

## Detailed Description

**Context** The context for our project consists, centrally, of (I) the well-known relational (‘possible-worlds’) semantics for modal propositional logic and its various extensions to modal predicate logic, a technical resource first flourishing from the late 1950s and over the course of the 1960s. The context is filled out by two branches from this central component, each of them first flourishing from the late 1960s over the course of the 1970s: (II) the ‘modal metaphysics’ tradition of reading metaphysical interpretations into the technical resources from (I) and/or invoking these resources to shed light on pre-existing metaphysical questions; and (III) the ‘modal pragmatics’ tradition of extending the resources from (I) to accommodate the broadly pragmatic phenomena of context-sensitivity and speech-act content.

(I) Contemporary research into the logic of modalities commenced in the opening third of the twentieth century, with CI Lewis’s syntactic exploration in [75] of a variety of systems of intensional logic; roughly concurrently, the conception of a possible-worlds semantics was nascent in Wittgenstein’s *Tractatus* [154], with its informal theory of sentence-meanings as truth-conditions on possible states of affairs. The 1940s witnessed Carnap’s gradual accretion [12–14] of certain central elements of a *Tractatus*-inspired possible-worlds semantics for an elementary modal predicate logic (with its propositional fragment the strongest non-trivial modal propositional system, Lewis’s S5, and the modality interpreted as a universal quantifier over worlds); alongside this early semantical work came Ruth Barcan’s [2–4] contributions to the development of axiomatic modal predicate logic. Over the 1950s, scattered efforts by a number of authors would gradually integrate these semantical and syntactical strands, culminating in the near-simultaneous publication by Hintikka [57], Bayart [5], and Kripke [69] of completeness proofs for quantified S5, and later by Kripke [70] for many sub-S5 propositional systems.<sup>1</sup>

The apparatus of relational semantics for propositional modal languages is robust, and familiar in philosophy: a ‘frame’ pairs a set of ‘possible worlds’ with an ‘accessibility relation’ over them; a set of frames  $\mathbf{F}$  characterizes a propositional modal system  $\mathbf{S}$  as the set of all sentences true under any valuation in any world from any frame in  $\mathbf{F}$ , where, in particular, for a frame with accessibility relation  $R$ ,  $\Box\phi$  is true in world  $w$  just if  $\phi$  is true in world  $w'$  whenever  $R(w, w')$ . The strength of  $\mathbf{S}$  varies (in a richly-explored manner) with the constraints on ‘accessibility’: so the set of all equivalence frames (with  $R$  an equivalence relation) characterizes the system S5 (the normal modal system with axioms  $T: \Box p \supset p$ ;  $4: \Box p \supset \Box\Box p$ ; and  $B: p \supset \Box\Diamond p$ ); while the set of all reflexive, transitive frames characterizes the system S4 (with axioms  $T$  and  $4$ ); and so forth.<sup>2</sup>

Semantical analysis of modal predicate languages is perforce more complex, its robustness attenuated proportionately, with the most straightforward implementation impeded by immediate philosophical worries. That implementation enriches relational semantics with an individual domain, while analyzing  $Fa$  as true in  $w$  just if  $F$  is satisfied in  $w$  by the denotation of  $a$  (perhaps, following Carnap, by the  $w$ -value of the ‘individual concept’ assigned to  $a$ ), and  $\forall x Fx$  as true in  $w$  just if  $F$  is satisfied in  $w$  relative to the entire domain: but these analyses validate  $\Box\exists x x = a$  (‘necessarily,  $a$  is something’) and represent quantifiers and modals as freely commutable, yielding the so-called ‘Barcan Equivalence’ of  $\Box\forall x \phi$  and  $\forall x \Box\phi$ —thus predicting the putatively unattractive necessity of existence and nonexistence. Weaker systems require more intricate characterizing semantical analyses; an assortment have been proposed, each facing generally recognized shortfalls of either technical or conceptual adequacy. Such shortfalls are mirrored in attendant complications to the underlying (axiomatically characterized) logic: ‘classical’ modal predicate logic in the style of Barcan and Carnap is sound and complete relative to the straightforward semantical implementation noted above, and so includes both  $\Box\exists x x = a$  and the Barcan Equivalence as theorems.<sup>3</sup>

<sup>1</sup>For detailed analysis of this period, see [25]: signal works discussed are [101, 63, 64, 147, 102, 104, 69, 71, 58].

