Chapter 8

RELATIVIZED METAPHYSICAL MODALITY

Index and context

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8.1 Introduction

A familiar and useful representation of modality invokes a space of *possible worlds*, and *quantification* over it: necessity and possibility are represented, respectively, with *universal* and *existential* quantification—so that necessity is truth at all possible worlds; possibility, truth at some. While modality comes in many varieties, a familiar thought gives a singular position to *metaphysical* modality, as the broadest objective variety, pertaining to 'what could not have been otherwise no matter what' (Burgess 2009, 46). Combining these ideas, metaphysical modality is represented as absolutely unrestricted quantification over the space of possible worlds.

This representation is called on by an austere, 'Carnapean' semantic analysis of the contribution of a modal operator, used metaphysically, to possible-worlds truth-conditions: in such uses, *necessarily*, φ is true in a world just if φ is true in every world, while *possibly*, φ is true in a world just if φ is true in some world (compare Carnap 1947, **41-1**, 183). A 'classical' semantics for quantified modal languages combines this analysis with comparably austere analyses of reference and quantification (compare Carnap 1947, **41-2**, 184–5). The result is attractive for its inherent simplicity; moreover, its predictions arguably capture strongly held *logical* intuitions about the various underlying subject matters—the phenomenon of modality, and its interactions with individuation and with ontology.

But various literatures, each spanning many decades, discuss an array of puzzling phenomena involving all these subject matters, leading to *metaphysical* challenges to the classical theory. Preserving the classical theory requires revising intuitive metaphysics; conversely, preserving intuitive metaphysics requires revising the classical theory. Unfortunately, these literatures presume an alliance between intuitive logic and the classical theory—thereby presenting an unappealing choice of revisionisms, in logic or in metaphysics.

Fortunately, the presumed alliance is false, holding only under a implicitly assumed 'modal absoluteness' to modality, individuation, and ontology: if instead, as we propose, what is metaphysically possible or necessary is *relativized to which world is actual*, the puzzling phenomena demand revisionism in neither logic nor metaphysics.

Our approach—*relativized metaphysical modality* (RMM: Murray and Wilson 2012; Murray 2017)—is based around a *double-indexing semantics* for modal languages, on which truth is twice over relativized to a possible world. This basis is interpreted with a metaphysics and a pragmatics. Metaphysically, with a *moderate modal naturalism*, on which metaphysical possibility (associated with a first dimension of world-relativity—the 'horizontal' dimension, in a familiar picture: compare Stalnaker 1978) is explained in part by abstract metaphysical principles and in part by actual matters of contingent categorical fact (associated with a second, 'vertical', dimension of world-relativity). Pragmatically, with a *Context–Index* representation of modal reasoning (Lewis 1980a; compare Kaplan 1977), on which the second dimension of world-relativity is fixed independently of language, by the actual contingent categorical facts (our 'context'), while anything comprehensible as a 'modality' is restricted de jure to the first dimension of world-relativity (the 'indices' generable through the semantic powers of the language): our access to the second dimension is exclusively through an imaginative exercise of falsely supposing things to be other than they are—by 'considering worlds as actual' (as contrasted with 'as counterfactual', which requires no false supposition and is associated with modal reasoning properly so-called).

RMM may be heuristically understood as a substantive metaphysical repurposing of more familiar 'epistemic two-dimensional' (E2D: compare Chalmers 2005) semantical machinery, which similarly distinguishes between 'consideration' of a possible world 'as actual' and 'as counterfactual' (Jackson 1994). But the concerns of the approaches are very different. E2D focuses on the 'apriority' of a sentence (representing this status with its truth in every possible world when considered as actual); RMM, by contrast, focuses on what is required of semantics and pragmatics to make sense of moderate modal naturalism without revising intuitive logic (and accords no distinctive role to quantification over worlds considered as actual).

Remaining sections of this entry progress as follows. Section 8.2 describes the 'classical' approach to semantic theorizing, analyzing a nested series of modal fragments: Section 8.2.1 treats a basic propositional modal fragment; Section 8.2.2 adds predicate–term syntax; Section 8.2.3 adds quantification. Section 8.3 describes the metaphysical puzzles to each of the classical proposals in series: in each case, the puzzle motivates a familiar 'postclassical' semantics to preserve intuitive metaphysics by revising intuitive logic. In Section 8.3.1, a puzzle concerning laws of nature motivates a postclassical 'accessibility' semantics, revising intuitive 'S5' modal logic; in Section 8.3.2, a puzzle concerning individual essence motivates postclassical treatments with either accessibility or 'counterparts', revising S5 logic either way; in Section 8.3.3, a puzzle concerning ontology motivates postclassical treatments with 'contingent domains', revising intuitive 'Barcanite' logic (compare Barcan 1946).

The puzzles in Section 8.3 involve a common presupposition, to be labeled the 'In-Light Principle' (ILP), which identifies possibility *in light of which* and possibility *that* such-and-such: going through the puzzles, we identify where the ILP is exploited. Section 8.4 develops RMM as a way to reject the ILP and solve the puzzles: Section 8.4.1 calls on double-indexation to restructure the postclassical semantic proposals, identifying possibility *that* and *in light of* with the 'horizontal' and 'vertical dimension' indices, respectively; Section 8.4.2 sketches the association with moderate modal naturalism, while Section 8.4.3 turns to Context–Index pragmatics to rebut an objection. Section 8.5 concludes with historical speculation as to why the RMM solution has so long remained elusive.[1]

8.2 The classical theory

We begin by giving precise expression to our label, the 'classical theory'. This is an account of the truth-conditions and logical consequence relations for a series of increasingly complex *modal fragments*: a *propositional* fragment; and two predicate fragments, a *referential* fragment and a *quantificational* fragment.

We use this notation for expressions of the object-language: φ and ψ are 'schematic', to be substituted with any formula of the object language; $\neg$, $\wedge$, and $\supset$ are used for *negation*, *conjunction*, and the *material conditional* (with $\varphi \wedge \psi$, 'φ and ψ' abbreviating $\neg(\varphi \supset \neg\psi)$, 'it is not the case that if φ, then not-ψ'); $\Box$ and $\Diamond$ for (metaphysical) *necessity* and *possibility* (with $\Diamond\varphi$, 'possibly φ' abbreviating $\neg\Box\neg\varphi$, 'it is not the case that, necessarily, not-φ'); Γ^n and τ are schematic, to be substituted with any n-place predicate and any term, respectively; and $\forall$ and $\exists$ are used for ('metaphysical'—understood also with maximal breadth) *universal* and *existential* quantifiers: a *quantifying operator* is of form $(\forall\tau)$ or $(\exists\tau)$ (with $\exists\tau.\varphi$, 'some τ is such that φ' abbreviating $\neg\forall\tau.\neg\varphi$, 'it is not the case that every τ is such that not-φ').

We use $\vDash$ for a metalinguistic truth-predicate of formulae of the object-language, decorated with various sub- and superscripts to represent relativization of truth to various parameters; $\vdash$ means the relation of logical consequence, holding between a set of zero or more *premiss* formulae of the object language and a *conclusion* formula of the object language, and analyzed as truth-preservation across all parameters to which truth is relativized;[2] we strike through these turnstiles to negate them; and we use ':=' to abbreviate *is defined as*. All analyses to come analyze $\neg\varphi$ as true (relative to an appropriate list of parameters) just if φ isn't, and $\varphi \supset \psi$ as true (again, appropriately relativized) just if either φ isn't or ψ is.

