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Neural Consolidation and Ontological Variance: Metaphysical Constraints In Self-Emergence and Human Nature

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Abstract

The Future of Human Nature, Jurgen Habermas' treatise on issues of genetic manipulation, invokes normative concerns arising out of a framework of a material re-ordering of human nature (2003). Implicit in Habermas' critique is a presupposition causally linking the human ontological status to a material program intrinsic to the human body and its mechanistic generation of the mature individual. This presupposition persists through numerous recent accounts that follow his work which are taken at the level of the neural architecture, as well as in various neuroaugmentation proposals. Together these reflect an epistemological approach seeking to deduce human nature from an exclusively empirical assessment of neural operation, a philosophical praxis that has been termed cognitive ontology. This praxis adopts a paradigm widely employed for explication in living systems, now dominating discourse on the nature of reality and touted as the new mechanistic wave. Recourse to ascriptions of human nature grounded in a mechanical causal order, however, has been challenged by recent philosophical approaches for its severance of the metaphysical link between human properties and their predication in an entity, and the inversion of the conceptual order between ontology and epistemology. Unlike mechanistic approaches, these are related to formal organizational order; hence, they are termed non-causal or design explanations. This paper proposes that strictly mechanist, causal sequences also fail to account for systemic operation in cognition and need supplementation with formal causal notions. Accordingly, they also implicate a material instantiation of propertied faculties that conforms to metaphysical principles of unity and property predication, which is to say that the instantiation of self and faculty circuitries are necessarily determined by extrinsic and realist principles of material order. This has the important ethical consequence of siting value to the whole individual and not solely to the perceptual realization of human faculties as proposed in modern cognitive ontology accounts.

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1 INTRODUCTION

The Future of Human Nature, Jurgen Habermas' essay on the radical possibilities of the new genetic technologies (2003), invokes a normative proscription on their individual and social consequences that elicited contentious debate at the time of its release. Arising in the context of a material reordering of human nature, Habermas invocation of a species specific risk amplified tensions that have been introduced by the technology's perceived abilities to alter fundamental human attributes. Philosophers and anthropologists, as well as experts working within the domain of health prognostics such as genetic counseling, repudiated the critique on such varied grounds as a lack of insight into the material realities of implementation, a new Kantian abstention, or inconsistencies with his former anthropological perspective. Nicolas Rose (2007), among others, challenged the critique for its denial of the intrinsic good of individual autonomy with regard to the prospects of new forms of self identification, as did John Harris (2007) noting its bleak conception of the interaction between human nature and technology and a foreclosure of a liberal eugenics directed to a post human future. Thinkers like Francis Fuyukama, by contrast, warned against the harmful ethical and socio-economical consequences of genetic enhancement, (2002), implicitly adopting a normative posture that viewed the human being as anthropologically referential, a point also undertaken by Leon Kass, who underscored the human wisdom tradition for its profound characterization of the human being (2002).

Similar debates over the philosophical and ethical dimensions of a potential division in human nature introduced through biological manipulations have emerged in the neurosciences, where the material seat of human behavior is considered even closer to a human ontology than genetics. Advances in the neurosciences, already significant in light of the Decade of the Brain in the Americas, have accelerated with the recent advent of the BRAIN initiative (Brain Research for the Advancement of Innovative Neurotechnologies) in the Americans, the HBP (Human Brain Project) in Europe, as well as continental programs in Asia and Latin America. These research initiatives now form the basis for efforts to directly modulate brain operation. While such efforts remain largely and overtly directed to therapeutic objectives, such as neurorehabilitation in Spain and in Switzerland, contemporary philosophers such as Harris of Manchester and Nick Bostrom of Oxford (Bostrom, 2005), and scientists such as Jean Pierre Changeux (Doucet, 2007), advance normative frameworks premised on enlightenment, emancipatory ideals that seek the new neurotechnologies for their perceived augmentation potential — efforts that philosopher Francois LeCourt has termed neurotriumphalism (Doucet, 2007).

Emerging from the normative proscriptions, and constituting their metaethical ground, is an epistemological presupposition that causally links the human ontological status to a material program intrinsic to the human body that mechanistically unfurls to yield the mature individual. This presupposition persists through numerous recent accounts of human nature that follow Habermas work that are taken at an organismal level of the neural architecture, ie., at a level of the expressed behavioral features that characterize a human ontology. Included, among others, are Husserl's shared life world conception (Cabrera and Weckert, 2013), Nussbaum's capabilities approach (Coekelburgh, 2011), and a variety of evolutionary legacy accounts of the human faculties (Goldsmith, 1991; Defelipe, 2011).

Together these reflect an epistemological approach that has been adopted within the neurosciences that seeks to deduce human nature from an exclusively empirical description of neural architecture and operation. This is to say that the metaphysical ground for an ontological understanding of human nature has been replaced by an epistemological program limited to a deciphering of empirically accumulated data, typically about causal relations amongst the brain's neuronal elements. This epistemological understanding of human nature is perceived to flow from an understanding of how the brain achieves various functions that are stated to endow the human faculties, rather than to assist in the conceptual development of an epistemology adequate to its ontological foundation.

