Kant and biological theory

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1. Introduction

In a recent paper, 'The extended evolutionary synthesis', Laland et. al. (2015, 1) call for a new 'conceptual framework' for the biological sciences. Their radical goal is to replace the Modern Synthesis (MS), which privileges population genetics as the fundamental cause in the evolutionary process, with a revised synthesis that includes constructive processes, ecological interactions, and systems dynamics in the evolution of organizational complexity. The accepted view of the MS as a unified theory reflects a historical achievement that occurred in the 1930s and 1940s, which drew the Darwinian principles of variation, inheritance, and natural selection together with Mendelian population genetics. Adopting the MS, the biologist views the evolutionary process as the alteration in gene frequency across a species' population (Dobzhansky 1937). Natural selection is seen as the most important evolutionary force responsible for alteration, for it determines the differential reproductive success of inheritable traits (Mayr 2004, Sober 2000). Yet Laland et. al. contend that by prioritizing the gene as the fundamental unit of study, the MS fragments the evolutionary process into discrete strata and overlooks research programs that consider biological causation at multiple levels, including evolutionary developmental biology (Evo-Devo), developmental plasticity, inclusive inheritance, and niche construction. In contrast to the MS, which privileges the singular and linear causation of genetic variation in a species' population, these research programs examine the multilevel and reciprocal causation at work in biological individuals.

The question raised by Laland et. al. is how research programs concerned with the causal dynamics of biological individuals ought to feature in our best understanding of biological theory. Take niche construction, which considers the process by which an organism alters its own (or another's) environment. For proponents of the EES – call them 'extenders'[1] – niche construction is a causal process whereby 'the metabolism, activities and choices of organisms modify or stabilize environmental states' (Laland et. al. 2015, 4). It thus affects the selective pressures that act upon them and other species (Müller 2017). For extenders, niche construction does not simply operate alongside natural selection but also assists to explain adaptation (genes are 'followers'). A biologist who adopts the EES would consider the inheritance of selected traits across a species' population to 'share responsibility' with developmental processes (Laland et. al. 2015, 8).

However, for those who reject the need for an EES – call them 'accretionists'[2] – the phenomena studied in niche construction can be accounted for within the scope of the MS. Accretionists argue that the MS must continue to progress by elaborating the theoretical structures that have been in place since the original synthesis (Sober 2000, Whitfield 2008, Wray et. al. 2014, Futuyma 2015, Charlesworth et. al. 2017). While this progress involves the integration of current research on organismal dynamics into the MS, accretionists remain committed to the theoretical claim that 'allele

[1] Extenders argue that the EES 'is not just an extension of the MS but a distinctively different framework for understanding evolution' (Laland et. al. 2015, 3).

[2] I borrow this term from Lewens (2019, 708), who describes accretionists as those who claim that new developments in biological research can be integrated into the theoretical structure of the MS in a process of 'progress by accretion.'

frequency change caused by natural selection is the only credible process underlying the evolution of adaptive organismal traits' (Charlesworth et. al. 2017, 10).[3] In the case of niche construction, the organism's capacity to choose and carve out a niche can be viewed as a fitness differential in a species' population. This is what Alan Grafen (1991, 6) terms the *phenotypic gambit*: 'to examine the evolutionary basis of a character as if the very simplest genetic system controlled it.'

In this chapter I examine the two synthesizing arguments (extension and accretion) by turning to a historical source that has recently captured the attention of philosophers on both sides of the debate: Immanuel Kant's *Critique of the Power of Judgment*. Scholars sympathetic to the original MS appeal to Kant's account of teleological judgment to identify a tradition of thinking about function in biological systems that explains the purposiveness of singular organisms in terms of human judgment rather than a natural causal structure (Kreines 2005, Ginsborg 2006, Quarfood 2006, Breitenbach 2009). Those dissatisfied with the MS have long found in Kant's account of the natural purpose an important precursor to research practices that focus on the activity of the singular organism, which is characterized by a self-constituting structure of organization (Varela 1979, Maturana and Varela 1980, Weber and Varela 2002, Thompson 2007, Mossio et. al. 2009, Moreno and Mossio 2015). The shared interest in Kant, I suggest, indicates a general turn in biological theory toward a second-order level of reflection that acknowledges the role of theory construction in determining the explananda of evolutionary biology. My proposal is that Kant – or at least the recent interest in Kant – offers a point of convergence from which we can evaluate the scope and force of synthesizing arguments.

[3] As Walsh (2006, 788) characterizes the position, accretionists hold that 'there is no need to extend to organisms – much less their purposiveness – an explanatory role if sub-organismal causal mechanisms are explanatorily adequate.'