Space requires us to blur over without comment various important details and background assumptions.[3]

8.2.1 A propositional modal fragment

The formulae of this fragment are generated on a base set of simple formulae, and include just those complex formulae $\neg\varphi$, $\varphi \supset \psi$, and $\Box\varphi$.

We postulate in the semantic machinery a set of possible worlds, W; metalinguistic variables like 'w' range over this set.

Truth is relativized to a possible world, with $\vDash_w \varphi$ meaning 'φ is true in (according to; relative to) the world w'.

The classical truth-condition for $\Box\varphi$ (*necessarily*, φ) is as follows (recall that $\Diamond\varphi$ (*possibly*, φ) abbreviates $\neg\Box\neg\varphi$, and truth-conditions for *negation* and the *material conditional* are as earlier):

$$(\Box_{cl}) \qquad \vDash_w \Box\varphi := \text{for every possible world } w', \vDash_{w'} \varphi$$

('Necessarily, φ' is true in a world just if φ is true in every world.)

Familiarly, analysis $(\Box_{cl})$ validates the following principles:

T $\quad \Box\varphi \supset \varphi$ $\quad$ (if, necessarily, φ, then φ)

4 $\quad \Diamond\Diamond\varphi \supset \Diamond\varphi$ $\quad$ (if it is possibly possible that φ, then it is possible that φ)
5 $\quad \Diamond\Box\varphi \supset \Box\varphi$ $\quad$ (if it is possibly necessary that φ, then it is necessary that φ)

When these are added as axioms to a certain basis,[4] the result is a logic known as **S5**. **S5** deserves special distinction as the logic that is arguably (compare Williamson 2013, 44; Williamson 2016) definitive of our concept of *metaphysical* modality, as it makes the metaphysical modal facts themselves a matter of metaphysical necessity—perhaps in contrast with narrower modalities, for which (say) the *morally* possible or necessary acts may depend on which morally possible acts have been performed.

8.2.2 A referential modal fragment

The simple expressions of this fragment include a set of terms and a set of *n*-place predicates (including a two-place identity predicate '='), with simple formulae prefixing an *n*-place predicate to a string of *n* terms; the complex formulae include those with forms as from the propositional modal fragment.

We add to the semantic machinery a domain D of individuals, with metalinguistic variables like 'd' ranging over D; an *individual concept* k maps W to D, selecting for each world $w \in W$ a unique individual $k_w \in D$.

The meaning of a term τ is given by an individual concept k^τ, with k_w^τ as the 'w-designatum' of τ (the entity τ refers to *in*, or *relative to* w: τ is a 'rigid designator', therefore, only if k^τ is a constant function—only if there is a unique individual $d \in D$ such that the individual concept for τ maps each possible world to that d). And the meaning of a predicate is given by a world-relative relation of *satisfaction in w* between an *n*-place predicate and an *n*-place sequence of individuals—intuitively, the pair of Caesar and Cleo satisfy the two-place predicate *loves* in w just if, in w, Caesar loves Cleo—with exactly the pairs $\langle d,d \rangle$ satisfying '=' in w, for every world w.

Truth-conditions for complex formulae follow the analyses for the propositional fragment; for a simple formula, the truth-condition is this:

- $\vDash_w \Gamma^n \tau^1 \ldots \tau^n :=$ the sequence $k_w^{\tau^1}, \ldots, k_w^{\tau^n}$ satisfies Γ^n in w

(For example, 'the McCosh Professor has greeted the Pierce Chair' is true in a world just if, in that world, the entity which, in that world, is the McCosh Professor has greeted the entity which, in that world, is the Pierce Chair.)

Quite clearly, **S5** continues to be validated.[5]

8.2.3 A quantificational modal fragment

All formulae of the referential fragment are formulae of this fragment; in addition, its formulae include those prefixing a quantifying operator to a formula.

We add to the earlier semantic machinery the device of the *assignment*: an assignment g maps each term τ to an individual concept, notated alternatively as g^τ or as k_g^τ. (A *variable* term τ, accordingly, is one for which sometimes $k_g^\tau \neq k_{g'}^\tau$; otherwise, τ is *constant*. If there are constant terms, there are fewer assignments than functions from terms to individual concepts.) An assignment g' is a *τ-variant* of g, notated $g' \sim^\tau g$, just if g' does not differ from g at any term other than τ.

Truth is relativized to an assignment and a world, with $\vDash_{g,w} \varphi$ meaning 'φ, relative to g, is true in w'. Predicate-satisfaction continues to be relativized only to a world. The 'designatum' of τ, as pertains to the truth-condition of a simple sentence, is relativized both to an assignment and a world: namely, for a given g and w, $k_{g,w}^\tau$. Accordingly, a simple sentence has this truth-condition:

- $\vDash_{g,w} \Gamma^n \tau^1 \ldots \tau^n :=$ the sequence $k_{g,w}^{\tau^1}, \ldots, k_{g,w}^{\tau^n}$ satisfies Γ^n in w

(For example, 'x loves y' is true in a world, relative to an assignment just if: for that individual d such that the individual concept for 'x', relative to that assignment, maps that world to d, and for that individual d' such that the individual concept for 'y', relative to that assignment, maps that world to d', are such that in that world, d loves d'.) Truth-conditions for complex Booleanized or modalized formulae are merely 'up-parametrized' from the referential fragment.

For a complex quantified formula, the truth-condition is:

$$(\forall_{cl}) \qquad \vDash_{g,w} \forall \tau.\varphi := \text{for every } g' \sim^{\tau} g, \vDash_{g',w} \varphi$$

('Every τ is such that φ' is true in a world relative to an assignment just if φ is true in that world relative to every τ-variant of that assignment.)

The analysis preserves the validity of **S5**. With quantification analyzed with ($\forall_{cl}$), the following are also validated:

$$BF \qquad \forall \tau.\Box\varphi \supset \Box\forall \tau.\varphi$$

(if everything is necessarily such that φ, then necessarily everything is such that φ)

$$CBF \qquad \Box\forall \tau.\varphi \supset \forall \tau.\Box\varphi$$

(if necessarily everything is such that φ, then everything is necessarily such that φ)

Logics adding *BF*, *CBF*, and the **S5** principles and rules to the principles and rules of non-modal predicate logic stand in an analogous position to **S5**, as arguably (compare Linsky and Zalta 1994, 1996; Williamson 1998, 2013) definitive of the interaction of *metaphysical modality* and *metaphysical quantification*—objectual quantification in the broadest possible sense.[6]

8.3 Metaphysical challenges to the classical theory

A distinctive metaphysical puzzle challenges the classical treatment of each fragment: for the propositional fragment, the puzzle concerns laws of nature; for the referential fragment, individual essence; for the quantificational fragment, ontology. Preserving metaphysical intuition requires revising the classical analyses. The 'postclassical' analyses proposed in the literature, unfortunately, revise the attractive logical predictions of the classical theory.[7]

We set up these puzzles to illustrate the reliance of each on the *In-Light Principle* (ILP): namely, that possibility *in light of which*, φ, is possibility *that* φ. For the puzzles from *laws* and *essence*, the ILP maintains that possibility in light of possibility is possible possibility; for the puzzle from *ontology*, that existence or nonexistence in light of possibility is possible existence or nonexistence. Without the ILP, logic and metaphysics do not clash. The next section explains the RMM strategy for rejecting the ILP: to foreshadow, we associate possibility *in light of* with 'consideration as actual', possibility *that* with 'consideration as counterfactual'.