Functional imaging during task performance, for example, is often used to relate neural activity to performance, typically by reconstructing the 'functional' order of their occurrence (Roskies, 2016), that is, how the organ of the brain performs its activities. Inferences made from such practices, in fact, have been termed 'cognitive ontology' (Roskies, 2016). Similarly, inferences on such faculties as reason, agency, and the self, likewise ground themselves in frameworks of empirical epistemology.

Attempts to ascertain ontology from epistemology, however, particularly an empirically derived one, constrict the body of knowledge about human nature to one that is compositional and performative. This is to say that it decomposes its functionalist ascription into the manner in which the brain performs its operations by determining the causal relationship between its compositional elements, that is, how functions mechanistically emerge from neural operation (Spencer and Perrone, 2008; Roskies, 2016) Typically absent from such an understanding is a supra or metaphysical qualification linking the individual to an organizational state that is designated as an existent. In this latter conception, the brain's dynamical operation can be viewed holistically, thus retrieving (Laughlin, 2014; Gillett, 2016; Esfeld, 2004) substance based notions that trace their origin to Aristotelian and Thomistic roots. In current empirical accounts the individual is constituted, instead, by his properties rather than being the subject of their predication, thereby introducing a division in the conception of the subject. Hence, a cognitive ontology drawn from empiricist accounts alone is necessarily divisive and reductive.

Recourse to mechanistic explanations now dominate discourse on the nature of reality and is used to explicate that of living organisms. However, there is a growing recognition of the explanatory need for grounding systemic operation in metaphysical conceptions of entities and of the failure of mechanistic, empiricist accounts to explain why properties accrue to entities rather than merely how they do so (Braillard, 2010). This failure has been the stimulus for proposals that invoke 'non causal' explanations, termed design explanations, that is, explanatory accounts not derived from a strict causal succession (Braillard, 2010). These explanations seek to account for why particular organizational forms are adopted and so resemble Aristotelian formal causal notions. They constitute, therefore, a retrieval of classical metaphysical principles related to the nature of being. In contrast to mechanistic explanations that reference an intrinsic, efficient causal order that is perceived as ontologically generative, ontological ascriptions that are derived from non-causal explanations are accounted for by metaphysical principles related to a 'formal' order to which the organism is subject.

This paper will argue, accordingly, that accounts of cognitive ontology that derive solely from causal succession, also fail to account for the formal order, meaning that explanatory accounts strictly based on a mechanist understanding are insufficient for ontic adequacy, and require a supplemental explication invoking non-causal explanations for the organizational and dynamic order underlying cognition. In particular, the consolidation of a neural architecture for the cognitive representation of the 'self' exemplifies the use of formal, design principles deducible from the metaphysical transcendental of unity. This paper will thus argue that the instantiation of self circuitry flows from the need for a predication of properties that are contingent in a subject, that is, a holistic entity. Contingent properties emerging from the neural order, including those that define a human nature, for instance, reasoning, agency, and identity, predicate from a single entity, metaphysically encapsulated by the self, that is ontologically generative, here understood as integrational and determinative, as opposed to a mechanistic program. Normative proscriptions flow from the failure of empiricist epistemology to adequately conceptualize ontic adequacy, that is, to afford a realist account of the metaphysical dimensions of a human anthropology, and thereby separate ontological ascriptions from their mooring in a subject from which they predicate diminishing the value inherent in human nature.

The paper's argument will pursue the following order. First, it will review existing conceptions of cognition that are regarded as ontologically definitive and that are generally uniform in extrapolating from the neurosciences a functionalist and causal ascription of human anthropology. Second, it will argue that new wave, mechanist thinking retrieves substance based notions in its attempt to supplement explanatory limitations encountered in purely causal, mechanistic accounts. Third, the paper will consider that such substantivist retrievals afford a philosophical basis for arguments for a material instantiation of cognition that is formally structured by extrinsic metaphysical principles of unity and property predication. Normative implications of this conception are then considered in light of current human nature accounts that adopt an empirical epistemology to ground human ontology.

