Physical Necessitism

Hasen Khudairi

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Abstract

This paper aims to provide two abductive considerations adducing in favor of the thesis of Necessitism in modal ontology. I demonstrate how instances of the Barcan formula can be witnessed, when the modal operators are interpreted 'naturally' – i.e., as including geometric possibilities – and the quantifiers in the formula range over a domain of natural, or concrete, entities and their contingently non-concrete analogues. I argue that, because there are considerations within physics and metaphysical inquiry which corroborate modal relationalist claims concerning the possible geometric structures of spacetime, and dispositional properties are actual possible entities, the condition of being grounded in the concrete is consistent with the Barcan formula; and thus – in the geometric setting – merits adoption by the Necessitist.

1 Introduction

This essay aims to provide two abductive considerations adducing in favor of the thesis of 'Necessitism' in modal ontology. The Necessitist hypothesis is induced by the augmentation of an intended model structure with the Barcan formula, '$\Diamond\exists xFx \rightarrow \exists x\Diamond Fx$', from which the principle of the 'Necessary Necessity of Being' (NNE) can be derived; i.e., '$\Box\forall x\Box\exists y(x = y)$'. The Barcan formula states that – on an unrestricted interpretation of the domain of quantification – possibly if there is something which satisfies a condition, then there is something which possibly satisfies that condition.[1] NNE states that necessarily everything is such that necessarily there is something to which it is identical. The principle can be paraphrased as stating that it is necessarily the case that all entities have necessary being. Arguments for Necessitism – at both first- and higher-order – have proceeded abductively. E.g., Williamson (2013: 6.1-6.4) targets issues for haecceity comprehension, if Contingentism – i.e., the negation of Necessitism – is true at first-order, and thus for objects. With regard to properties and relations at higher-order, Williamson's arguments have further targeted closure conditions, given a modalized interpretation of comprehension principles; e.g., the scheme for mathematical induction, and the completeness properties countenanced via ordering relations on collections, in order to capture their least

[1] For further discussion, see Barcan (1946; 1947).

upper bound. The arguments are abductive, because Necessitist modal systems are shown to satisfy conditions on theory choice; e.g., strength, simplicity, and compatibility with what is known. It is then argued that non-modal versions of the comprehension principles cannot satisfy the foregoing abductive criteria on theory choice, both (i) if Contingentism is adopted at all orders, and (ii) if Contingentisim is adopted solely at the first-order, with an asymmetry in yet accepting Necessitist comprehension at higher-order.

In this note, I endeavor to provide further abductive support for the Necessitist hypothesis at all orders, by examining the interaction between the Barcan formula and geometrically possible worlds. The proposal aims to demonstrate how Necessitism can be vindicated in a naturalistic setting, without relying on Lewis's (1986: 1.8) conception of possible worlds as concrete, spatiotemporal systems.[2] I provide two abductive considerations adducing in favor of the plausibility of the Necessitist hypothesis, by demonstrating how instances of the Barcan formula can be witnessed when the modal operators are interpreted 'naturally' – i.e., as including geometric possibilities – and the quantifiers in the formula range over a domain of natural, or concrete, entities and their contingently non-concrete analogues. The natural entities that I target are, at first-order, the metric structures of spacetime; and, at higher-order, dispositional properties.[3] The foregoing concrete entities are assigned a unique non-concrete object via a partial function.

The first abductive argument for Physical Necessitism is that, assuming a form of dispositional essentialism, the modal profile of dispositional properties at higher-order requires the adoption of Necessitism at first-order.[4] In order to be tracked by their essential properties, objects at first-order must have necessary being. The second abductive argument for Physical Necessitism is that the epistemology of necessary beings has a naturalistically adequate basis.

In Section **2.1**, I examine first-order Physical Necessitism. In Section **2.2**, I examine higher-order Physical Necessitism, and provide the first of the foregoing abductive arguments. In Section **3**, I outline the second of the foregoing abductive arguments, by developing a phenomenal version of haecceity comprehension. I endeavor thereby to provide a naturalistic account of the epistemology of necessary beings. Section **4** provides concluding remarks.

Beyond providing further abductive considerations adducing in favor of the Necessitist hypothesis, the significance of the present contribution can be wit-

[2]Williamson (2016) argues in favor of a fixed-domain semantics, and thus for first-order Necessitism applied to possible values of variables and higher-order Necessitism applied to propositions, in the setting of a possible worlds interpretation of the state spaces countenanced in dynamical systems theory. The present approach differs from Williamson's by examining possible physical geometric structures rather than dynamical systems, as well as the Necessitist thesis as it applies at higher-order to relations, rather than to propositions.