8.3.1 Laws of nature and the propositional fragment

8.3.1.1 Nomological necessity and sensitivity?

Are the laws of nature metaphysically necessary? Is it true that, if the laws of nature require that φ, it is metaphysically necessary that φ? (We will assume that nothing metaphysically impossible can be permitted by the laws of nature.)

Necessitarians say yes, citing the explanatory power of appeals to law (Loewer 1996, 2012; Fine 2005, 247): if we answer the question 'Why, if it goes up, will it come down?' with 'It is a law of nature that what goes up comes down', necessitarianism avoids the further question 'Yeah, but what distinguishes this case from one of those cases where it is a law of nature that what goes up comes down, but things can go up without coming down?'—a peculiar question, best avoided: to the credit of necessitarianism.

But a powerful challenge comes from the idea that the laws of nature should be sensitive to the 'categorical' facts on the ground. Leading theories of laws incorporate this *sensitivity* doctrine: according to *best-systems* theory (Lewis 1973, sect. 3.3), the laws are the simplest, strongest systematization of the categorical facts; according to a broadly *Aristotelian* approach (Shoemaker 1980), the laws are generated by the categorical fact that exactly *these* properties are instantiated. Each of these theories predicts a phenomenon we may call *undermining*[8]—categorical facts yielding laws permitting categorical facts yielding different laws, which disagree with the earlier laws over what is possible.

Undermining comes in two types. Type (i), with possibly possible impossibilities: categorical facts F yielding laws L permitting categorical facts F' yielding different laws L' permitting categorical facts F'', where L forbid F''; so for the necessitarian, what counts (*in light of* facts F and their laws L) as an impossibility (namely, the facts F'') sometimes counts as a possibility *in light of* a possibility (namely, a possibility *in light of* the laws L' generated by the possible facts F')—so if (by ILP) a possibility *in light of* a possibility is a possible possibility, an impossibility is sometimes a possible possibility. Type (ii), with possibly impossible possibilities: categorical facts F yielding laws L permitting categorical facts F' and F'', yielding respectively laws L' and L'', where L' do not permit F''; so for the necessitarian, what counts (*in light of* the facts F and their laws L) as a possibility (namely, the facts F'') sometimes counts as an impossibility *in light of* a possibility (namely, an impossibility *in light of* the laws L' generated by the possible facts F')—so if (by ILP) an impossibility *in light of* a possibility is a possible impossibility, a possibility is sometimes a possible impossibility.

The classical truth-conditions, recall, validate *4* (recall, $\Diamond\Diamond\varphi \supset \Diamond\varphi$), which prohibits possibly possible impossibilities and type (i) undermining, and *5* (recall, $\Diamond\Box\varphi \supset \Box\varphi$), which prohibits possibily impossible possibilities and type (ii) undermining. But sensitivity predicts both type (i) and type (ii) undermining. So the following would seem to be jointly incompatible: classical truth-conditions; necessitarianism; sensitivity. Strategies to avoid the conflict would seem to be exhausted by: *metaphysical revisionism*, abandoning either necessitarianism (losing its explanatory advantages) or sensitivity (losing contact with leading theories of laws); or adopting nonclassical truth-conditions.

8.3.1.2 Postclassical semantics: accessibility

One 'postclassical' approach (adapting an approach to the essence puzzle, to be discussed in Section 3.2[9]) adopts *accessibilist* truth-conditions. Let A be a 'metaphysical accessibility' relation between worlds (with the intended interpretation that wAw'—w' is *accessible from w*, or w' is *w-accessible*—just if w' is metaphysically possible *in light of w*); then the classical analysis ($\Box_{cl}$) is replaced with the following:

$$(\Box_A) \qquad \vDash_w \Box\varphi := \text{for every world } w' \text{ such that } w\,Aw',\ \vDash_{w'} \varphi$$

('Necessarily, φ' is true in a world just if φ is true in every world *accessible from* that world.)

If it is assumed also that wAw' (w' is accessible from w) only if the w-laws allow w', necessitarianism combines with ($\Box_A$) to weaken the condition of the classical necessitarian—namely, the w-laws require φ only if φ holds in every *w-accessible* world. This is compatible with undermining: type (i) shows that A is not transitive (sometimes $wAw'Aw''$ but not wAw''—w accesses w' which accesses w'', but w does not access w''), while type (ii) shows that A is not 'Euclidean' (sometimes wAw' and wAw'' but not $w'Aw''$—w accesses both w' and w'' but w' does not access w''). But for nontransitive A, ($\Box_A$) invalidates the *4* principle; and for non-Euclidian A, ($\Box_A$) invalidates the *5* principle—an undesirable *logical revisionism*.

8.3.2 Essence and the referential fragment

8.3.2.1 'Chisholm's Paradox': moderate centering origin essentialism?

Are facts about *individual essence* metaphysically necessary? Talk of essence applies to features of a thing which are, roughly speaking, 'definitive of it'. Whatever this may amount to, we assume, as is more-or-less standard, that if a is essentially F, then necessarily, a is F;[10] and we additionally ignore the (perhaps important: Fine 1994) distinction between essential properties and those held with 'mere' necessity, assuming therefore also the converse. So it is compatible with a's essence that a is F just if it is metaphysically possible that a is F; so the initial question reduces to whether it is a necessary matter *whether* it is metaphysically possible that a is F. The classical analysis ($\Box_{cl}$) says yes; unfortunately, a consideration known as *Chisholm's Paradox* (CP: locus classicus, Chisholm 1967) seems to say no.

CP arises out of this *moderate centering* assumption concerning the essence of an artifact a originally constituted out of a certain quantity of matter m: (a) for every 'small enough' part p of m, it is not essential to a that its originally constituting matter include p; but (b) it is essential to a that for some 'big enough' part q of m, its originally constituting matter include q.[11]

The problem is that moderate centering yields cases analogous to the two types of undermining. Type (i), possibly possible impossibilities: sometimes a pair of small replacements in sequence make a big replacement—so sometimes what counts by (a) as a possibility *in light of* a possibility (namely, the second small replacement *in light of* the first small replacement) counts by (b) as an impossibility (namely, both small replacements together): so if (by ILP) a possibility *in light of* a possibility is a possible possibility, sometimes an impossibility is a possible possibility. Type (ii), possibly impossible possibilities: sometimes the right pair of alternative small replacements seem big to one another—so sometimes what count by (a) as possibilities (namely, each of the small replacements), count, *in light of* one another, by (b), as impossibilities (namely, because each sees the other as a big replacement): so if (by ILP) an impossibility *in light of* a possibility is a possible impossibility, sometimes a possibility is a possible impossibility. But as before, these are in conflict with the classical truth-conditions: type (i) cases conflict with the *4* principle, type (ii) with the *5* principle.