2 CAUSAL LACUNAE: MECHANISMS IN COGNITION

2.1 *Modern Ontic Commitments*

Historically, ontological ascriptions of cognition draw traction from propertied features that characterize individuals as entities, whereas empiricist discourses invoke ontology from compositional explananda that exhibit causal continuity and mechanistic performance. Adina Roskies (2016) provides an explication that is illustrative

> "The way I have been thinking of cognitive ontology has been prompted by my interest in neuroimaging. Functional neuroimaging studies measure changes in blood flow that correlate with the changes in neural activity of cognitive processes involved in various tasks"

This statement means that in Roskie's view ontology emerges from a decomposition of the brain's propertied features and a determination of the order by which the parts causally effect performance, a praxis inherent in empiricism that neuroscience has pursued since the work of Ramon de Cajal. Although firmly situating studies of the brain in the biological sciences, Cajal's work nevertheless generally foreclosed other philosophical approaches that contextualized cognition within broader existential dimensions. This has since left mental function to be viewed as an ordered sequence of effects mediated by successive neuronal interactions. This conception is explicitly adopted in the American BRAIN and European HBP initiatives, for example, in their proposal to elucidate the connectome, which is to say that in the prevailing view, the brain's function is premised on the connectivity and composition of its parts.

Approaches said to characterize human nature also share this ontic commitment, which is generally presupposed in studies on the mind (Shallice and Cooper, 2011). Principal models for self agency, for example, center around predictive representations that are formulated by the brain in anticipation of bodily movements (Bayne and Pacherie, 2007). In these models motor commands, that are dispatched to sensory cortical centers prior to expected movements, are compared with sensory observations of the actual movements that subsequently occur to distinguish those that are self generated from those that are independent of individual control. This succession of events is thus understood to constitute the faculty for agency. Current models for personal identity are similarly committed. Here, the neural architecture links the body form to the neural activity representing it. In the scheme proposed by Damasio (2014), somatotopically distributed, afferent input is assembled throughout the body before integrating it into a composite representing the three dimensional configuration of the whole corpus. Self identity is thus neurally linked to the whole body and results from the sequence of unique neural events that generate its material representation. Ontological faculties, accordingly, are seen only as a series of neural events that culminate in their perceptual realization.

Current conceptions of cognition thus possess ontic commitments to a causal understanding characterized by determinate relations that display continuity between cause and effect, typically assessed by contiguity and temporal succession, since gaps would require additional causal factors as explanans (Bunge, 1979). Identifying, circumscribing, and elucidating the composition and relations of such interruptions constitute the essence of the empiricist praxis not merely because previously determined causal sequences are no longer in need of resolution but because cognitive properties are themselves seen as processional and sequentially determinate. Indeed, these models are revealing not only for how cognition and its ontological manifestations are to be understood, but how this understanding flows from the experimental paradigm used to assess their structure, meaning that experimental praxis is determinative for the ontological conception. Experimental praxis is thus recapitulated in the steps that are identified, which is to say that the use of the empiricist approach itself elicits the programmatic features that confirm the ontological account. Cognition, accordingly, is epistemically conceived leaving causal presuppositions to constitute the ontic commitment of modern cognitive ontologies. Realist ascriptions, in consequence, are limited to a functionalist conception that is the product of a set of change effecting relations.

2.2 Mechanisms and Mechanistic Philosophy in Cognition

Causal explanations are now the subject of discourse under the rubric of the new mechanistic approach to living systems and are claimed to exhaustively explicate cognition. Cognitive operation is thus interpreted within a framework that explicitly draws from this explanatory origin and, therefore, displays its explanatory features. Accordingly, mechanists are concerned with causal sequences and propose that — since causal relations are unidirectional — ordered relational sequences must originate in a causal nexus, that is, a source from which successive points of interaction and influence occur (Machamer, Darden, and Craver, 2001) . Analogously, successive interactions must have an intermediary stage, and a termination that is productive of a unique causal output, that is designated a phenomenon. The case of synaptic vesicle release is often used for illustration. Here the designated causal nexus is that of the axonal membrane depolarization that initiates the event sequence that occurs at the synaptic locus. Included in this sequence are the influx of calcium ions, activation of calcium dependent protein kinases, vesicular priming, release of the synaptic vesicle from its mooring and finally delivery of the neurotransmitter contents into the synaptic cleft between neurons. These events contribute to the phenomenon of interneuronal communication. Together, the sequence of events is thus likened to a mechanism, with its particular processional order that ultimately generates its unique and overall output. Cognitive mechanisms, accordingly, are functionally defined, that is, they 'do' something. This direct link between the phenomenon and its prior causal sequence has been captured in Abrahamsen and Bechtel's (2012) functionalist definition

> "A structure performing a function in virtue of its component parts, component operations, and their organization. The orchestrated functioning of the mechanism is responsible for one or more phenomena."

Crucially, cognitive ontologies are likewise seen as complex mechanisms (Shallice and Cooper, 2011). Autobiographical, or episodic, memory, for example, is proposed to engage a causal sequence specific to CA1 and CA3 cells of the hippocampus and to their adjoining connections. These cells exhibit recursive loops forming dynamically stabilized circuits, known as attractors, which function to retain the memories. Treves and Rolls (Rolls, 2016) episodic memory model that is based on Hopfield attractors proposes several steps leading to memory storage formed of attractor storage basins. These include the pattern of activity originating in the CA3 cells that initiates activity in CA1 cells, as well as an hypothesized mechanism for self contextualization. In a minimally causal sense, autobiographical memory thus arises in the CA3, and then CA1 cells that then recursively structure the attractor basin, the last constituting the dynamic endpoint of the sequence.