I argue that both accretionists and extenders pick out a key component of Kant's account of teleological judgment, which, according to Kant, must be held together. Those who accept the theoretical stability of the MS take up Kant's reflective account of teleological judgment, and yet sideline the transcendental character of his critical method. Those who attribute to developmental processes a causal role in evolution highlight Kant's analysis of the whole-to-part structure of organic form, and yet overlook the reflective status of his analysis. By emphasizing one part of Kant's account of teleological judgment at the expense of the other, both sides miss the practical nature of his critique. Kant does not simply identify the conditions that render it necessary to judge some products of nature teleologically. He also demonstrates the need for second-order inquiry from which to define various domains of inquiry based on the explanatory demands encountered in empirical nature. The shared turn to Kant, I argue, suggests that synthesizing arguments can be evaluated in light of their capacity to accommodate ongoing negotiation between the plurality of research aims in practice. I conclude that a deflationary version of the extension argument is best suited to the task.

2. Kant's descriptive metaphysics

Before turning to the features of Kant's critique of teleological judgment that have recently gained attention in biological theory, I want to begin by highlighting the distinctive features of his transcendental conception of nature. My aim is not to provide an exhaustive account, but to provide a sketch that will assist us to see the distance between Kant's theory construction and the positivist conceptual framework that inspired the architects of the MS. As Vassiliki Smocovitis (1996) demonstrates in her important study of the unification of biology, the MS was initially forged under a belief in the unity of science as laid down by the logical positivists of the Vienna Circle in the

1920s and 1930s. Under the guidance of Ernst Mach's demand that unification must take place via the destruction of metaphysics, the architects of the MS attempted to express the unique explanatory demands of biology while simultaneously showing that biological phenomena are dependent on and reducible to physicalist terms.

Herein lies a first notable difference between Kant and the architects of the MS. While Kant maintains the unity of science as a regulative ideal for our theory construction, the level on which this unity plays out is not itself theoretical. As Peter Strawson contended in the 1950s, Kant's critical method differs from positivism to the extent that it defends a *descriptive* kind of metaphysics. In contrast to traditional metaphysics, which assumes that the world has a given structure, descriptive metaphysics aims to 'describe the structure of our thought about the world' (Strawson 1959, 9). For Kant, the nature of a thing is not revealed in bare experience or conceptual analysis, but by an account of its representation. Rejecting the attempt to provide a first-order theory of nature as the total domain of what there is, he begins on the second-order level from which we can reflect on thought's relation to objects as such.[4] From the second-order level, experience does not disclose the properties and structure of nature understood as a pre-constituted domain, but the representation of finite beings whose knowledge is epistemically conditioned.

The first task of philosophy, then, is to discern the conditions that enable our representation of an object in its most general and abstract form, which Kant terms '*nature in general*' (B165). Following Robert Butts (1986), call this Nature [N]. For Kant, to be an object of our representation is to feature 'as lawful appearances in space and time' (B165). In its most abstract form, a law for Kant is a necessary judgment generated by a lawgiver of some kind (Watkins 2019, 2). The sciences concerned with

[4] For an extended account of the levels in Kant's theory construction, see Cooper (2018, 3111–3116).

formalizing the laws of Nature [N], and demonstrating how they necessarily apply to material nature, are the 'pure' sciences (mathematics and physics). Their laws are not legislated by anything external to thought, such as a divine lawgiver or the empirical objects themselves, but by the synthetic application of the understanding's form to perceptions as they appear for our intuition (*MF* 4:469).

While Nature [N] requires that to be an object of our representation is to adhere to the laws of the understanding, the arrangement of objects is contingent according to those laws. The totality of appearances that stand under Nature [N] constitutes the manifold of material nature, which Kant terms 'the sum total of all appearances' (B164; *P* 4:295). Call this nature [n]. The problem with nature [n] is that one cannot, according to the laws of Nature [N], expect to find a systematic arrangement of the laws that govern those appearances. Yet if there are to be *sciences* of empirical nature (chemistry, geology, biology, etc.), we *must* do so. To seek laws that govern particular material objects and processes, the natural scientist must assume that those laws cohere within a system, such that every particular law ultimately falls under one of the higher laws of Nature [N] (*MF* 4:470–71). For instance, when a geologist examines the layers of rock exposed on a mountainside, and compares these layers with other such layers, she does not simply represent them adjacent to one another in time. She also seeks particular rules to explain their arrangement (for instance, rules that explain their causal history), without which the arrangement of the layers would remain contingent. Reflecting on the geologist's research practice, the critical philosopher asks, what is the condition of the geologist's presupposition *that* such rules can be found? It cannot be anything captured by Nature [N], which gives rise only to nature [n].[5]

[5] For an organic example, see Kant's example of an eye in *CPJ* 20:240. As Friedman (1991, 89) explains, the natural scientist *seeks* to 'arrange more specific empirical concepts and laws into a classificatory and hierarchical system.'