The literature canvases various ways of resolving the contradiction. *Metaphysical revisionists* revise moderate centering. There are three options. *Immoderate antiessentialists* (Chisholm himself) reject (b), maintaining, for example, that this desk could have originated in entirely different matter; no chain of small replacements makes a replacement too big for compatibility with its essence: implausibly. *Immoderate essentialists* reject even the 'dual' of (a) (namely, that for *some* small enough part p of m, it is not essential to a that its originally constituting matter include p), maintaining that there is *no* part p of m such that it is not essential to a that its originally constituting matter include p, maintaining, for example, that this desk could not have originated in matter differing even by one atom—no replacement is small enough to be compatible with its essence (compare Kripke 1980, 114n56): implausibly. And *moderate anti-centrists* (Williamson 1990, ch. 8) reject (a) while accepting its 'dual', maintaining that for *just some* part p of m is it inessential to a

that its originally constituting matter include p, maintaining that while there is a range of possible material origins for this desk, at some point in that range—just below the threshold level of bigness of change from a certain center—had the desk had that very origin, not even the slightest difference in origin along a certain dimension (that which would push over the edge to big change from the alleged center—though only a very small change from the hypothesized origin) would have been compatible with its essence: an asymmetry of unappealing arbitrariness.

8.3.2.2 Postclassical semantics: counterparts

The alternative is to adjust the classical truth-conditions. Those canvased in the literature on CP are 'postclassical', *logically revisionary* of **S5**: a famous debate between Salmon and Lewis concerns which such way is best.

Salmon (1981, 240–52: following Chandler 1976), adopts accessibilist truth-conditions for metaphysical modality, as in ($\Box_A$).

Lewis (1986b, 248: compare Lewis 1968, 28–9 on 'transitivity' and 'symmetry'; contrast Forbes 1984[12]) prefers instead to leave the domain of metaphysical modal quantification unrestricted. Instead, he makes an appeal to an approach unavailable in the propositional fragment, and proper to the referential fragment—the complicated *counterpart-theoretic* approach to the interaction between modality and designation (locus classicus, Lewis 1968).

Confusing stereotypes of counterpart theory abound, not all of which are germane to the logical revision demanded by CP;[13] our approach adapts Fara's (2008, 2012) interpretation of the central semantic hypothesis of counterpart theory. The gist is that the possibilities for an entity d are given by how its counterparts are, the possible possibilities by how the counterparts of its counterparts are; but being a counterpart of d is different from being a counterpart of a counterpart of d, with a counterpart sometimes failing to be a counterpart of a counterpart and a counterpart of a counterpart sometimes failing to be a counterpart—so the possibilities for d differ from the possible possibilities for d, with some possibilities failing to be possible possibilities (against *5*) and some possible possibilities failing to be possibilities (against *4*).

Now more explicitly: (i) truth is relativized to (and logical consequence quantifies over) not just a world w but also a set of individual concepts $\boldsymbol{k}$, where $\boldsymbol{k}$ is apt to determine, for every term τ, an individual concept k^τ from that set, which establishes (relative to $\boldsymbol{k}$) the designation for the term τ; (ii) a certain *counterpart function* κ maps a 'source' concept-set $\boldsymbol{k}$ and world w to a 'target' concept-set $\kappa(\boldsymbol{k},w)$; and (iii) a modal, in addition to shifting a 'source' world to a 'target' world, shifts a 'source' individual concept to a 'target' individual concept determined as the counterpart of the source individual concept relative to the source world. Accordingly, an outermost iterated modal shifts an initial source world w and concept-set $\boldsymbol{k}$ to a first target world w' and concept-set $\boldsymbol{k}' = \kappa(\boldsymbol{k},w)$; with w' and $\boldsymbol{k}'$ as the new source, the second-outermost modal shifts those to a second target world w'' and concept-set $\boldsymbol{k}'' = \kappa(\boldsymbol{k}',w') = \kappa(\kappa(\boldsymbol{k},w),w')$—thereby shifting the designative behavior of any embedded terms, and consequently which satisfaction-relations are relevant to the truth of an embedded simple sentence, from those which hold at the initial source world.

And formally:

- $\vDash_{\boldsymbol{k},w} \Gamma^n\tau^1\ldots\tau^n :=$ the sequence $k_w^{\tau^1},\ldots,k_w^{\tau^n}$ satisfies Γ^n in w

(For example, 'the McCosh Professor has greeted the Pierce Chair' is true in a world, relative to a concept-set just if, in that world, the entity which, in that world, by the lights of that set, is the

McCosh Professor has greeted the entity which, in that world, by the lights of that set, is the Pierce Chair.)

$$(\Box_\kappa) \qquad \vDash_{\boldsymbol{k},w} \Box\varphi := \text{for every } w', \vDash_{\kappa(\boldsymbol{k},w),w'} \varphi$$

('Necessarily, φ' is true in a source-world, relative to a concept-set just if, for every target-world, φ is true in the target-world, relative to the source-world counterpart of the concept-set.)

Assembling, $\vDash_{\mathbf{k},w} \Diamond\Gamma\tau$ ('possibly, τ is Γ' is true relative to a concept-set and source world) just if for some w', $\kappa(k^\tau,w)_{w'}$ satisfies Γ in w'; and $\vDash_{\mathbf{k},w} \Diamond\Diamond\Gamma\tau$ just if for some w' and w'', $\kappa(\kappa(k^\tau,w),w')_{w''}$ satisfies Γ in w''. The second does not require the first: perhaps there is no w' such that the w'-counterpart of τ-in-w is Γ in w', but some w'' and w' such that the w''-counterpart of (the w'-counterpart of τ-in-w)-in-w' is Γ in w''—against the *4* principle. Similar counterexamples to the *5* principle are also available.

8.3.3 Ontology and the quantificational fragment

8.3.3.1 Are existence and nonexistence necessary?

Are facts about *ontology*—which individuals exist and do not exist—metaphysically necessary?

The answer can seem obvious: *no*—for reasons of two types. (1) *Existence* does not seem metaphysically necessary (compare Williamson 1998, 258). After all, for any given existing human, *a*, they were begat by their parents; evidently, the activity by *a*'s parents through which *a* was begat could have been avoided: there is a possibility that *a* was not begat; because *a*'s begetting is required for *a*'s existence, there is a possibility lacking a requirement of *a*'s existence; because a possibility lacking a requirement of *a*'s existence is a possibility *in light of* which *a* does not exist, there is a possibility *in light of* which *a* does not exist; so if (by ILP) a possibility *in light of* which *a* does not exist is a possibility of *a*'s nonexistence, there is a possibility of *a*'s nonexistence—in which case, something which exists (namely, *a*) possibly does not exist. (2) *Nonexistence* does not seem metaphysically necessary (compare Kripke 1963, 65–6; Williamson 1998, 258). After all, for some given pair of humans, *f* and *m*, who failed to beget, they could instead have begat: so it is a possibility that *f* and *m* beget; because begetting by human parents suffices for the existence of a human they beget, there is a possibility of a sufficiency for the existence of a human begat by *f* and *m*; because a possibility of a sufficiency for the existence of an *F* is a possibility *in light of* which an *F* exists, there is a possibility *in light of* which a human begat by *f* and *m* exists; so if (by ILP) a possibility *in light of* which an *F* exists is a possibility of the existence of an *F*, there is a possibility of the existence of a human begat by *f* and *m*; plausibly, whenever *f′* and *m′* are a pair of humans not both identical to *f* and *m*, nothing *f* and *m* could have begat could have been identical to anything *f′* and *m′* could have begat: so there is a possibility of the existence of a human nonidentical to any existing human; plausibly, any possible human is essentially human—in which case, possibly something exists which is distinct from each of those things which in fact exists.