To explain these events mechanists adopt several postures in their discourse (Venturelli, 2016) that range from a reductive and linear succession (Bickle, 2006) to more integrative perspectives (Craver and Bechtel, 2007) of cognitive operation. Overall, however, while there exists a plurality of positions within the mechanistic 'gestalt', the various proponents within the spectrum are generally uniform in opposing a pluralistic stance toward explanation that would allow for the possibility of other explanatory modalities for cognition, or living systems generally (Venturelli, 2016). This uniformity of commitment to ontic adequacy has militated against positions that do not lay exclusive claim to an efficient and strict causal succession. Responses to challenges to the mechanist understanding have therefore remained within the explanatory framework of the efficient causal terrain.

These challenges have arisen from several quarters and are both trivial and substantive. Trivial concerns arise in the arbitrary nature by which said mechanisms are circumscribed. The selection of axonal depolarization as a causal origin clearly ignores preceding neuronal events that transpire at the level of the axonal hillock, cell body, or dendrites, or even priors constituted by other neuronal cells whose activity ultimately precipitates vesicular release. Likewise, termination can include post synaptic receptor activation, passive voltage dendritic spread, or activation of further neurons along subsequent circuits. Similar arguments hold for episodic memories.

Trivial concerns, however, reveal deeper difficulties that arise in mechanist approaches to cognitive properties. Indeed, William Bechtel (2017) draws attention to the critical conceptual dimension introduced by boundaries in biological systems: "The issue of where to draw boundaries around a mechanism is, in fact, a crucial issue in biology" that complicates a mechanist understanding. According to Bechtel, this relates to an organizational arrangement that possesses recurrency and that is ubiquitous in nervous systems, in fact, is requisite for their functioning, that is, the necessity of feedback for integral systemic functioning. The nervous system, especially, is constructed as one vast neuronal network where it is not possible to arbitrarily draw boundaries to reveal causal nexi or termination conditions. Such a systemic structure imposes limits on the degree to which the mechanist conception adequately reflects cognitive operation.

This is seen, first, in purely reductionist forms of mechanist proposals (Bickle, 2006) which are not easily reconciled with systemic operation. Recurrent feedback especially challenges the understanding of temporality (Bunge, 1979) that is introduced by this type of causal thinking. Recurrent processes, notably, are causally posterior, which means that they do not occur before or simultaneous with causal priors, yet they can effect changes in steps that are antecedently needed to generate recurrency. Genetic expression, for example, often results in feedback loops that regulate and usually delimit further gene expression. Indeed, network cycling means that in its progression through successive stages events within the loop eventually return to the same, which means that the loop may itself be regarded as a single temporal event, adopting a synchronic dynamic rather than a diachronic succession of the sort that distinguishes mechanistic conceptions (Bechtel, 2017).

Brain activity is noted for the predominance of synchronic patterns that adopt complicated but stable forms (Kelso, 1995; Friston, 2013). In complex systems, such as neural networks, recursive behavior regularly oscillates through a defined operational range. Stable heteroclinic channel attractors, for example, display multiple saddle points that lead to different trajectories (Kirbel and Friston, 2013). Though temporally extended such behavior cannot be considered as temporally successive, but rather a-temporal, resonating within a fixed oscillatory and dynamic profile.

This activity is the result of the brain's massive and complex network, which displays the characteristics of dynamical systems. Dynamic behavior arises from the balance incurred between thermodynamic energy inputs and dissipative entropic output (Kelso, 1995). The general governance of cognition, in consequence, appears to be thermodynamically determined which has led to the invocation of the free energy principle (Friston, 2013), where cognitive processes are conceived as flowing energetically downward. Crucially, thermodynamic dependence governs brain activity in a holistic sense. Although activity is distributed over a 'rugged' energy landscape and partitioned into performance 'motifs' with their individualized energy profiles, e.g., attractors, such motifs are variably joined via bifurcations to the entire neural network in a continually changing operational patterning that is globally distributed (DeHaene, 2015). This means that brain activity may be regarded as comprising a single entity, and not as a collection of independent events.

Equally significant in challenging mechanistic accounts is an understanding of causality that assumes a strict independence, i.e., extrinsic, of influence of one entity on another, an understanding on which these accounts are broadly premised. Ontic adequacy in this causal understanding has been traditionally resolved by recourse to explanations invoking causal relations that operate between the entities of a pathway chain. These change inducing relations are unique to the entities in question, and are imparted unidirectionally, from one entity to the next. Such efficient causal relations are thus, by definition, extrinsic to the entities being acted upon (Bunge, 1979), which is to say that the entity being acted upon is independent of the cause of its change. More precisely, the entities in question possess non relational properties that individuate themselves, thereby necessitating externalized, change effecting relations. Bunge, in his analysis of efficient causality, extends extrinsicity to the whole of the power of change

> "In order to be causal, an explanation must assign the whole power of origination or production to what is outside the entity ....the inner processes

> of changing object do not count and may not even exist for the doctrine of efficient causality, where every change is conceived by this theory as the inevitable result of a cause external to a changing thing".