<sup>2</sup>Overviews of these issues abound; a small selection: [20, 26, 6].

<sup>3</sup>For a systematic, opinionated overview of the technical options, see [46–48], and [152, Ch. 3].

(II) Shortly following (or sometimes concurrently and in concert with) these technical developments, theorists came to notice a variety of applications, particularly in the analysis of the conceptual repertoire of the natural sciences; and also a variety of interpretive challenges, pertaining especially to ontology (among these latter are ‘Chisholm’s Paradox’ from the Summary description, and also the ‘Barcanite’ issue just now briefly sketched). This cluster of applications and challenges has over the interim coalesced into an identifiably, if somewhat diffusely, interconnected literature on ‘modal metaphysics’, with its highly influential touchstone works Kripke’s [72] and DK Lewis’s [87] (notably also: [114, 145, 131, 37, 54]). We now sketch three such challenges fitting the STABILITY/DEPENDENCE structure noted in the Summary—severally cutting across the logical types addressed in (I), collectively illustrating the broad significance of modal perspective.

(A) An *undermining* puzzle about laws of nature. A STABILITY principle here would exclude inter-world variability in the truth-value of  $\varphi$  whenever it is a *law of nature* that  $\varphi$ . On its behalf, *necessitarians* cite the explanatory power of appeals to law: 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 virtuously avoids the peculiar 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?’.<sup>4</sup> If, as is generally agreed, the logic of metaphysical necessity is S5, this reasoning excludes such variability.

But a powerful case for DEPENDENCE (admitting such variability) comes from the idea that the laws of nature should be sensitive to the ‘categorical’ facts on the ground—on pain of being ‘brute’, inexplicable sources of constraint without reciprocal responsibility to the categorical—an idea incorporated by leading theories of laws: perhaps the laws are the simplest, strongest systematization of the categorical facts (‘Humean’ laws); or perhaps properties carry their causal powers essentially, and the laws are generated by the categorical fact that exactly *these* properties are instantiated (‘Aristotelian’ laws). But this sensitivity predicts *undermining*—actual categorical facts yielding actual laws permitting categorical facts yielding different laws differently permitting categorical facts: perhaps *richly*, permitting actually forbidden possibilities; or perhaps *leanly*, forbidding actualities. Within the literature, DEPENDENCE theorists forego the explanatory power of necessitarianism; though the prospect exists of ‘accessibilism’ (as under (B)) for metaphysical necessity (abandoning *transitivity* for *rich* undermining, or *symmetry* for *lean* undermining).<sup>5</sup>

(B) *Chisholm’s Paradox* of individual essence. Recall the ‘Summary’ example of hammer *H* actually built from iron+oak: the STABILITY principle moves from *H could (metaphysically) not have been built from lead+elm* and its metaphysical necessity, along with the S5 logic of the latter to the unavailability of any possible world verifying *H could have been built from lead+elm*; while the DEPENDENCE principle proceeds from *H could have been built from iron+elm* (or *H could have been built from lead+oak*) together with reasoning by parity between actuality and an iron+elm-world (single-part replacements are possible in both or neither) to the truth at an iron+elm-world of *H could have been built from lead+elm*.

Within the literature, some resolutions of the conflict abandon STABILITY: whereas with (A), the *it is a law of nature* operator may be weakened below S5, the only operator available for such weakening in (B) is *metaphysical necessity*. One such strategy adopts an ‘accessibilist’ structure for metaphysical necessity, declaring a world in which *H* is made from lead+elm to be actually ‘inaccessible’ (and thus impossible) but ‘accessible’ from an iron+elm-world (and thus ‘possibly possible’). But a sub-S5 logic is also attainable via a ‘counterpart’ semantics, according to which the shifts in index-world induced by a modal operator can adjust the individual concept assigned to an embedded term: then we may allow that, contrasting the actual world *a* with an iron+elm-world *w*, indexing to the one rather than the other shifts

<sup>4</sup>For defense, see [96, 98]; and in the context of the undermining puzzle, [39, p. 247].