The classical truth-conditions, recall, validate *CBF* ($\forall\tau.\Box\varphi \supset \Box\forall\tau.\,\varphi$—if everything is necessarily such that φ, then necessarily everything is such that φ), by which the conclusion of (1), that there is something which possibly does not exist, entails that possibly, there is something which fails to exist—but it is impossible that there is something which fails to exist: so the classical truth-conditions are incompatible with the reasoning in (1). They also, recall, validate *BF* ($\Box\forall\tau.\,\varphi \supset \forall\tau.\Box\varphi$—if necessarily everything is such that φ, then everything is necessarily such that φ), by which the conclusion of (2), that it is possible that there exists something distinct from everything that exists, entails that there exists something which is possibly distinct from everything that exists—in which case that thing would have to be possibly distinct from itself, which is an impossibility: so the classical truth-conditions are incompatible with the reasoning in (2).

Preserving the classical truth-conditions requires some form or other of *metaphysical revisionism*. On (1), actual existence–possible nonexistence: perhaps no actual begetting could have been avoided—and our ordinary judgments of metaphysical modality are entirely unreliable: implausibly. Or perhaps no human requires begetting for their existence—we are not essentially human, and could have existed, unbegat, as 'nonconcrete' (Linsky and Zalta 1996; Williamson 1998, 266; Williamson 2013 passim): strangely. On (2), actual nonexistence–possible existence: perhaps every possible begetting actually occurs—again, overthrowing the reliability of ordinary modal judgments: implausibly. Or perhaps a begetting by human parents does not suffice for the existence of a human they beget—a merely possible begetting yields no novel particular, but only a novel rearrangement of qualities: a route to skepticism about our own existence. Or perhaps our parents are inessential to us: but this is of no help for cases which strictly extend the set of actual humans. Or perhaps merely possible humans exist actually as 'nonconcrete': again, strangely.

8.3.3.2 Postclassical semantics: world-relative domains

Avoiding metaphysical revisionism requires revising the classical semantics: in the literature, strategies for this are *logically revisionary*, invalidating *BF* and *CBF*. In intuitive terms, their validity stems from the 'absoluteness', or absence of world-relativity, of the individual domain on the classical approach: if a possible world in which certain parents beget requires a domain including their child, then the possibility of that world requires that child to inhabit the domain for any other possible world, including a world in which the parents do not beget; conversely, if a possible world in which certain parents do not beget requires a domain excluding their child, then the possibility of that world excludes the child from the domain for any other possible world, including a world in which the parents beget. The canonical way to avoid this, then, relativizes the individual domain to a possible world—permitting the domain for the begetting-world to include the begotten, while the domain for the nonbegetting-world excludes any such thing.

Common to the variety of approaches for implementing this (for details and references see notes 6 and 14) is a function Q mapping a world w to a 'w-relative domain', a subset of the superdomain D ($Q(w) \subseteq D$). With such a Q, for a term τ and world w, let Q_w^τ be a set of assignments containing g just if $k_{g,w}^\tau \in Q(w)$—just if the Q-domain for w contains the g-relative designation of τ for world w: fixing a Q, such a g can be said 'w-designating for τ'. The following postclassical analysis of quantification then replaces ($\forall_{cl}$):

$$(\forall_Q) \qquad \vDash_{g,w} \forall\tau.\varphi := \text{for every } g' \in Q_w^\tau \text{ such that } g' \sim^\tau g, \vDash_{g',w} \varphi$$

('Every τ is such that φ' is true in a world relative to an assignment just if, for every τ-variant of that assignment which, according to Q, maps τ to an entity which exists in that world, φ is true in that world relative to that τ-variant.)

Adjusting the classical quantificational fragment to include ($\forall_Q$) yields the intended logical revision.[14]

Concerning type (1), actual existence–possible nonexistence: we have $\vDash_{g,w} \forall x.\Box\exists y.x = y$ ('everything is necessarily identical to something') just if for every g', an x-variant of g which is w-designating for x, and every world w', there is some g'', a y-variant of g' which is w'-designating for y, such that the w'-designata of x and y, by g'', are identical. Suppose that Bill is in $Q(w)$ but not in $Q(w')$: then, relative to w, Bill is a candidate rigid designatum of x by some g'; but relative to w', Bill is not a candidate designatum of y by any g''; so the sentence is not valid. But by *CBF*, the uncontroversially valid $\Box\forall x.\exists y.\, x = y$ ('necessarily, everything is identical to something') entails it; so *CBF* is invalidated. Concerning type (2), actual nonexistence–possible existence: let F be a predicate and S a subset of the domain such that, in any w, F is satisfied by an entity just if it is a member of S and a member of $Q(w)$. Then $\vDash_{g,w}\forall x.\Box Fx$ ('everything is such that it is necessarily F') just if for every x-variant g' of g which is w-designating for x, and every world w', the w'-designatum of x by g' satisfies F; with x rigid, and if $Q(w) \subseteq S$, this holds by the stipulation for F. But $\vDash_{g,w}\Box\forall x.\, Fx$ just if for every w' and every x-variant g' of g which is w'-designating for x, the w'-designatum of x by g' satisfies F: and with x rigid, whenever $Q(w') \nsubseteq S$, this fails to hold by the stipulation for F—so *BF* is invalidated.

8.4 Relativized metaphysical modality

As announced, the RMM strategy with each of the challenges is to reject the ILP: to distinguish possibility *in light of* which, φ, from possibility that φ. This section expands on this strategy. We begin with technicalities: by stating our proposed non-ILP adjustment to the classical truth-conditions, and explaining how despite advancing nonclassical truth-conditions, we nevertheless avoid the *logical revisionism* of the postclassical approaches. After this we turn to interpretive matters, and explain how we intend also to avoid *metaphysical revisionism*.

This combination of technicalities and interpretation, in the abstract, is what constitutes RMM: though we want to stress that the various solutions to the various puzzles are 'modular', with none requiring any other; more generally, we do not identify RMM with any of these proposals, but rather with their common technical move and its interpretation.

8.4.1 Technicalities: double-indexation

In a 'double-indexing' semantics, truth is relativized to a certain parameter twice over. RMM relativizes twice over to a *world* parameter, providing a definition of truth relative to (perhaps inter alia) a *pair* of possible worlds, notated $\vDash^{v}_{w}\varphi$: in intuitive terms, setting the value of v to a given world involves 'considering that world as actual'; when the value of w is set to a world distinct from the value of v, then from the point of view of that v-world, the w-world is 'considered as counterfactual'. This approach is apt to reject the ILP, at least in structural terms: roughly, possibility *that* φ goes with w-relativity; possibility *in light of which* φ, with v-relativity.