[3]See Brighouse (1999) and Belot (2011), for a defense of modal relationalist approaches to geometric modality. See Bird (2007: 111-114), for a defense of the Barcan formula, when instances of the formula include dispositional properties.

[4]The argument parallels Williamson's (op. cit.: 269-271) argument that there must be first-order necessary beings, because the haecceities thereof would not be able to track them in their absence.

nessed by undermining a distinction that has been drawn between (i) Contingentists who reject NNE and claim that necessarily everything is 'grounded in the concrete' (CON_c) – such that, if not grounded in the concrete, it is not the case that possible non-concrete entities are something, i.e. not everything has necessary being; and (ii) Necessitists who eschew of any such restriction.[5] Because there are considerations within physics and metaphysical inquiry which corroborate modal relationalist claims concerning the possible geometric structures of spacetime, and dispositional properties are actual possible entities, the condition of being grounded in the concrete is consistent with NNE; and thus – in the geometric modal setting – merits adoption by the Necessitist.[6]

2 Individuals and their Dispositions

2.1 First-order Necessitism: Geometric Modality

In this subsection, I define and discuss the axioms comprising the modal system for natural possibilities. The modal system for natural necessity is here assumed to be normal, satisfying axiom K and the rule of necessitation. Necessitation states that '$\vdash\phi \rightarrow \vdash\Box\phi$'. On its naturalist interpretation, the modal operator satisfies K, i.e. '$\Box(\phi\rightarrow\psi) \rightarrow (\Box\phi\rightarrow\Box\psi)$', given a general conception of the dynamics of a physical system which takes the latter to have modal properties, rather than having the non-modal form of, e.g., structural equation models for causation.[7] A natural interpretation of the modal operator satisfies axiom T, i.e. '$\Box\phi \rightarrow \phi$', which records the factivity of the modal profile of material configurations and dispositional properties. Thus, e.g., the rigidification of a Langrangian function – calculated by the difference of the total kinetic energy of a system and the total potential energy of the system – will be factive; and similarly with the Hamiltonian function, calculated as the sum of the values of the foregoing variables.[8]

Care must be taken with regard to the assessment of the remaining axioms. Sider (2009) argues, e.g., that augmenting principles of recombination to the

[5]See Williamson (op. cit.: 314-315), for an argument that difference in the domains of the quantifiers is such that, beyond modalized universal generalizations that are neutral formulas in Necessitist and Contingentist systems, there are formulas accepted by proponents of NNE which are inconsistent with frameworks augmented by CON_c.

[6]Dispositional properties can further be generalized, in order to account for laws of nature; cf. Bird (op. cit.). Williamson (op. cit.: 326-329) refers to the property of being grounded in the concrete, $\lambda C.C(v)$, as 'being chunky'. The position of 'chunky-style necessitism' is mentioned, and taken to be comprised of NNE; the postulate (23): '$\forall x\Diamond Cx$'; and the postulate (26): '$\Box\forall x_1 \ldots x_n[(Fx_1 \ldots Fx_n) \rightarrow (Cx_1 \ldots Cx_n)]$'. On the revised approach to 'chunky-style' Necessitism examined here, the proposal eschews of Williamson's postulate 26, such that – given the restriction to geometric modal frames and spaces – properties can be instantiated by contingently non-concrete objects.

[7]Models for structural equations have been developed by, inter alia, Galles and Pearl (1998); Pearl (2000); Woodward and Hitchcock (2003); and Briggs (2012).

[8]For a counterfactual analysis of the modal profile of physical dynamical laws, see Butterfield (2004).