<sup>5</sup>Humean: [80, sec. 3.3]; Aristotelian: [129]. Humean undermining: [87, p. 20]; Aristotelian undermining: [15, sec. 3.1], [39, p. 244–5]; ‘undermining’: [86, p. xv] on [84]—compare [39, p. 246n16].

the individual concept for ‘*H*’ so that, in a lead+elm-world, indexing to *w* yields a lead+elm aggregate but indexing to *a* does not—thereby verifying both *H could not have been built from lead+elm* and possibly, *H could have been built from lead+elm* (the former because the index for ‘could’ is fixed to *a*, and the latter because the embedding modal shifts it to *w*).<sup>6</sup>

Other resolutions abandon DEPENDENCE: ‘mereological essentialism’ rejects *H could have been built from iron+elm* (dually, ‘antiessentialism’ admits *H could have been built from lead+elm*); while a ‘sharp cutoff’ view denies any legitimacy to reasoning by parity from an iron+elm-world: folks there accept *H could have been built from lead+elm*, but are brutally wrong in doing so. **Still other resolutions preserve both STABILITY and DEPENDENCE only by substantially complicating the ‘simple and intuitive’ logic and metaphysics that generate the apparent puzzle.**<sup>7</sup>

(C) A Barcanite challenge about the necessity of existence and nonexistence. Very briefly: can there be inter-world variability in truth-value of statements of ontology (to the effect, perhaps, that the cardinality of the existents is exactly such-and-such; or that some individual (designated ‘de re’) exists; or that some essential, severally unsatisfiable predicate is satisfied or not)? On behalf of STABILITY is the simplicity and strength of the Barcan–Carnap logic and semantics resulting if it cannot. But on behalf of DEPENDENCE is the thought that, for a certain human *d*, whether *d* exists depends on whether their parents engaged in appropriate begetting activity: in possibilities where they do not, matter is not ordered in a way sufficient for *d* to exist as a human; and if *d* is a human, *d* is essentially so, and could not possibly exist as ‘contingently nonconcrete’.<sup>8</sup>

(III) The end of the 1960s witnessed breakthroughs in the application of intensional semantics to broadly ‘pragmatic’ phenomena, particularly through the isolation of an important distinction in the broader category of ‘context-sensitivity’, a distinction giving rise to certain logical peculiarities. The fundamental technical resource for accommodating these phenomena, developed in the early 1970s, was a ‘two-dimensional’ (2D) foliation of the earlier intensional semantics. Later in the decade, epistemologically-minded theorists located within the expanded approach the representational import of its ‘horizontal’ and ‘diagonal’ projections; this, in turn, led to the discovery of the ‘as-counterfactual’/‘as-actual’ contrast in modal perspective mentioned in the Summary.

To expand. A long-standing interest of logicians of tense was the ‘indexicality’ of temporary sentences like *the sun is in eclipse* in interaction with temporal operators like *always* or *henceforth*: analogously to the world-semantics for a contingent sentence like *Hamilton was born on Nevis* and the quantificational action of modals, a moment-semantics relativizes truth-value to moments of time (perhaps under a certain ordering), and analyzes *always* as a universal quantifier over moments. The category of ‘indexicality’ was unsettled by Kamp’s 1967 discovery (*avant le lettre*) of the ‘rigidifying’ action of *now*: the apparent logical validity of *ϕ just if now, ϕ* is not sustained through embedment under *always*; a generalization to the modal case, swiftly observed by DK Lewis, involves the rigidifying *actually*: the apparent logical validity of *ϕ just if actually, ϕ* is not sustained through embedment under *necessarily*.<sup>9</sup>