RMM truth-definitions for modality and quantification merely 'up-parametrize' the classical ($\Box_{cl}$) and ($\forall_{cl}$):

$$(\Box_2) \qquad \vDash^{v}_{w}\Box\varphi := \text{for every } w', \vDash^{v}_{w'}\varphi$$

('Necessarily, φ' is true relative to worlds v and w just if, for every world w', φ is true relative to v and w'—true, 'considering v as actual', just if for every w' 'considered as counterfactual', φ is true relative to v and w'.)

$$(\forall_2) \qquad \vDash^{v}_{w,g}\forall\tau.\varphi := \text{for every } g' \sim^{\tau} g,\ \vDash^{v}_{w,g'}\varphi$$

('Every τ is such that φ' is true relative to worlds v, considered as actual, and w, considered as counterfactual, and assignment g just if, for every τ-variant of g, φ is true relative to v, w, and that τ-variant.)

Possibility *that* is represented with w-relativity, possibility *in light of* with v-relativity. (A bit more precisely: relative to v and w, possibility *that blah* is the existence of some w' for which, relative to v and w', it is true that *blah*; while, relative to v and w, possibility that *blah in light of* a possibility is the existence of some v' (a possible world relative to v and w: namely, for some φ, $\not\models^{v}_{v'} \varphi$) such that for some w', relative to v' and w', *blah*—considering v' as actual and w' as counterfactual, *blah*—in evident conflict with the ILP.)

Postclassical apparatus is reassigned to a more fundamental role:

- For the propositional fragment (and the *laws* puzzle), the accessibility relation A from ($\Box_A$) is repurposed to restrict the truth-definition: whether $\models^{v}_{w} \varphi$ is *undetermined* unless $w \in A(v)$.
- For the referential fragment (and *Chisholm's Paradox*), the $\boldsymbol{k}$ parameter is converted to an 'upper' parameter (namely, the truth-definition is for $\models^{v,\boldsymbol{k}}_{w} \varphi$—for the significance of this, see note 18); while the counterpart function κ from ($\Box_\kappa$) is reassigned to, in the evaluation of a term τ, mapping the individual concept (k_τ) it determines in a context, together with a context world v, to an individual concept, with the following effect on the truth-definition for elementary sentences:[15]

$$\left(\Gamma_{2,\kappa}\right) \qquad \models^{v,\boldsymbol{k}}_{w} \Gamma^n \tau^1 \ldots \tau^n := \text{the sequence } \kappa\,(k^{\tau^1}, v)_w, \ldots, \kappa\,(k^{\tau^n}, v)_w \text{ satisfies } \Gamma^n \text{ in } w$$

- For the quantificational fragment (and the *existence* and *nonexistence* puzzles), the domain function Q from ($\forall_Q$) is repurposed to restrict the truth-definition: whether $\models^{v}_{w,g} \varphi$ is *undetermined* unless, for every τ, $g \in Q^{\tau}_{v}$

It should be evident that despite this use of the postclassical apparatus, the truth-definitions in themselves are inadequate to invalidate **S5**, *BF*, or *CBF*: avoiding logical revisionism.

8.4.2 Interpretation

It remains to assess whether RMM avoids *metaphysical* revisionism—an issue to be settled not with a piece of mathematics but with its interpretation. As previously indicated, the v and w indices go with possibility *in light of* and possibility *that*. To complete the interpretation, we discharge this jargon by sketching, first, a 'moderate naturalist' metaphysical account of which phenomena 'in reality' answer to possibility *in light of* and possibility *that*; and, second, a 'Context–Index' pragmatical explanation of why possibility *in light of* is not, eo ipso, possibility *that*.

For reasons of space, we restrict consideration to the laws puzzle involving type (i) undermining—a useful exemplar for both its technical simplicity and the particularly stark interpretive challenge it raises; the remaining puzzles have broadly analogous resolutions.[16]

8.4.2.1 Moderate naturalist metaphysics

Our intended picture is *moderate modal naturalism*: facts about natural law (and, in turn, about metaphysical possibility) have a hybrid explanation: some such facts are underdetermined either by any abstract metaphysical principles alone, or by any actual contingent 'categorical' facts alone, but instead become determined only through the concretization of certain true such principles in actual categorical facts.[17]

Using the analysis of the propositional fragment, the 'metaphysical principle' input is represented by the course of values (varying v) of the set $N(v) = \{w \mid vAw\}$ containing just those worlds accessible from v; the 'actual categorical fact' input is represented by a possible world @ (such that for any proposition p, p is true *simpliciter* just if p is true in @). It is possible *that* such-and-such just if for some $w' \in N(@)$, the set of worlds accessible from the actual world, such-and-such is true in w'. But it is possible, *in light of* a possible world v (considering v as actual), *that* such-and-such, just if for some (counterfactually-considered) $w'' \in N(v)$, the set of worlds accessible from v, such-and-such is true in w''.

Let us now revisit type (i) undermining with this RMM story: by *sensitivity*, the totality of actual categorical facts (represented with @) yield, via the abstract principles, actual laws ($N(@)$) permitting a nonactual totality of categorical facts—an *ok-world*, $v^\dagger$—($v^\dagger \in N(@)$) yielding, via the abstract principles, nonactual laws ($N(v^\dagger)$) permitting a totality of categorical facts—a *bad-world* $w^\dagger$ — ($w^\dagger \in N(v^\dagger)$) forbidden by the actual laws ($w^\dagger \notin N(@)$). By *necessitarianism*, the bad-world $w^\dagger$, which counts *in light of* actual categorical facts (@) and their principle-determined laws ($N(@)$) as an impossibility ($w^\dagger \notin N(@)$) sometimes counts as a possibility *in light of* a possibility (namely, *in light of* the ok-world $v^\dagger \in N(@)$; and *in light of* the ok-world $v^\dagger$, the bad-world $w^\dagger$ is indeed a possibility: $w^\dagger \in N(v^\dagger)$). The ILP would therefore require that the bad-world $w^\dagger$ is a possible possibility. But by the double-indexing semantics for modals ($\Box_2$), the possible possibilities are exactly the possibilities: so the bad-world $w^\dagger$ is a possible possibility only if $w^\dagger \in N(@)$—and it isn't, making for a counterexample to the ILP.

8.4.2.2 Context-Index pragmatics

Consider a (v-independent) sentence—the *bad-sentence*, $\varphi^\dagger$—false (for every v) in every $w' \in N(@)$ but true (for every v) in the bad-world $w^\dagger$: we claim that the bad-sentence $\varphi^\dagger$ is a *mere* possibility *in light of* a possibility. One might reasonably complain: why 'mere'? Why isn't there some reasonable sense in which the bad-world $\varphi^\dagger$ remains *possible*? (A very 'broad' sense it may well be—but *metaphysical* possibility, our target, is after all supposed to be the 'broadest' form of possibility.) But otherwise, how can we claim to preserve *necessitarianism*?