Barcan formula entails that one can generate a set of non-sets of greater cardinality than the cardinality of an initial set of non-sets.[9]

Uzquiano (2015) argues that modal plenitude and recombination are inconsistent with Cantor's thought that there is a single maximal magnitude for absolute infinity. Suppose that there is a proposition for each live cardinal, where a live cardinal records that there is a set of exactly a concrete objects (10). Then, 'there are no fewer propositions than classes of live cardinals' yet, via Bernays (1942)'s generalization of Cantor's theorem from sets to classes, there are more classes of live cardinals than there are live cardinals (8). Then, 'there are strictly more propositions than there are live cardinals' (11), yielding at least two absolutely infinite magnitudes. His proposal is to define propositions as falling under zero-place predicate variables, rather than objectual variables. Then, 'only individual objects are members of classes. But the Cantorian doctrine of the absolutely infinite is exclusively concerned with classes of individual objects and has no bearing whatever when it comes to items in the range of predicate or sentence variables. More generally, the challenge from recombination arises when we ignore the fundamental rift between the values of objectual variables and the values of predicate and sentence variables. While the quantifiers of BGU [Von-Neumann-Bernays-Gödel set theory with urelements - HK] range over absolutely all objects, whether urelements or sets, propositions are neither urelements nor sets' (16-17).

Turner (2016: 239-244) responds to cardinality issues for Necessitism, by distinguishing between the entities countenanced in a language of linear geometry which he takes to be fundamental and thus to reflect 'metaphysically sober reality', and a non-fundamental, or 'apparent', language of 'object-quality representations' (op. cit.: 24-25). He argues then that the two notions can be availed of, in order to place a restriction on recombination, because, for cardinals κ and λ: $\kappa < \lambda$, while κ is real and λ is apparent.

Rather than precluding propositions from involvement in paradoxes of cardinality entrained by applications of Bernay's theorem by arguing with Uzquiano that they are neither urelemente nor sets, or arguing with Turner that the cardinality of object-quality representations is apparent, the retention of both the principle of recombination and the existence of a fixed domain with a fixed cardinality can be argued for. Following Cantor (1883/1996: §5:¶3, Endnote 1), one can argue that the height of the cumulative hierarchy of sets has an Absolute cardinality, despite set-forming operations, such as Power-set, and Cantor's theorem. In the modal model-theoretic setting which validates the Barcan formula at first-order, both (i) a background logic of S5, which partitions the domain into equivalence classes, where each possible world is accessible to the others, and (ii) the fixed height of the hierarchy of a first-order domain of possible objects, is similarly consistent with Bernays' theorem, and with Vlach-operators

[9]Nolan (1996: 246-247) provides a similar argument against the idea that the totality of possible worlds form a set, by an application of Cantor's (1891/1996) theorem to the effect that the cardinality of a set is less than the cardinality of its powerset; and he argues in favor, then, of the thought that possible worlds are proper classes, i.e. classes, or non-sets, which do not themselves form a class or set (op. cit.).

(see Vlach, 1973), which permit of multiple-indexing in order to account for the relatively expanding domains of the model. The cumulative hierarchy of sets exists with a maximal, metaphysical necessity, yet expansions thereof are consistent with there being non-maximal objective modalities tracking the increases in cardinality. Thus, the relatively expanding domains of a first-order modal model theory governed by S5 is consistent with the cardinality of the domain having a unique absolutely infinite magnitude.

On the naturalist interpretation of the operator, an argument for the validity of axiom B can proceed by witnessing that if there is a particular material configuration in a dimension of spacetime, then it is necessarily possible that the configuration obtains; formally, '$\diamond\phi \rightarrow \Box\diamond\phi$'. However, axiom 4 and axiom E would appear to require further argument, which might not be witnessed by considerations adducing from physical inquiry alone. 4 states that '$\Box\phi \rightarrow \Box\Box\phi$', and E states that '$\neg\Box\phi \rightarrow \Box\neg\Box\phi$'. The principle of the Necessary Necessity of Being – which states that necessarily everything is such that necessarily there is something to which it is identical – requires axiom 4. When conjoined to the system KTB, the system of geometric modality becomes S5. Thus, if there are contingently non-concrete entities actually corresponding to natural entities, the necessity of being is itself necessary, vindicating axiom 4. We augment the system of natural modality with the Barcan formula and its converse, '$\diamond\exists xFx \rightarrow \exists x\diamond Fx$' and '$\exists x\diamond Fx \rightarrow \diamond\exists xFx$'. For the purposes of this note, we adopt Barcan S5 as a working hypothesis; the aim of the essay is to examine whether it is consistent with present physical and metaphysical inquiry.[10]