In other words, entities that are so constitutionally independent do not mediate change inducing relations on themselves.

For mechanistic frameworks, however, extrinsicity introduces the question of how efficient causal relations are to be effected within an organizational order that is composed of multiple levels. Such levels are manifestly evident in living systems composed of hierarchies of numerous parts (Bechtel, 2017). In this organizational order, parts share propertied relations with successive levels, which is to say that parts do not constitute entities independent of the higher levels that they compose. Efficient causal influences, therefore, cannot be effected between compositional levels, but must instead remain confined within fixed levels. This means that causal influences are extrinsic to the entities of a single level alone and so remain intrinsic to the mechanism as a whole. Higher order organization is thus modified to the extent that a constituent of the whole mechanism has been altered, but the change in higher order organization is not the direct result of a causal influence on the whole.

In the case of cognition the complexity and neural entanglement of the brain precludes the sort of facile and direct technical characterization that would unambiguously segregate levels (Venturelli, 2016). Yet the spectrum of analytical approaches used to examine brain function, not to mention the obvious behavioral stratifications that appear to compose the structuring of brain operation (Allen and Friston 2013), are consistent with an operational profile that possesses hierarchy (Friston, 2013). There is, notably, a distinct hierarchy between the cellularly confined, biophysical and biochemical processes of action potential generation that are modeled by Hodgkin Huxley formulations and referenced by mechanists, and those neural circuits that are constitutive of intercellular communication that underlie brain operation and behavior. In such cases the organizational scaling is easily differentiated and clearly demarcated both physically as well as conceptually. Less clear is the organizational scaling that occurs at interneuronal levels where recurrency, redundancy, and partitioning predominate. Analyses here, however, also reveal a hierarchical organizational network (Hermenstad et al., 2011; Sporns, 2011) that builds on simplified microcircuits governing primitive behaviors and that are employed to generate a more complex stratified organization for complex ones. Studies from affective neuroscience, for example, appear to show a progressive increase in sophistication and refinement with evolutionary development that overlays more primitive neural networks (Paanksapp, 1998). Brain networks, moreover, have been the object of an increasing gendre of methodological and technical approaches that adopt graphical and topological profiling to reveal underlying cognitive order. Explications of higher order levels that resort to mathematical topologies defined by these approaches are grounded on the unique functional and anatomical features of the nervous system. These have been used, for example, to show the presence of functional modules characterized by abundant recurrency and designated 'rich club hubs', that are linked via sparsely connected nodes into larger neural architectures (Hermenstad et al., 2011; Sporns, 2011). This arrangement is proposed to link modules within an operational hierarchy that is constituted by levels.

The existence of levels in neural architectures has the effect of placing mechanists in the position of proposing explanations for cognition that rest on causal succession but servicing an explanatory thesis that can be mediated only within and not between levels. Attempts to address this lacunae, while simultaneously preserving a form of causal sequencing, that is, having relationally extrinsic effects mediated by a prior, invoke the notion of constitution to explicate inter level effects (Craver and Bechtel, 2007). This is understood to mean that what is effected within levels are new part/entity properties, which, because the part is constitutive, is transmitted constitutionally to the whole of system. Constitutional effects are thus intended to supplement explications of causal effects that occur within levels.

Mechanistic explications notwithstanding, the invocation of multiorganizational levels that moor causal succession within and not between levels has the effect of rendering mechanistic explications insufficient and topologically incomplete. Presuppositions of ontic adequacy that pare down cognitive performance to ascriptions of causal succession thus necessitate supplementary explanatory modes that are needed for cognitive phenomena to occur. Because such dimensions do not invoke explicit causal relations, they are explanatorily independent, and require, therefore, supplementary, noncausal explanations. What is thus being explained in cognitive ontologies are phenomena only partially explicated by a mechanistic explanans.

By invoking non causal explications that reference multi level organizational order, these supplementary explanations also implicate organizational order as fundamental to ontology; in other words cognitive properties in such accounts derive not solely from causal succession but also from the organizational order of the neural architecture. This explanation, like that of synchronic operation, again invokes entity based accounts to explicate the generation of cognitive properties; that is, they are entities because the whole of the neural architecture is subsumed in the organizational order. Metaphysically, this means that contemporary mechanistic explanations necessarily retrieve entity based notions in their explication of cognitive ontologies.