Our answer appeals to the *Context–Index* (CI) pragmatics (as codified in Lewis 1980a): this interpretation of double-indexation sees the truth-value of a natural language sentence as relativized to a possible world both *as index* and *as context*. The two central ideas are these: the truth-value of a sentence φ as asserted in a possible world w^* is that of φ relative to w^* both *as index* and *as context*; by the rules of language, index-relativity is amenable to control by operators such as modals, while context-relativity is protected against such control. So in the course of compositional determination of the truth-value of an assertion in w^*, worlds other than w^* may be involved *as index*, but only w^* is ever involved *as context*.

We intend w-relativity to be *indexical*, v-relativity to be *contextual*.[18] Accordingly,[19] for a sentence φ, any assertion of φ in the actual world @ is true just if $\vDash^{@}_{@} \varphi$ (just if true relative to the actual world both as context and as index); and for any operator O which could be used in natural language, whether $\vDash^{@}_{@} O\varphi$ (whether an actual-world assertion of $O\varphi$ is true) is determined by the course of values, varying w, of whether $\vDash^{@}_{w} \varphi$ (of whether φ is true relative to the actual world *as context*, but relative to an arbitrary world *as index*). Presumably a natural language operator never counts as a *possibility modal* if sometimes $\vDash^{v}_{w} O\varphi$ (if for some context-world v and index-world w, $O\varphi$ is true relative to v and w) when for no w', $\vDash^{v}_{w'} \varphi$ (when there is no index-world w' with φ true relative to the old v as context and the new w' as index); so, because it is determined whether $\vDash^{@}_{w} \varphi$ (whether, with an actual-world context and specified-world index, φ has a truth-value) only if $w \in N(@)$—only if w is an actual-world nomological possibility—and for all v and all $w \in N(@)$, $\nvDash^{v}_{w} \varphi^{\dagger}$ (the bad-sentence is false whatever the context-world, if the index-world is nomologically accessible from the actual world), then O cannot count as a possibility modal if $\vDash^{@}_{@} O\varphi^{\dagger}$ (if $O\varphi^{\dagger}$ is truly asserted in the actual world). Finally, we insist on the unintelligibility of any sense in which φ is 'possible' unless natural language contains or is extensible with some possibility modal operator O for which $O\varphi$ is truly asserted: so, as desired, the fact that $\vDash^{v^{\dagger}}_{w^{\dagger}} \varphi^{\dagger}$—the fact that, relative to the ok-world as context and the bad-world as index, the bad-sentence is true—yields by itself no intelligible sense in which $\varphi^{\dagger}$ is possible.

On the CI pragmatics, our actual uses of sentential operators cannot give us access to nonactual values of v: we are stuck in our actual world context, from which sentential operators are powerless to dislodge us. Yet we can access nonactual values of v: just not through language alone. In 'serious' assertion there is no hope: the v-parameter is inexorably actualized by our actual world context. Fortunately, our assertions are not always serious: sometimes, we introduce a supposition, and for a while perform assertions against that background; if the supposition is that the ok-world $v^{\dagger}$ *is actual*, then (while the supposition remains in force) what matters to us in asserting φ is not the *real* truth-value $\vDash^{@}_{@} \varphi$ but the truth-value *within the supposition* $\vDash^{v^{\dagger}}_{v^{\dagger}} \varphi$. To introduce such a supposition is to commence 'considering the ok-world $v^{\dagger}$ as actual' (Jackson 1994). While the supposition is in force, we are right to assert $\Diamond\varphi^{\dagger}$ ('possibly, *the-bad-sentence*'); once the supposition is canceled, we are right to assert what is true, namely $\neg\Diamond\varphi^{\dagger}$ ('it is impossible that *the-bad-sentence*'). The assertability of $\Diamond\varphi^{\dagger}$ within the supposition does not give any sense in which $\varphi^{\dagger}$ is possible, or possibly possible: the supposition is *false*; what we assert within it is *mere pretense*: correct assertion of possibility within a mere pretense is not eo ipso any kind of genuine possibility, and eo ipso nothing more than pretend possibility. (No more so, anyway, than pretending that this easy chair is a bison makes it a genuine bison.)

8.5 Concluding historical speculation

Double indexation is an old and venerable tool, invented in 1968 (Kamp 1968), published first in 1970 (Lewis 1970a) and then by its inventor in 1971 (Kamp 1971), and put to a wide array of high-profile philosophical uses since then (Kaplan 1977; Stalnaker 1978; Chalmers 2010). Why then do the literatures on the various metaphysical puzzles overlook our RMM solution? Several distinguishable barriers may be collectively relevant (with barriers to initial uptake persisting as barriers through the general path-dependence of scholarly traditions).[20]

First, the postclassical tools are all older than double indexation: accessibility was invented in the mid-to-late 1950s (see Copeland 2002: compare Meredith and Prior 1956, Kripke 1959); counterpart theory, first announced in a letter to Føllesdal from 6 March 1966,[21] was published soon after (Lewis 1968); domain relativity was invented in the mid or late 1950s (Kripke 1963).

Second, the literatures are themselves old (with their order of genesis reversing the complexity of the classical analyses they challenge): the *ontology* puzzle arises together with its postclassical treatment (compare Kripke 1963 on Sherlock Holmes); the *essence* puzzle arises in the late 1960s (Chisholm 1967; independent rediscovery, Lewis 1968, 28, together with its postclassical treatment); and the *laws* puzzle, discovered only somewhat recently (Carroll 1994, sect. 3.1) and overlooked until quite recently (Fine 2005, 243–8), was perhaps implicit in Lewis's early antinecessitarian development of best-systems theory (which was, moreover, in service of a *single-indexing* analysis of the counterfactual conditional: Lewis 1973).

Third, a leading figure in the literatures, David Lewis, was by his own acknowledgement (Lewis 1980a, 42) 'compartmentalized' in his theorizing in early days, in some moods using double-indexing (Lewis 1975), in others overlooking it (Lewis 1970b); Saul Kripke, casting a long shadow on the literatures, would not to our knowledge explicitly discuss double-indexing.

Fourth, double-indexing is not yet the diagonal account of consequence as developed in Kaplan 1977: as observed briefly in note 17, the deep story makes critical appeal to this; but the metatheory of diagonal consequence poses inherent challenges, with attendant delays in its uptake in metaphysical application.

Fifth, the CI pragmatics developed gradually over the late 1970s (compare Kaplan 1977; Stalnaker 1978), and only reached its final form in Lewis's 'Index, context, and content' (Lewis 1980a)—that last, moreover, was not collected in Lewis's *Philosophical Papers* and long escaped wider attention (and is, moreover, an odd, protean paper)—and in addition, was applied most prominently to explaining apriori knowledge (Kaplan and Stalnaker, among others), an issue remote from the literatures on the metaphysical puzzles. Moreover, the tradition in analytic philosophy is to do linguistic analysis at the level of the semantics of the sentence: still poorly integrated are such acts and attitudes as *supposition* and *assertion*, to which RMM makes crucial appeal.

Sixth, grasping the commonalities among the various puzzles requires understanding counterpart theory *as a semantics*: Lewis never presented it as such, and in consequence such a treatment was entirely lacking until Fara's (2008, 2012) work of the last decades; this in particular obscured its logical significance, with prominent discussion of CP in the 1980s failing to see the connection to **S5** revision (and, anecdotally, the connection remains poorly recognized even today).