Because nothing contained in the representation of the layers of rock contains the idea of a systematic arrangement of laws, the critical philosopher concludes that the geologist's search for a rule – her presupposition that nature is arranged as a system of empirical laws – is grounded in a 'principle of purposiveness', that is, a principle of the 'lawfulness of the contingent' (*CPJ* 5:217). This principle is not applied to nature itself, and nor is it discovered in the course of experience. It is applied to judgment for the reflection on nature, enabling the natural scientist to examine how the various parts hold together as they do in a machine, where every part has a functional relation to the whole. Call this the examination of nature [a] – nature as *art* – for it is enabled by a conception of nature as 'the object of a concept, insofar as the concept is seen as the cause of the object' (*CPJ* 5:222). Kant is clear that the principle of purposiveness does not 'ground any theory', and nor does it 'contain cognition of objects and their conditions' (*CPJ* 20:205). It simply 'gives a principle for progress in accordance with laws of experience, whereby the investigation of nature becomes possible.' This is to say that the systematic order of empirical nature is not given with the representation of an object as law-governed. Nature [N] makes it the case that every object of possible experience has a cause, and nature [n] is the aggregate of all appearances (*CPJ* 20:234–5). It is only by reflecting on nature as a product of a concept – as an ordered system of laws, just like that for which the understanding seeks – that it becomes intelligible to us (*CPJ* 20:213). The regularities we discover cannot be laws in Kant's strict sense of the term (they are not necessary judgments generated by a lawgiver). They are rather empirical rules we *take* to be laws given the role they play in our systematic modelling of nature [n].[6]

[6] Space does not permit a longer examination of the epistemic and modal status of so-called 'empirical laws' in Kant's philosophy of science. For an overview of the issues at stake, see Messina (2017).

Nature [a] renders particular appearances intelligible according to a law insofar as they are structurally analogous to products of art. Products of art are constituted by a linear causal relation whereby the parts determine the whole. Thus natural science for Kant is premised on a concept of nature as mechanism (nature [a]), in which emergent levels of complexity can be reduced to the interaction of their component parts. It is vital to maintain, however, that nature [a] is merely a regulative principle that governs our reflection on the manifold of appearances. Kant is well aware that there are some products of nature that express a lawfulness that is underdetermined by nature [a]. For instance, some products are judged as products of nature *and* producers of themselves; what Kant terms a 'natural purpose [*Naturzweck*]' (*CPJ* §65). The challenge of grasping Kant's argument here is to discern how the representation of a natural purpose can be dependent on experience without making any determinate claims about the object of that experience. A natural purpose is not an empirical concept, like the concept *tree*, *mammal*, or *living being*, which can be abstracted from experience and then applied to objects by determining judgment. The concept of a thing as a natural purpose is rather 'an empirically conditioned concept, i.e., one that is possible only under conditions given in experience' (*CPJ* 5:396).

The notion of an empirically conditioned concept requires some unpacking. Kant acknowledges that we could consider anything in nature as purposive if we think of it as the means to a purpose that is external to it. Yet the concept of a *natural* purpose is legitimately applied only if two criteria are met in experience. Call these the *design criterion* and the *self-organization criterion*.[7] An item fulfils the design criterion if 'its parts (as far as their existence and their form is concerned) are possible only through

[7] Clark Zumbach (1984, 4) describes the two criteria as 'design-like' and 'designer-like'. In the case of a watch we judge it to be design-like but not designer-like. In the case of the bird, however, we examine it through both analogies.

their relation to the whole' (*CPJ* 5:373). This criterion is met in both artefacts and organized beings: each part of a machine is there only on account of the whole for which it serves a functional role. For an item to qualify as a natural purpose it must meet a further criterion: its parts must be 'combined into a whole by being reciprocally the cause and effect of their form' (*CPJ* 5:373). The self-organization criterion separates artefacts from organized beings, for the former are produced by an external cause while the latter cause themselves. This is clear in Kant's example of a watch: 'one part is the instrument for the motion of another, but one wheel is not the efficient cause for the production of the other' (*CPJ* 5:374). A watch meets the design criterion, for one part exists 'for the sake of the other'. Yet it does not meet the self-organization criterion, for the parts do not exist 'because of it [i.e. the whole]'. This is to say that a watch, unlike a natural purpose, 'cannot by itself replace its parts', 'make good defects in its original construction', or 'repair itself when it has fallen into disorder'. It manifests merely descending causality, for the purpose is the result of an exterior, efficient cause (the designer). Natural purposes, on the other hand, have 'descending as well as ascending dependency', which is to say that they deserve 'the name of a cause of the same thing of which it is an effect' (*CPJ* 5:372).