The early 1970s subsumed proposals of Kamp and Lewis under a general ‘double-indexing’ framework assigning truth-values along two ‘dimensions’ and providing a ‘diagonal’ or ‘real-world’ analysis of logical consequence. For modals, truth is relativized to both an ‘index’- and a ‘context’-world; the data of

<sup>6</sup>Accessibilism: [19, 122, 123]; objections: [87, pp. 246–8], [149, sec. 8.3]. Counterpart theory: [76, 79, 89]; as a semantics: [32, 34], [56, sec. 3.2.2]; objections: [55, 155, 35, 33]; and CP: [41], [87, p. 248]; objections: [149, sec. 8.3].

<sup>7</sup>Essentialism: [21–23, 158, 141]; objections: [115, 148, 68]; antiessentialism: [100]. Sharp cutoff: [149]. Complicated logic: [41]; complicated metaphysics: [74, 59, 156].

<sup>8</sup>‘Barcanists’ siding with STABILITY: [157, 94, 95, 150, 153]. Barcanism and the ‘contingently nonconcrete’: [95], [150, p. 266], [153]. Contingent existence: [46, p. 257], [150, p. 258], and cites in [153, ch. 1]; nonexistence: [71, pp. 65–6], [150, p. 258]. The canonical ‘domain relativization’ semantics for DEPENDENCE: [71, 134]; complaints: [46, 47, 150, 153]; taxonomy of other strategies: [46, p. 250]; ‘individual concepts’: [144, 47]. An approach with some affinity to RMM: [38].

<sup>9</sup>‘Indexicality’: [105, 106, 78]. ‘Rigid’: [72]; rigidification: [65, 66, 118, 77].

the embedment puzzle are then explained thus: relative to worlds  $i$  and  $c$ , *necessarily*,  $\phi$  is true just if for every world  $i'$ ,  $\phi$  is true relative to  $i'$  and  $c$ , while *actually*,  $\phi$  is true just if  $\phi$  is true relative to  $c$  and  $c$ ; and  $\phi$  is logically valid just if (on all frames and valuations) for every world  $c$ ,  $\phi$  is true relative to  $c$  and  $c$ .<sup>10</sup>

Later in the decade, various theorists noted an affinity to, and thus a prospect of interpreting, Kripke's dissociation of metaphysical necessity from apriority:  $\phi$  *just if actually*,  $\phi$  is predicted to be logically valid and thus presumably apriori—but with its embedment under *necessarily* not valid, is predicted to be not metaphysically necessary; while the above apriority suggests that *actually*,  $\phi$  has the same epistemic status as  $\phi$ , so that both are aposteriori if either is—but *actually*,  $\phi$  is predicted to be noncontingent.<sup>11</sup>

Late in this literature, 'consideration as actual' was coined to label reasoning about truth-values along the diagonal; during a mid-1990s resurgence of interest, 'consideration as counterfactual' was applied to reasoning about truth-values along the horizontal. This terminology drove an eventual explanatory theory of the Kripkean dissociation: what we care about in valid reasoning is security against error about how things *are* (actually); while metaphysical necessity is manifestly concerned with how things *could be* (counterfactually)—thus, the dissociation stems ultimately from a distinction in *modal perspective*.<sup>12</sup>

**Objectives and methodology** Despite the roughly concurrent appearance and early development of components (II) and (III) of the context, each long unfolded in large part or entirely in isolation from the other. Their mutual relevance, as sketched in the Summary, is that each puzzle in (II) can be resolved by appeal to the distinction in modal perspective from (III): to wit, it is variation in the world considered *as counterfactual* which displays the putative STABILITY, whereas the putative DEPENDENCE appears varying instead the world considered *as actual*—so the appearance of conflict is engendered by an equivocation of modal perspective. This observation was to our knowledge first published in 2012 by Murray and Wilson [110]; what has since come to be known as the 'Relativized Metaphysical Modality' (RMM) program develops the observation in service of a systematic reassessment of a variety of subregions of metaphysics. Hellie joined the RMM program as the co-supervisor (with Wilson) of Murray's dissertation [108], and was the primary drafter of the overview [56] (the puzzles in (II) are expanded on there in sec. 3, and technicalities of RMM resolutions sketched in sec. 4).<sup>13</sup>

