and schemes, and other 4E concepts presuppose the existence of mereological relations of constraint between parts and wholes, let us now examine more closely the role of multiple realizability itself in bringing about functional dependencies.

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