The representation of a thing as capable of maintaining its parts in a state of equilibrium is contingent according to the empirical laws of nature [a], for art entails that the parts cause the whole. The capacity for growth, self-maintenance, and reproduction can only be understood as lawful if one can conceive of a process whereby the whole causes the parts (*CPJ* 5:365). Yet Kant maintains that the only whole-to-part causality we know is rational causation, either the ordering of a system of knowledge (the representation of the whole determines the location of the parts) or the realization of an idea through practical judgment (the representation of an idea determines the action). Thus our capacity to represent the arrangement of the parts of an organized being as an effect of the whole must be made possible by an analogy, whereby we transpose the form of purposiveness according to ends into a form of judgment that guides our reflection *on* an empirically given object (*CPJ* 5:352–3). The analogy does not exactly fit, for nothing given in experience can truly adhere to the form of practical reason, in which an action is the conclusion of a syllogism (*CPJ* 5:374). Nevertheless, it enables us to seek causes that would otherwise have remained impervious to us. The key here, as Angela Breitenbach (2009) notes, is that the concept of a natural purpose precedes and enables scientific investigation of organic structure, just as nature [a] precedes and enables natural science in general; neither the concept of a natural purpose nor the concept of nature as mechanism is discovered by natural science.

By defining the 'empirically conditioned' concept of a natural purpose according to two criteria (design and self-organisation), Kant maintains an analogy *and* a disanalogy between rational and organic creativity. Taken together, the two criteria generate what Hannah Ginsborg (2014) describes as the 'problem of coherence': we cannot understand the possibility of organized beings unless we evoke the notion of design, yet we lose the distinctive character of natural purposes when we do. This problem does not occur on the theoretical level, from which one might analyse what an organism is according to its concept. It occurs on the level of practice; it concerns two principles that govern research. The key to Kant's account of nature is that it describes the conditions that make a domain of inquiry possible. The domain in which the natural scientist investigates the developmental processes of living structure arises because certain objects in nature are such that we can render them intelligible only by introducing a principle derived through an analogy with our own causality as rational agents. Natural purposes tell us nothing about nature [n] or Nature [N], and thus do not warrant an empirical claim that there is either design of self-organization in an item's etiology. And yet our representation of some items as naturally purposive allows us to seek empirical laws that govern their structure.

3. Accretionists, extenders, and Kant

With this sketch of Kant's critical philosophy in hand, we are now in a position to discern which of its features have resurfaced in recent debates concerning the theoretical unity of biology. Let us begin with the synthesizing argument put forward by accretionists. Recognizing that processes occurring in the singular organism raise a challenge to the original synthesis of modern biology, several scholars have claimed that the MS meets Kant's design criterion to the extent that it provides an account of how the biologist examines certain things *as if* they were purposive (Lewens 2004, Kreines 2005, Ginsborg 2006, Breitenbach 2009, Huneman 2017). Consider Kant's well-known example of the shape of a bird's wings (*CPJ* 5:360). According to nature [a], the arrangement of the parts of a bird are contingent, and thus do not call for an examination according to laws. The task of understanding a thing as a natural purpose, however, is to seek the rules that govern its parts as members of the whole. For instance, to inquire into how the parts of a bird are adapted to specific environmental conditions we must 'conceive of nature as *technical* through its own capacity' (*CPJ* 5:360). Natural purposiveness is thus the idea that some things we encounter, while contingent according to nature [a], have a lawfulness of their own. Once we reflect on the structure of the wings as purposive, we can pick out and examine the particular features that realize this purpose ('the structure of a bird, the hollowness of its bones, the placement of its wings for movement and of its tail for steering, etc.,'). Likewise, the MS entails that evolution by natural selection can occur when a set of entities feature variable heritable properties. While the variations of these properties are blind to their possible functionality, the principle of natural selection enables us to attribute to such variations a fitness value.

On this reading, Kant's descriptive metaphysics can explain how the biologist is able to maintain (a) the theoretical assumption that functional parts can be exhaustively explained by liner causes acting on population genetics, and (b) a regulative account of purposiveness on the level of the organism. On the *theoretical* level – the vantage we adopt when interpreting data in biological theory – changes in organic form can be explained according to changes in the frequency of genes across a species' population. On the *practical* level – the standpoint of the researcher – the examination of traits in a biological individual is teleological. Kant therefore assists us to solve the Machian dilemma of accommodating biology's unique explanatory demands without violating the causal closure of the physical, for it explains why the teleological level (reflection on acquired traits *as* selected) is practically necessary (without it, the science of evolutionary change would not be possible) and yet theoretically contingent (function ascriptions can be reduced to population dynamics).