Concrete objects are material configurations of spacetime. Rather than being identical to the point-particles which are configured in 3-dimensional spacetime, concrete objects are thus regions of configuration spacetime themselves, spanning lower (3-) and higher ($3n$)-dimensions.[11] Suppose that there is a region of spacetime with metric affine structure of dimension n, and a generalized inner product with signature specifying positive and negative eigenvalues of eigenvectors, (+,-), s.t. $\langle 1, n\ \text{-}1\rangle$ $n \geq 2$.[12] The structure is affine, given the line that can be drawn between a pair of material points, within both 3- and $3n$-dimensional spacetime. The affine structure is metric, given the distance relations that can be defined on the directed lines, i.e. vectors. The distance measure satisfies the following conditions: 'm(x,y) = 0 iff x = y'; symmetry – 'm(x,y) = m(y,x)'; and

[10] I prescind here from targeting topological theories, which have been axiomatized by intuitionistic models and are taken to satisfy S4. For S4 systems of topological semantics for modal logic, see McKinsey and Tarski (1944); Goldblatt (1993); Awodey and Kishida (2007); and Lando (2010). Kremer (2009) provides an S5 system for topological semantics.

[11] See Skow (2005); Schaffer (2009); and Dorr (ms), for the proposal that material objects just are regions of configuration space, which span 3- and $3n$-dimensions. The present discussion is agnostic about which of the dimensions is fundamental. For a view on which the entity represented by the wavefunction in $3n$-dimensional space is fundamental, by contrast to the entities residing in lower, 3-dimensional space, see North (2013). For a view on which physical ontology ought, instead, to target density operators on systems of states of spacetime, see Wallace and Timpson (2010).

[12] An inner product is a scalar, i.e. a real number which is an element of a field. The source of affine structure is discussed in Maudlin (2010).

triangle inequality – 'm(x,z) ≤ m(x,y) + m(y,z)'.[13] A generalized inner product on a vector space, V, on which metric structure is built, satisfies the following four conditions:

The product is a binary mapping from V to the set of reals, R, s.t.

(i) ∀a,b∈V ⟨a,b⟩ = ⟨b,a⟩;

(ii)∀a,b,c∈V ⟨a, b+c⟩ = ⟨a,b⟩ + ⟨a,c⟩;

(iii) For all reals, r, in R and ∀a,b∈V, ⟨a, rb⟩ = r⟨a, b⟩; and

(iv) ∀a≠0∈V,∃b∈V, s.t. ⟨a,b⟩≠0.[14]

When the inner product of the vector space on which the distance measures are defined has signature, (+,-), s.t. (n, 0) with $n \geq 2$, then the metric affine space is *Euclidean*. When the inner product of the vector space on which the distance measures are defined has signature, (+,-), s.t. (1, n - 1) with $n \geq 2$, then the metric affine space is *Minkowskian*.

Material configurations of spacetime ground a possible metric affine space which comprises the concrete spatial-temporal geometry of a world.[15] The condition of groundedness permits the modal relationalist to match the ontology of substantivalist approaches, according to which there is only one actual material and spatial geometry. The conditions of (i) groundedness and (ii) identification of material objects with regions of configuration space, ensures therefore that the modal relationalist proposal does not come at the cost of eschewing of a material ontology. The modal relationalist proposal is thus consistent with the contention that, as Field puts it: 'Modality is not a general surrogate for ontology' (1989: 252).

2.2 Higher-order Necessitism: Dispositions

In this subsection, I target instances of the Necessary Necessity of Being at higher-order, focusing on dispositional properties. Dispositional properties are actual possible properties. In order to complete the first abductive argument for Physical Necessitism, I argue that the necessary being of dispositional properties requires the adoption of the Barcan formula at first-order.

In order to induce a correlation between concrete and contingently non-concrete entities, we introduce a partial function, v, interpreted as a value assignment.[16] The value assignment maps concrete entities to the contingently non-concrete entities in the domain. We assume both that the domain is closed, and that two assignments do not assign two concrete entities to a single non-concrete entity.

Dispositional properties can take the following form:

Necessarily, a concrete object, x, instantiates a dispositional property, α, if and only if ϕ. ϕ includes, as a necessary clause, the condition that, were x to

[13] For further details, see Belot, op. cit.: 12; and Malament, op. cit.: 2.4.

[14] For further details, see Malament (ms: 15-18).

[15] Cf. Belot (op. cit.: 78-79). For the logic of ground, with both an operator-based and a relation-based semantics, see Fine (2012a; 2012b).

[16] A similar maneuver, with regard to assigning individuals – including concrete and abstract objects – to their arbitrary counterparts, is pursued in Fine (1985).

be stimulated [S( )] then α would be manifested [M( )].