Notes

1 The issues here are wide-ranging in subject matter and straddle subdisciplinary borders, and they are also intricate technically and challenging conceptually. To give more than a sketch, a great deal should be said. Because of space, our sketch here ignores much, and often without comment: hopefully enough is sketched for novices to get the gist and for experts to fill in what we leave out.

2 But see note 17.

3 For example: care with parentheses; the free swapping of 'official' and 'unofficial' object-language expressions; the distinction between constant and variable terms; the valuation-relativity of base-expression truth and satisfaction; the distinctions among frames, structures, and models; the distinction between syntactic and semantic consequence, with familiar metalogical correspondence results presupposed.

4 Namely, 'normality'—as axioms, all propositional tautologies, and the principle *K*: $\Box(\varphi \supset \psi) \supset (\Box\varphi \supset \Box\psi)$ ('necessities don't entail contingencies'); as rules, *modus ponens* and *necessitation* (the latter requiring inclusion of $\Box\varphi$ for every included φ).

5 One principle that is *not* validated is *NI* (the 'necessity of identity'; compare Kripke 1980, 3–5): $\tau = \tau' \supset \Box(\tau = \tau')$—perhaps *the professor is the janitor* is an intuitive counterexample. Still, *NI* is valid for a subfragment containing only rigidly designating terms.

6 Various options from Garson's (1984, 250) systematization of quantified modal semantic theories are available: fixed-domain approaches are systems **Q1** (Kripke 1963), in a rigid subfragment with constant terms; and **QC** (Garson 1984, 265–6), with nonrigid variables. As Garson observes, quantification over individual concepts is equivalent in strength to second-order quantification, so that **QC** lacks any complete axiomatization; and moreover, **QC** problematically validates 'something is necessarily the author of counterpart theory'.

7 Moreover, in combination with the Context–Index pragmatics treatment of speech act content (Lewis 1980a, 37–8), each postclassical analysis faces what we call the 'Generalized Humphrey Problem' (locus classicus: Kripke 1980, 45 n. 13) against counterpart theory; but also, on the most charitable readings, Lewis's 'by what right' objection (Lewis 1986b, 246) against accessibility semantics and Williamson's accusation (Williamson 1998, 263) that relative domains theory is 'philosophically unsatisfying'). Very roughly, the problem is that the postclassical analyses 'change the subject', with the truth-condition for $\Box\varphi$ sometimes diverging from the condition for the content of φ to be necessary. Space prohibits further treatment.

8 For best-systems undermining, see Lewis 1986b, 20; for Aristotelian undermining, see Fine 2005, 244–5, following Carroll 1994, sect. 3.1. The terminology is from Lewis 1986a, xv, discussing Lewis 1980b—compare Fine 2005, 246 n. 16.

9 We do not know of an author advocating this approach to the laws puzzle; more generally, the literature on this puzzle is poorly developed.

10 A possible point of controversy: many advance a weaker condition, that necessarily, *if a exists*, then *a* is *F*. This pertains to the further issue of the interaction of modality and quantification, so we set it to the side.

11 The vagueness of 'small/big enough' is not relevant.

12 Forbes's approach differs importantly from Lewis's in offering a more complex, contextually ambiguous translation scheme, potentially with logically non-revisionary semantical results comparable to those available through our proposal ($\Gamma_{2,\kappa}$): space prohibits adequate consideration of Forbes's approach. Thanks to Forbes for discussion.

13 Stereotypically—and, indeed, per both leading partisans to the debate (Lewis 1968, 28 and Kripke 1980, 45 n. 13)—counterpart theory is a metaphysical doctrine that nothing exists in more than one world. But any reasonably permissive metaphysics of 'derivative' objects can insist only that 'fundamental' objects be thus 'worldbound': allowing even for rigid designation and *NI* (see note 5) with this metaphysics; through its use of individual concepts, the classical, **S5**-validating semantics is compatible with the worldbound metaphysics: so the latter cannot by itself help with the essence puzzle; and the schematic way with the essence puzzle in the main text is compatible with rigid designation and transworld individuals.

14 Further issues remain to be settled for a determinate position in the Garson taxonomy, as discussed in note 6. Of just the approaches avoiding free logic and truth-value gaps: with all terms rigid and without constant terms, the result is system **QK** (Kripke 1963); with nonrigid variables (and otherwise making maximally straightforward choices), **Q2** (Thomason 1969).

15 The contextual occurrence of ***k*** is preserved for two reasons: first, pedagogically, to highlight the contrast with the counterpart-theoretic formulation ($\Box_\kappa$), in which the parameter occurs indexically, and thereby exemplify the general strategy here of moving indexical parameters to contextual parameters; and second, doctrinally, to permit the potential for primitive metaphysical context-sensitivity in term-designation, broadly along the lines considered in Lewis 1971. Thanks to Cian Dorr for encouraging greater explicitness in stating and elucidating the view here.

16 For *laws*, see Murray and Wilson 2012, sect. 3 and Murray 2017, ch. 3 (though the former deals with a somewhat different challenge, apparently requiring partitioning modal space by laws).

For *CP*, see Murray and Wilson 2012, sect. 2 and Murray 2017, ch. 4 (though where the former invokes ($\Box_2$) and the restriction of truth-conditions as part of a more broadly 'accessibilist' outlook, the latter invokes ($\Gamma_{2,\kappa}$) on behalf of a more broadly 'counterpart theoretic' approach. Our 'official' stance is that the RMM framework makes room for both options, remaining neutral between them and permitting the choice to be settled on the merits).

For *existence* and *nonexistence*, see Murray 2017, ch. 5.

17 The full story involves 'diagonal' logical consequence. The hybrid explanation maintains that, where φ is a consistent maximally specific statement of categorical facts, there is some sentence λ^φ giving a full statement of laws, such that $\vdash \varphi \equiv \lambda^\varphi$—namely, $\vDash_v^v \ \varphi \equiv \lambda^\varphi$ for every v. Diagonalization is needed because while φ is contingent ($\nvdash \varphi \supset \Box\varphi$), λ^φ is noncontingent ($\vdash \lambda^\varphi \supset \Box\lambda^\varphi$)—a substitution-failure between logical equivalents, both structurally analogous to the familiar equivalence between the contingent φ and the noncontingent *actually*, φ, and handled with the same logical apparatus.

18 More generally, 'upper' parameters are contextual, 'lower' parameters indexical.

19 To save space, two gross simplifications: technically, we neglect relativity of truth to non-world parameters; conceptually, we treat the propositional modal fragment with our double-indexing semantics as representative of all natural language modal discourse, sidestepping many important complications.

20 To save space, our focus here is on tractable and therefore narrowly 'technical' barriers; as for candidate barriers arising from a putative philosophical consensus—'scientism'; a striving for 'objectivity'; a 'universalist' conception of logic; Kantian hangovers from the Vienna Circle; metaphysical antinaturalism; discomfort with 'perspective'; an association between possibility and meaning—whether genuine or not, the matter is too big to settle here.

21 http://www.projects.socialsciences.manchester.ac.uk/lewis/wp-content/uploads/2018/05/Lewis-David-to-Follesdal-Dagfinn-06.03.1966.pdf

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