Scholars who account for the apparent tension between population dynamics and the activity of the singular organism with the aid of Kant's account of teleological judgment tend to focus on the similarities between Kant's view and what Daniel Dennett (1995, 1998) describes as the 'intentional stance', a non-scientific view of nature in search of reasons. Adopting the intentional stance, Dennett (1995, 213) explains, 'we try to figure out what reason, if any, "Mother Nature" – the process of evolution by natural selection itself – "discerned" or "discriminated" for doing things one way rather than another'. The intentional stance opens a method of 'reverse engineering', the attempt to infer selection pressures from observed organismic solutions. Reverse engineering is a method in behavioural ecology that examines functional adaptations as technical solutions to adaptive problems on the assumption that natural selection is a designing force. This view assumes that parts should be studied as solutions to problems raised by environments where the organism is found. The reverse engineer does not attempt to show that organisms *are* engineered machines, but rather follows a regulative principle to examine their properties *as* parts of a machine. This method is based on the idea that we cannot account for organisms *as organisms* unless we assume that they are systems designed to cope with environmental demands while remaining fully aware that we cannot empirically prove that they were designed. Reverse engineering thus affirms Kant's insistence that the design criterion regulates inquiry but does not posit design in an item's etiology (see *CPJ* 5:361).

Extenders, by contrast, seek to integrate constructive processes, ecological interactions, and systems dynamics into evolutionary theory. A research program concerned with such processes upholds Kant's second criterion for a natural purpose. One says 'far too little about nature and its capacity in organized products if one calls this an analogue of art', Kant states, 'for in that case one conceives of the artist (a rational being) outside of it' (*CPJ* 5:374). By rejecting the capacity of the artefact analogy to capture organized products, Kant is closer to Aristotle than he is to the architects of the MS. A natural purpose is moved by an idea intrinsic to itself, manifest in the circular and interdependent causal structure between whole and parts. In contrast to a product of art, a natural purpose is something that 'is cause and effect of itself'. In such a circular causal structure, 'each part is conceived as if it exists only *through* all the others, thus as if existing *for the sake of the others* and *on account of* the whole' (*CPJ* 5:373).

Extenders tend to locate their position in continuity with Kant on the grounds that he provides a theoretical structure for the study of developmental processes. As Gerd Müller (2017, 4) explains, a research practice focused on multilinear and reciprocal causation ‘starts from the premise that the genotype-phenotype relation is not merely a statistical correlation, but that the rules of developmental processes govern phenotypic outcomes while relying on additional inputs not coming from the genome.’ Stuart Kauffman (2013, 5) describes the unit of development as a ‘Kantian whole’ to designate complex structures made up of parts that bear real functions, that is, causal roles that intend to sustain the existence of the whole. Kauffman views Kant as a precursor to Evo-Devo, for the idea of a natural purpose identifies a biological unit that is causally prior to the dynamics of natural selection. Matteo Mossio and Leonardo Bich (2017, 1099) build on Kant to argue that ‘teleology is grounded in a *specific* kind of circular regime’ they term ‘self-determination’. Self-determination, they suggest, consists of ‘a network of mutually dependent components, each of them exerting a causal influence on the condition of existence of the others, so that the whole network is collectively able to self-maintain.’ On this reading, Kant shows us that biological processes are possible only on the condition of the existence of organisms, that is, complex systems characterized by individuation, agency, and self-regulation. If Kant is right, then organisms play an irreducible causal role in the evolutionary process, for they ‘counter and remove potentially deleterious variations, while preserving useful variations’ (Mossio, Montévil and Longo 2016, 26).

Philippe Huneman (2017, 284) claims that the MS and Evo-Devo each fulfil one of Kant’s two criteria that must be satisfied if a thing is to be judged as a natural purpose. The MS fulfils the design criterion, he explains, for it ‘explains the design of such a whole by appealing to a designing trend that is realized by natural selection, which maximizes inclusive fitness.’ Evo-Devo fulfils the self-organization criterion, for ‘epigenetic self-production of parts by parts is here understood under the presupposition of a viable whole.’ Huneman concludes that ‘an organism in the Kantian sense is the *locus* of a synthesis between Modern Synthesis and developmental biology.’ This is to say that Kant’s account of the natural purpose is able ‘to support two explanatory projects – one about functions or adaptions, the other about development’ (Huneman 2017, 378). If Kant is right that privileging one standpoint over the other leads to a reductive program that overlooks a necessary feature of organic structure, then the synthesis question can be cut along Kantian lines. For Huneman (2017, 384), the open question is how to understand ‘the relation between the two Kantian criteria in current biology.’