3 DESIGN EXPLANATIONS – INSTANTIATING NON-CAUSAL EXPLANATIONS

The retrieval of entities as explananda for cognition, which is to say the invocation of cognitive explanans that reference organizational order and operational confinement, introduces the question of why a particular order may be effective for performance, while another organization is not. Indeed, such questions are generally pertinent to living systems. Braillard (2010) points out that they are distinguished from mechanist assertions that invoke causal sequences having functionally prescribed ends. The latter, instead, are concerned with the manner of achieving performance, which can be idiosyncratic and particularist. Such functionalist designs, in fact, are often regarded as modular, that is, they can be replaced with a different sequence that is mathematically described by its own suite of equations (Woodward, 2002). Questions related to why particular orders are effective are directed to the identification of principles on which a particular order must be grounded, which thereby govern performance and are termed design principles (Braillard, 2010). Therefore, they have general validity.

Questions that involve design principles, that is, why versus how questions, are critical to the explanation of cognitive performance in at least two ways. In the first they help to illuminate the factors needed in formal organizational arrangements that enable cognitive operation. Kelso (1995), in a prescient commentary, remarks that while nature's forms are abundant, its principles are few, and carefully preserved. Applied to cognition, this also means that design is neither arbitrary nor haphazard. Indeed, numerous studies now document the adoption of such design principles in the construction of complex biological systems. These studies are intended to show the existence of preferred operational arrangements that are widely adopted. For example, it has been shown that gene regulation networks in cells are constructed of a handful of recurring circuit elements, each of which can carry out specific dynamical functions autonomously (Alon, 2007). Moreover, at the level of interacting cells, that is, at a level corresponding to neural networks, Hart et al (2012) find that pleiotropic, intercellular signaling molecules are required to generate system like characteristics. Pleiotropic signaling confers on these circuits the ability to resonate through a performance space. As in the case of biological networks, only a small set is operationally successful. The design of the element is thus a critical dimension in the network's operation.

In a second way, questions attempting to address why certain orders are preferred point to a source extrinsic to the living system that nevertheless influences the adopted order, which is to say that the adopted configurations are not uniquely determined by the organism but rather are the result of extrinsic influences to which the organism is conformed. Indeed, the fact that only a small set of configurations is operationally successful necessitates the instantiation of such designs for viability. For example, in experiments that manipulated circuit topologies Hart et al discovered that only four out of a potential 280 topologies enabled resonance, that is, enabled a configuration that successfully sustained a stable level of differentiated cells. What these studies emphasize is the apparent universality of the deployment of successful designs. Design principles, accordingly, must be instantiated by living organisms because they constitute universally valid principles of operation on which the dynamic order of the living organism must be grounded for successful performance. They represent, therefore, extrinsic influences to which the organism is subject. By contrast efficient causal sequences originate within the organism, that is, they are intrinsic to the organism and subject to its determination. Such sequences are thus particularist and widely variable.

Design principles are exploited in cognitive performance as well, and have been widely studied. For example, a key concern has been the basis of robustness and stability in cognitive performance. Answers to why cognition is robust have been attributed to dynamical system behavior in far from equilibrium states that settles into activity profiles energetically resistant to deformation, that is, attractors (Friston, 2013). In analogy with gene networks, attractors constitute performance motifs, that is, elementary and dynamical operational units that are exploited in cognition for their stability. This stability requires that network constraints impose limitations on the patterns that can be adopted. Energetically, however, they are maintained at a metastable state (Friston, 2013), which also allows them to be combined in various patterns to generate distinct brain activities governing different behaviors.

The instantiation of attractor motifs in neural network operation constitutes an attractive design feature for brain activity since they confer consistency in operation, yet are linked to the system wide neural network activity of the brain. Friston points out, for example our exchanges with our environment are constrained to an exquisite degree by local and global brain dynamics and that these dynamics have been carefully crafted by evolution, neurodevelopment, and experience to optimize behavior. Indeed, the attractor profile is optimally balanced for the selection of an array of alternate activity pathways. This balance is attained through numerous bifurcation points that conjoin their activity to that of other attractors, constituting thereby a large globally dynamic system. It is, therefore, constitutionally designed so that nervous system behavior, though topologically closed, nevertheless achieves operational coordination and control; that is, the adopted design reflects the operational needs of the whole organism under varying environmental circumstances.

4 SUBSTANTIVIST COGNITION AND THE INSTANTIATION OF SELF CIRCUITRIES

Alon's work is revealing for demonstrating why some and not other organizational orders must be used by organisms and so affords explanations of dynamic entities, that is, it assists explanations of why instantiated orders cannot be 'arbitrarily' constructed by living and active organisms but can only be adopted. It serves also to illustrate why the organism's material composition must be molded to an organizational end for which the whole of the organism is designed. As evolutionary philosopher Cliff Hooker points out (2009), it is the activity of the whole of the organism that interacts with the environment and the whole organism that is shaped by evolutionary pressures. Because this design objective is holistically oriented organismal performance can only be explicated by accounts that are premised on substantivist ascriptions. Passively generated forms, for example and by contrast, such as complex physical phenomena, are understood to adopt dependent relationships on the physical parameters of their state space, which means that they are not independently organized as entities but constitute parts of larger wholes. A key to explicating extrinsic influences in accounts of cognitive ontology is thus organismal perseverance. In other words self initiated actions presuppose an extrinsic and supraphysical influence that dictates the adoption of a persistent, entity based organization.