Formally:

$\Box[\lambda\alpha.\alpha(x) \equiv \phi]$, where

ϕ only if $S(x) \Box\!\!\rightarrow M(\alpha)$.

The disposition would become manifest, were its corresponding concrete object to undergo a stimulus. In the absence of the stimulus, the dispositional property is an actual, possible property of the concrete object. The concrete object's stimulus induces the concrete manifestation of the actual possible disposition.

The argument for first-order Necessitism would appear to require a version of dispositional essentialism, i.e. the claim that two objects are identical only if they possess identical dispositional properties.[17] Actual dispositional properties which could be instantiated necessarily track their objects, only because the dispositions can be defined on both concrete and non-concrete, possible structures of spacetime. So, dispositional properties cannot track possible objects in the latter's absence. In order to be tracked by their essential properties, objects at first-order must have necessary being.[18]

The foregoing provides an abductive argument for Physical Necessitism at first-order. Assuming that objects bear their dispositions essentially, then – because dispositions are actual, possibilia – the existence of dispositional properties requires the existence of possible objects to which they can be modally and essentially correlated.

3 Naturalist Conditions on the Epistemology of Necessary Beings

In this section, I develop, finally, a phenomenal analysis of haecceitistic properties.[19] Similarly to abstraction principles for abstract objects, the phenomenal profile of haecceities provides an epistemically tractable comprehension scheme; and enables thereby a non-reductive, though naturalistically adequate, account of the epistemology of necessary beings grounded in the concrete. A naturalistically adequate account of the haecceitistic properties of necessary beings provides a second abductive argument for general Necessitism.

In perceptual – in particular, visual – psychology, state frames are a set, Ω, of physically possible worlds, and they encode information about the source of lightwave spectra. Ω is therefore a subset of the frame of physically possible worlds examined in Section **2** above. Ω is closed under complementation and intersection; a σ-algebra is thus defined thereon.

[17] Cf. Bird, op. cit.: ch. 5.

[18] See Korbmacher (2016) for an argument to the effect that haecceitistic properties are essential properties.

[19] See Khudairi (ms), for further discussion, and for a defense of the claim that phenomenal consciousness has a metaphysical and modal haecceitistic profile. Qualitative haecceities are also discussed briefly in Fritz and Goodman (2017)

In the model, $<(\cup w\colon w \in \Omega), Pr>$, a random variable, a, in the [0,1] interval is a function from subsets of Ω to real numbers. Pr is defined as the probability density of a. The operations of Pr are further constrained by the following calculations:

- **Normality**

  $Pr(\mathrm{T}) = 1$

- **Non-negativity**

  $Pr(\phi) \geq 0$

- **Additivity**

  If ϕ and ψ are disjoint, then

  $Pr(\phi \cup \psi) = Pr(\phi) + Pr(\psi)$

- **Conditionalization**

  $Pr(\phi \mid \psi) = Pr(\phi \cap \psi) \ / \ Pr(\psi)$

The visual system calculates which of the possibilities in Bayesian perceptual models and spaces is the constancy; i.e. which possibility should be designated as actual. The constancy figures as the accuracy-condition for the attribution of properties, such as volume and boundedness, to distal particulars. Once the perceptual representational state has been derived via the visual system's computation of the constancy, phenomenal properties can be defined thereon. When phenomenal properties are instantiated on perceptual representational states, they induce phenomenal consciousness of the state.

- **Phenomenal Properties**

  Comprehension:

  $\texttt{Comp} = \lambda\alpha\forall x.\alpha(x) \Longleftrightarrow A$

  with α not free in A

Bottom-up (more generally, exogenous), spatial-based, property-based, and diffuse and focal mechanisms of attention comprise a necessary condition on the instantiation of phenomenal properties. The necessity of attention is corroborated by the phenomenon known as the 'attentional blink'. The attentional blink holds if and only if shifting attentional allocation to one of two stimuli induces lack of awareness of the distinct stimulus to which attention was previously distributed.[20] The normalized formula for the neurofunctional role of attentional mechanisms is as follows: $\bar{E}_i(n) = \frac{E_i(n)}{\sigma^2 + \sum_i E_i(n)}$ − i.e. the timed fire-rate oscillations of a set of neurons, referred to as a 'vectorwave' − is divided

[20]However, deployment of object-based attention might not comprise a necessary condition. Block (2013) argues that object-based attention might not be a necessary condition, because the grain of object-based attention is coarser than the grain of conscious object-based perception in cases of visual-identity crowding.

by the summed activity of a larger set of peripheral neurons (cf. Reynolds and Heeger, 2009). Thus, the formula A in phenomenal property comprehension principles includes '$\bar{E}_i(n)$' as at least a necessary clause.[21]

3.1 Haecceity Comprehension

The target haecceity comprehension principles can be precisified as follows.