Huneman is certainly right that Kant’s two criteria uphold multiple projects of research. However, this ‘open question’ is more demanding than he acknowledges, for Kant’s descriptive metaphysics operates on an entirely different level to that on which the synthesis debate is staged. The question might be rephrased as follows. Can we synthesize the two criteria that must be met for a thing to be judged as naturally purposive *on the level of biological theory*, that is, *without Kant’s transcendental framework*? Recall that Kant’s account of natural purposes does not describe anything in nature (understood as nature [n]). It describes something in *us*, i.e. why it is subjectively necessary to hold both criteria together, despite the fact that they do not cohere on the theoretical level. This is to say that Kant’s theory of natural science is not about nature understood as a totality of objects external to thought but about how nature is possible *for* thought. Teleological judgment does not provide causal explanations; it explains how we come to examine natural products either as mechanically ordered (nature [a]) or as governed by an inner principle of organization (natural purposes). Kant insists that teleological judgment ‘provides no information at all about the origination and the inner possibility of [organic] forms', but rather guides us to seek laws that govern structures that are *already* organized (*CPJ* 5:417). If we were to extrapolate from either the design criterion or the self-organizing criterion to the entire causal story, we would end up with either an exhaustively mechanical system, which would deny the causal role of development in the evolutionary process, or hylozoism, which violates the *a priori* laws of Nature [N]. The attempt to develop an 'original principle of organization' for Kant is 'inscrutable', lying beyond the reach of finite human cognition (*CPJ* 5:423). Recognizing the distance between Kant's account of a natural purpose and the explanatory goals of evolutionary biology, what could Kant possibly contribute to the present theoretical juncture?

4. Synthesis in practice

While Kant's two criteria invalidate the attempt to synthesize adaptation and developmental processes on the theoretical level, it nevertheless opens a possible synthesis on the level of practice. Here it is vital to note the different conceptions of nature assumed by accretionists and extenders. Accretionists share a structural feature with Kant's epistemology, for they conceive of the notion of design through an analogy with intentional agents. This is to say that purposiveness in nature is symptomatic of the way that *we* understand the natural world; it does not explain the presence of a trait but allows us to examine the role it plays within an existing system. In contrast, extenders claim that self-organization is a causal relation. Extending arguments claim to uphold the 'distributed causality' (Oyama 2001) of genetic and non-genetic factors by recognizing multiple factors that contribute to the evolutionary process. In this sense extenders envision a radically different kind of synthesis to that proposed by accretionists. Their argument does not presuppose a fundamental causal level that can be separated from higher levels of complexity without remainder, but accepts a plurality of causal factors studied by biologists, which operate at multiple levels in the evolutionary process.

One danger of overlooking the tension between the design and self-organization criteria is that we overdetermine the use of analogy in research practice. In the case of artefacts, we can discern the function of a trait in terms of a finite series of rational decisions selected by a designer. For instance, on Dennett's account of the design stance we can equally consider organic traits as solutions to engineering problems posed by ecologies.[8] Yet the reverse engineer faces the same problem as Kant: she cannot tell us why we should expect the intentional stance, which is enabled by a subjective principle, to tell us anything about *nature*. As Paul Griffiths (1996) notes, when we try to infer selection pressures from observed organismic solutions, we underdetermine the adaptive problems that are meant to be solved precisely because of the disanalogy between design and the evolutionary process. Reverse engineers are forced to make what Griffiths (1996, 515) calls 'functional generalisations', which state that any organism, faced with the same adaptive problem, will adopt a given solution. Griffiths contends that functional generalizations are unreliable, for the external environment is so fine-grained and the idiosyncrasies of the systematic features of the organism so specific that the solutions available to a lineage are utterly singular in character. The problem here is that the MS does not offer a naturalized account of what designing requires over and above mere causing; the design analogy does all the work. Without such a distinction, *every* effect of a process could be considered as a designed effect, such that Uluru could be seen to solve the problem of making just such a rock (Fodor 1996). Kant's account avoids this problem, for it does not connect design with causal

[8] Consider Dennett's (1995, 462) phrasing: 'Mother Nature (natural selection) can be viewed as having intentions, *in the limited sense of having retrospectively endorsed features for one reason or another*.'

history; design simply provides a form of representation by which we can make certain things and processes salient to us.

By prioritizing the design criterion, accretionists bracket out any possible role played by inner constitution in selection. Richard Dawkins (1978) for instance argues that the singular organism is merely an evolutionarily insignificant 'vehicle' for bearing genetic information when viewed from the scientific stance. This possibility remains open for extenders, who maintain the disanalogy between artefacts and organized beings captured by Kant's self-organization criterion (while an artefact is an item that suggests rationally determined organization, a natural purpose must also be considered as 'both cause and effect of itself'). Richard Lewontin (2001) examines the similarities between developmental processes in the populations of different species in order to discern how developmental, organizational, and other 'internal' factors actively contribute to selection. Susan Oyama (2001, 186) describes the relational interactions within an organic unit as 'a collection of interdependencies', resulting in what Griffiths and Gray (1994) describe as 'explanatory parity' across genetic and non-genetic factors. The theoretical frame of the MS blinkers the biologist from considering the causal role of non-genetic factors in controlling gene frequency, which can only be seen by observing developmental processes through large data sets and computational models of dynamic systems (Rosen 1972, Kitano 2002).