Kant's view of living organisms as purposeful wholes shares this recognition that the organism is shaped in the context of extrinsic influences directed to a goal oriented whole. This conception has been recently appropriated by philosophers of biology Maturana and Varela (1979) and by Moreno and Mossio (2015) to explain the abilities needed by organisms to enable purposeful behavior, that is, properties needed for telic character. In appropriating Kant's view, these authors propose an explanation of living organisms that premises goal orientation on a capacity for autonomy. Specifically, Maturana and Varela's conception states that living organisms are capable, literally, of producing themselves, and that the end of their purposefulness therefore is their sustained existence, attained 'by producing and maintaining the parts that contribute to the system, as an integrated, operational, and topologically distinct whole.' Autonomy, thereby, constitutes a capacity required by the organism to continue to exist that can only be exercised as an entity. To demonstrate this capacity Maturana and Varela point to the recursive restructuring that is necessitated by dissipative structures in the face of ongoing demands imposed by thermodynamic constraints. In fact, organismal autonomy conciliates well with evolutionary models that presuppose the existence of autonomous entities that progressively optimize their abilities to survive in an adaptive space. Organisms unable to maintain autonomy, conversely, perished.

Implicit, but not discussed in these accounts, is a conception of autonomy as a state, that is an ongoing condition for which active maintenance is required. This implicit understanding means that organisms must actively engage in those activities that can ensure their own survival, therefore presupposing certain dispositions that Fong (1996) and Ulanowicz (1986) have identified with self governance and agency and that behavioral repertoire than enables the organism to extend control over itself and its environment. Or, in Cliff Hooker's words 'the interactive dimension through which an autonomous system monitors perturbations from the environment and then acts on the environment to promote its own maintenance' (Hooker, 2009). Nancy Cartwright offers a contemporary reading of dispositions that reflects its substance based and, hence, metaphysical origin (2002). In her reading such dispositions exhibit latency, meaning that they are not always on display, and, generally, conditionality, that is, they are evoked by appropriate circumstances.

Inferences about a cognitive instantiation of capacities thus draw from an ontic commitment to existents, which is to say that their instantiation is influenced by a metaphysical ground defined by entity ascriptions (Esfeld, 2004). Such ascriptions traditionally draw from Aristotelian and Thomistic thinking that defines entities categorically. Accordingly, entities in the classical understanding are individuated because they 1) are the subject of a predication of properties 2) possess qualitative properties distinguishing them from all other entities, and 3) occupy a unique spatio temporal location. A current explication of entities adopts a Humean supervenience based thesis in which said properties are local and supervene on a distribution of space time points or field sources (Esfeld, 2004). According to this explanation entity persistence is traced to an organizational order that is instantiated in said space time points, and which therefore constitutes the subject of the property predication and the object of an epistemological frame absent from empirical analyses. Dispositions and capacities, accordingly, serve as qualifications that are conjoined to existents as properties. They express, therefore, ontological features but do not constitute the existent's essence, which is necessarily substantially prior to said capacities, meaning that capacities require an existent, but not conversely. Cartwrights's dispositional characterization (2002) affords a useful manner of conceiving of this distinction; that is, while a disposition may or may not be expressed, essence is, necessarily, extensible, meaning that it is neither subject to termination nor multiple for propertied features.

Cognitive ontologies, therefore, are metaphysically constrained when instantiated, which thereby constitutes a design explanans. The consolidation of a neural architecture underlying the cognitive percept of the self, accordingly, exemplifies a metaphysical conformity of the whole to the unity transcendental, which is to say that neural self circuitries constitute the material expression of a metaphysical ordering. Contingent properties that emerge from the neural architecture, including those that define human nature, for example, reasoning, consciousness, agency, and identity, thus predicate from the self, which is ontologically generative, and have separate neural circuitries that are distinguishable from that of the self, though nevertheless conjoined to it (Bayne and Pacherie, 2007; Rolls, 2016; Damasio, 2014).

What is then also significant in these explanations is the manner of dependence of the biological order, such as its developmental and evolutionary progression, on such extrinsic influences. This means that such explanations need to invoke the presence of a relationship between the two dimensions that can influence, and is unidirectional toward, the material order. This is to say that explanatory accounts for cognitive order must be concerned with the nature of this relationship, both its origin and the manner by which constraints on the instantiated order are imposed.