- **Haecceity Comprehension**

$\Box\forall x,y\Box\exists\Phi[\Phi x \iff (x{=}y)]$
$\Box\forall x,y[\Box\exists\Phi[\Phi x \iff (x{=}y)]\to\exists x(x{=}y)]$

Suppose that:

- $\lambda i\exists\iota x.(i_n)(x)$,

where x denotes a member of the domain of subjects, and i_n denotes the set of phenomenal properties instantiated by a subject at a context.

Then, haecceities modally-lock onto their subjects if and only if haecceities are individuated by the phenomenal properties instantiated by the subjects. Thus, necessarily there is a unique subject for whom necessarily a set of phenomenal properties is necessarily instantiated:

$\Box\forall x,y\Box\exists\Phi[\Phi x \iff (x{=}y)]$
iff
$\Phi(x) = \Phi(y)$ iff $\Box\lambda i\Box\exists\iota x.\Box[i_n](x)$.

The properties are metaphysically haecceitistic, because they target the identity-conditions on individuals rather than on worlds. The metaphysical haecceities have a hybrid profile, because individuals are uniquely typed by the phenomenal properties that they instantiate, however quantification over the individuals is an ineliminable condition on their identity and distinctness. The second abductive argument for Physical Necessitism is thus that a naturalistically adequate epistemic conduit can be specified for knowledge of the necessary beings at first-order.

If only human and non-human animal organisms instantiate phenomenal properties, the argument can be generalized to other objects by targeting their other qualitative properties, such as their origins, instantiation-conditions, and

[21]Deployment of the kinds of attention might not be sufficient for instantiation of the kinds of consciousness. Jiang et al (2006)'s results demonstrate the insufficiency of exogenous attention, in virtue of the phenomenon of interocular suppression. Interocular suppression involves showing distinct stimuli to each eye of the patient, one of which masks, i.e., prevents consciousness of the other stimulus to which however their attention is still exogenously distributed; so they attend without the visual representations becoming conscious. Exogenous attention might yet be sufficient, if the above results were interpreted as targeting a phenomenon distinct from attention, such as non-attentional microsaccade orienting.

physical grounds. These qualitative properties would thus be qualitative haecceities. Fritz and Goodman (2017) claim that most material objects lack qualitative haecceities, yet they provide one example of them. They note that possible mereological relations can be defined even in a one-object universe, such that the possible mereological relations between a possible object and a concrete object would serve as qualitative haecceites which individuate that possible object. There appears in any case to be no bar to conceiving of qualitative properties as being constitutive of the uniquely identifying properties of objects.

4 Concluding Remarks

In this essay, I have endeavored to provide two abductive arguments for Necessitism, on a restriction of the operators to naturalist modalities and a restriction of the quantifiers to concrete entities and their non-concrete analogues. Against Physical Contingentism, actual possible dispositional properties which could be manifested require the necessary existence of objects at first-order. If material configurations could be nothing, then dispositional properties could not track the latter in their absence. Thus, in order to be able to track their objects, the objects – concrete and non-concrete – must have necessary being. The second abductive argument against Physical Contingentism addressed the haecceitistic properties of necessary beings, via phenomenal haecceity comprehension. If some individuals are typed by the phenomenal properties that they instantiate, yet quantification over the individuals is an ineliminable condition on their identification, then the empirical conditions on phenomenal property instantiation enable a naturalistically adequate means of explaining our knowledge of necessary beings. The argument can be generalized to other qualitative haecceities for objects which do not instantiate phenomenal properties, such as their material origins, instantiation-conditions, and physical grounds. The arguments advanced in the foregoing provide preliminary abductive support for the generalization of the validity of Necessitism to metaphysically possible worlds. However, it is sufficient for the results here outlined to have demonstrated that – beyond the satisfaction of scientific criteria on theory choice – Necessitism about objects and higher-order entities can be vindicated in a naturalistic setting.

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