The disanalogy between artefacts and organisms suggests that we cannot account for the appearance of intentionality in nature through an exclusive reference to design, for design presupposes intentionality (Fodor 1996, 252). Neither Dennett nor Kant provides a reason for why we should expect a connection between the intension of natural selection (i.e. its teleological character) and the intention of design. In fact, Dennett removes the possibility of such a reason being given, for he posits a fundamental level of causality on which the higher level of reason giving and receiving supervenes. Thus conceived, the only purposiveness the MS can permit features within the auspices of rational agency. Similarly, by restricting whole-to-part causation to human thought and action, Kant denies that it can be directly extended to organisms and thus restricts teleology to reflecting judgment. As John Zammito (2009, 236) notes, Kant's analogy between purposiveness and rational agency denies the possibility of explaining the original emergence of organization from unorganized matter; *that* some natural products are self-organizing must be assumed.

Zammito draws our attention to the dilemma Kant faced in the 1780s. By acknowledging the emerging research practices concerned with the organizational structure of living beings, Kant was forced either to extend his notion of purposiveness to nature itself, and thus render the entire system contingent on natural processes, or to curb it to a mere subjective necessity. The first move would shift toward a naturalist epistemology in which the human mind features as a part of nature. The second would retain the *a priori* status of pure natural science while severely limiting the prospects of empirical science in general and the science of living beings in particular. Kant goes for the latter. Biologists adopting a developmentalist framework, in contrast, 'discern such features empirically' (Zammito 2009, 241). If such features were not empirical, how could the problem raised by things for which it is necessary to reflect on through analogies with reason have arisen in the first place? Despite their constant reference to Kant's criterion of self-organization, extenders call for a *naturalistic* account of organization. For example, Mossio and Bich (2017) examine intrinsic purposiveness as an empirically real form of self-constitution, for they consider organizational closure and differentiation as a causal relation that is instantiated in nature. Their developmental account of the evolutionary process, while building on Kant, transgresses the reflective restriction placed on teleological judgment.

The issue here is that Kant's two criteria were not developed through the elaboration of biological theory but through a critique of scientific practice. Indeed, Kant does not offer a theory of biology or a science of the living being. Instead, he offers an account of how the investigation of certain items in nature as organized is possible without rendering the initial starting point of our theory construction impossible (i.e., the human standpoint). The life sciences were developing rapidly in the late-eighteenth century without a unified theory, and Kant aimed to synthesize two opposing research projects: physicotheology, which restricted the examination of living beings to a mechanical, external kind of purposiveness, and vitalism, which posited animate powers in matter responsible for organization. Kant saw that the physicotheologians, who shift the origin of design to a cause outside of nature, rightly examine living beings in terms of the function of their parts. However, by construing this analysis as explanatory, they denied that the conditions of Nature [N] hold in every case, removing the imperative to seek the origins of organic structure *within* nature [n]. Kant also saw that the vitalists rightly examine living beings according to their structure, but once more violate the conditions of Nature [N] by attributing organizational forces to matter. Kant's charge is that both sides mistake a methodological problem for a problem of theory. He thus transformed the theoretical assumptions of both research projects into methodological criteria that are subjectively necessary for the examination of some natural things, capturing both their functional and structural elements, neither of which capture the things we judge as naturally purposive in their entirety. Kant insists that we can only investigate natural purposes in their functional and structural dimensions without contradiction if we accept that neither project offers an exhaustive theory of biological phenomena.

5. Synthesizing from the human standpoint

Kant's notion of a standpoint can assist us to examine the strength of synthesizing arguments, yet it requires that we take seriously certain elements of his critical project that are at odds with the positivism on which the MS was forged. A standpoint for Kant is a practical vantage from which we can refer to objects in a given domain while recognizing the situated nature of one's position. This is famously conveyed by Kant's idea of 'the human standpoint' (*CPR* A26/B42), from which we acknowledge the epistemic conditions of experience and then seek to describe those conditions via a critique of our representation of natural objects (Nature [N]). From the human standpoint we can discern the various domains of inquiry, including nature [n] (the totality of appearances), nature [a] (material objects as natural products), and natural purposes (things bounded by a whole-to-part causal structure). By starting from the human standpoint, the idea of a global domain – nature understood as a pre-constituted object that is independent of thought – is ruled out from the start. Instead, we ask *how* a given domain discloses nature. We cannot adjudicate the success of any one domain from the vantage of a global domain, for such would require a departure from the human standpoint. Theory construction for Kant is a modelling activity conducted by finite human knowers, whose knowledge is epistemically conditioned.