Michael Morange (2005) offers one line of reasoning, arguing that the imposition of such constraints is due to physical laws that impose limitations on outcome. He points, for example to allometric scaling laws that establish physical dependencies between different properties of an organism such as metabolism and size. In the case of the nervous system Kaufman (1993) also shows that dynamical properties of complex networks depend on the mean connectivity. Above a certain value network behavior is chaotic, below it is frozen, but in the range of this value, attractors, ie., performance motifs, appear. Thermodynamics constitutes yet another physical parameter that constrains network system behavior, such as the infusion of energy to reverse entropic disorder. These considerations illustrate that physical dimensions are important in imposing formative order.

Yet Morange's physical explication cannot be the sole basis on which an operational order is determined. Yi et al's study of integral feed back, for instance, shows that only this type of organization can achieve resonance. While this is certainly a physical and causal effect mediated by one element on another, the effectiveness of this operation is not itself solely a consequence of the physical dimension. What is critical is the presence of feedback connections and an organized composition in which the elements are circularly arranged. These latter features are abstract, that is, they are non-physical characteristics that nevertheless have a bearing on performance. For this reason recurrency in neural network operation is at once both a physical and an immaterial feature.

Indeed, non-physical influences underlie large scale as well as small scale formal order. Organized topologies of organisms that may include, for example, the sort characterized by Alon must assimilate themselves into an overall organization that exhibits coordination, and direct themselves to an end for which the dynamic organization is constructed. Because the material order is subsumed to these immaterial features the latter can be regarded as constituting a supraphysical influence affecting their material instantiation. The act of instantiations thus means that the material dimension, in a formally causal sense, is subordinate to an influence that is universally pertinent, exteriorized, and supraphysical and that is determinative for the adopted topology (Gillett, 2016).

5 METAPHYSICAL IMPLICATIONS FOR NORMATIVE VALUATION

Significantly, because the instantiation of self circuitries occurs in an evolutionary and performative context, metaphysical constraints affecting their embedding shape self circuitries in the context of the integration of both brain and body, directing value contingencies to the human entity, and not merely to the neural processes evoking its perceptual realization, as in modern cognitive ontology accounts. What is of value, then, is the systemic organization of the human in his embodied context. From these considerations it is apparent that metaphysical conceptions are key to understanding normative concerns, that is, they are the key metaethical dimension needed for the evolution of ethical praxis.

The recognition of the significance of this dependence has been pointed out by Karol Wojtyla, whose ontologically based personalism draws, as he claimed (Wojtyla, 1991), from a philosophy of 'genuinely metaphysical range', where the person 'constitutes a privileged locus for the encounter with being, and hence with metaphysical inquiry.' In this encounter, Wojtyla's proposed linkage binds the personalist subject to his existential foundation via a transphenomenal experience of subjectivity, which serves to guarantee identity in existence and activity. Evoking its Thomistic origin, this metaphysical ascription anchors the phenomenal experience in a realist and metaphysical account that finds its material expression in the phenomenal dimension of subjectivity, but sites to the personalist subject both its existential perseverance and ontological characterization in a substance mediated relation (Clark, 1993). In Wojtyla's formula the normative value of the personalist subject thus emerges specifially from a metaphysical and immaterial mooring, constituting the essential metaethical dimension for neuroethical praxis.

How metaphysics grounds ethical praxis is therefore a critical dimension often ignored in debates about human nature, that are currently exacerbated by the advent of neuro and genetic technologies, for its impact on ethical praxis that arise from presuppositions implicitly invoked in arguments. The premising of cognitive ontologies on exclusively mechanistic and causal inferences, for example, reduces the anthropological conception of the individual to a functionalist ascription. Human nature, as a result, is conceived in terms of its propertied features alone (Levy, 2011). This has the normative consequence of severing the individual as a metaphysical entity from the performative and propertied dimensions of his acts. Such divisions dominate, for instance, in perceptual accounts of personhood and human nature such as John Locke's perceptual account of personal identity and its derivatives (Parfit, 1982). Indeed, this anthropological conception has been the source of impersonalistic normative models which extend ethical parity to entities beyond the individual, which have been used to legitimate bodily interventions through value parity with non-human objects (Levy, 2011; Sgreccio, 2011). Similar inferences have been made by neuroessentialists, who adopt a wholly reductive posture toward human nature (Reiner, 2011). Metaphysical explanations that reference a natural order composed of entities, by contrast, challenges a neuroethical praxis derived solely from perceptual accounts, by siting value holistically.

Materialist presuppositions invoked in debates, moreover, cloud normative outcomes by assigning value contingency exclusively to the material dimension of the individual. Such presuppositions structure debates in a context of their epistemic character. That is, knowledge of the physical world is used to inform its ontological dimension, a prevailing presupposition adopted in physicalism. Debates are reduced thereby to an empiricist understanding of anthropology where competing normative assumptions draw from similar metaphysical frames of reference. These presuppositions fail to account for a physical order that is immaterially informed and metaphysically conceived, a failure that is itself a basis for the ontological inversions that complicate the neuroethical proscriptions they are intended to invoke.

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