This entails that a research project undertaken from a particular standpoint (genetic drift, Evo-Devo, niche construction, etc.) cannot be assessed from the outside. As a well-worn but easily-overlooked slogan: there is no view from nowhere. Since the advent of quantitative evolutionary theory, proponents of the MS have insisted that all models of evolution must ultimately be based at the level of genotypes and their dynamics.[9] Inheritance is thus genetically based, and development is the translation of those genes into phenotypes. The upshot of this view is that adaptive change is the result of natural selection acting on these expressed phenotypes (Buskell 2020). In contrast, extenders argue that because phenotypic outcomes are underdetermined by genotypes, and because of the plasticity of the organism's development in response to its environment, genes do not control the adaptive process, and neither can they be separated from the complex range of causal factors at work in evolution. From the human standpoint, a claim about the priority of a particular domain cannot be judged as either true or false (apart from the general claim that to be a natural object is to appear within the conditions of Nature [N]), for there are no conditions of reference outside a given framework. On the level of theory, we reflect on how the various domains disclose discrete regions of experience, we seek contradictions within a particular domain, we compare results with other domains, and we generate new lines of inquiry. The unity of domains for Kant is not itself a theoretical principle but an assumption that makes our theory construction possible. A synthesizing argument, then, would fail if it proposed a theory of evolution as *merely* a linear causal process. A synthesizing argument can only succeed if it offers a framework for linking together various domains of inquiry, provides practical guidance, and holds together a range of causal factors.

While a synthesizing argument made from the human standpoint falls on the side of the extenders, it is deflationary in comparison to the radical EES advanced by Laland et al. (2015) and Müller (2017). A deflationary EES would allow the biologist to accept the explanatory power of the MS, when it comes to examining the role of genetic change in natural selection, and yet also to take accommodate organic

[9] For a paradigmatic example, see Sober (2000, 121-122). C.f. Smocovitis (1996), Dieckmann & Doebeli (2005).

development when investigating the role of developmental features in selection. As Tim Lewens' (2019) explains, a deflationary EES would refrain from squabbling over whether a process picked out by a given research practice is fundamental to the evolutionary process and instead ask *whether it is important*. Various domains of inquiry thus 'allow us to shed light on phenomena that would otherwise go unseen, or remain unexplained' (Lewens 2019, 715). For the deflationist extender, shared causal responsibility does not result in a theoretical synthesis that extends the conceptual framework of the MS. The result is a methodological synthesis of the various domains of inquiry and a guide for new research questions concerning the role of structure in the selective process.

Once we acknowledge that the processes deemed to be causally salient are conditioned by a domain of inquiry, we begin to clear the ground for a synthesis that reflects the multilevel and reciprocal causal processes studied in current biological practice. Charles Darwin was interested in how form changes, not in ontogenetic origins (Amundson 2005, 104). Natural selection operates on items for which the ontogenetic origins are unknown, meaning that everything from emotions to instinct can be studied despite having no idea how they arise by ontogeny in the individual. This is to say that Darwin begins by *assuming* the existence of an ancestral population. Building within the scope of his inquiry, the MS does not attempt to explain the form of an evolutionary entity but the change in the entity through evolutionary time. Thus extenders (unsurprisingly) argue that the MS 'lacks a theory of organization that can account for the characteristic features of phenotypic evolution, such as novelty, modularity, homology, homoplasy or the origin of lineage-defining body plans' (Müller 2017, 4). Indeed, it does not recognize the provision of such as a requisite part of biological theory. As Laland et. al. (2011, 1516) argue, the MS 'encourages focus on single cause-effect relations within systems rather than on broader trends, feedback cycles, or the tracing of causal influences throughout systems.' Recognizing a plurality of research practices would not entail that the MS is false, as if there were a read-made meta-structure in nature to which a theory of biology is supposed to cohere. It would simply entail that the MS fails to capture several important processes in evolution. A conceptual framework must be epistemically modest and have a practical orientation, for explananda are context-specific; they feature within a particular domain of inquiry governed by its own conditions of sense.

6. Conclusion

My aim in this chapter was to draw attention to a return to Kant's account of teleological judgment made by scholars on both sides of the extension debate, and thus to locate common ground from which their synthesizing arguments might be assessed. I argued that this common ground lies in a shift in biological theory toward a second-order level of reflection that acknowledges the role of theory in constraining the explananda of evolution, manifest in the shared interest in Kant's critique of teleological judgment. Kant demonstrates that when we privilege the design criterion over the self-organization criterion, something is overlooked in the investigation of living beings. His account of a natural purpose, which holds the two criteria in tension, accommodates the plurality of research practices required to capture functional parts and organizational structure. Müller (2017, 9) is thus right to argue 'that a different theory structure is necessary to accommodate the new concepts that are in everyday use and have become part of the current toolkit of evolutionary biology.' Appeals to Kant from across the board suggest that this theory structure must adopt a standpoint that accepts different explananda while maintaining the methodological unity of biology.

Adopting this standpoint restricts the synthesis debate from descending into a squabble over explanatory priority. To properly examine synthesizing arguments, we require a theoretical level that does not already stack the chips in favour of the MS but takes seriously the plurality of research practices in contemporary biology.

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