The objective of our proposed research is to contribute to the rounding out and completion of the RMM program. The considerations involved are broadly distributable into: (IV) issues in metaphysics, including the metaphysics of science; (V.i) questions in philosophy of language; (V.ii) questions in philosophical logic; and (VI) matters of historical development. **Hellie's areas of expertise are more weighted toward the technical and historical, with contributions to the program falling primarily under (V.i) and (VI), and in localized subregions of (IV). Murray's areas of expertise tend towards the metaphysical and the logical, with contributions to the program falling primarily under (IV) and (V.ii), and associated subregions of (VI). Wilson's relevant expertise lies in metaphysics and in particular the metaphysics of science, with contributions to the program falling primarily under (IV) and significant subregions of (VI). During the granting period, we propose to each publish several papers developing aspects of the RMM program as it distributes across these respective areas. This individual research will then fold into a collaboratively authored book, the aim of which will be to provide comprehensive coverage and defense of the RMM framework. [We now say a bit more about the relevant areas above?**

(IV) An initial aspect of the metaphysical component involves a canvas of the literature for further puzzles fitting the same schematism and potentially resolvable along analogous lines: several examples stand out (preliminarily to a more thorough survey). Closely resembling (A) is Lewis's 'Big Bad Bug'

<sup>10</sup>Double indexation: [128]; diagonal consequence: [146, 67, 42, 43]; opposition: [27, 29, 51, 52]. 'Index'/'context': [82].

<sup>11</sup>2D and Kripke: [81, pp. 172–3], [67, 133, 31, 29].

<sup>12</sup>'As actual': [29]; 'as counterfactual': [16, 62]; resurgence: [61, 91, 7, 136, 17, 18, 49].

<sup>13</sup>For reactions to RMM, see [142, 45, 120, 30] **Yagisawai, Bassford, Forbes in prog.?**

concerning objective chance, with its well-known conflict between the conceptual role of chance (a source of STABILITY) and an attractive metaphysics (a source of DEPENDENCE—indeed, the ‘undermining’ considerations in (A) are directly analogous to phenomena Lewis so labels). Resembling aspects of both (A) and (B) is a tension between views of metaphysical truth as sensitive to each world’s deep categorical structure (thus motivating DEPENDENCE as regards the hypotheses of fundamental metaphysics), and conceptions of metaphysical inquiry as aimed at the uncovering of universal (and so invariant) truths concerning the nature of things (thus motivating STABILITY). A direct application of (C) is a well-known tension (arguably tracing to the *Tractatus* case for the necessity of objects, and thus their simplicity, and thus a logically perfect language) between the conception of propositions as sets of worlds (motivating STABILITY concerning the existence of propositions) and the thought that some propositions are ‘object-involving’ or *de re* (motivating DEPENDENCE).<sup>14</sup>

A further aspect involves situating, as against the theoretical backdrop of RMM, a wide swathe of concepts and distinctions in the toolkit of contemporary modal metaphysics, variously/independently introduced in recent decades in response to aspects of the stability-dependence puzzle (specifically the Barcanite issue). Such concepts and distinctions include: that between ‘inner’ and ‘outer’ conceptions of truth and falsity at a world [Adams, Fine, Stalnaker]; a contrast between ‘weak’ and ‘strong’ varieties of metaphysical possibility and necessity [Prior, Turner]; a parallel contrast between ‘worldly’ and ‘unworldly’ truth and falsity (and corresponding grades of necessity. Applications of/investigations employing these notions: pull in different, often incompatible, directions; each is subsumable under the broader aegis of the ‘as-actual’/‘as-counterfactual’ contrast. [Thus a kind of theoretical amelioration of a wide swathe of contemporary modal metaphysics and semantics].<sup>15</sup>

A final aspect involves the development of an underlying, explanatory picture: how can it be that what is metaphysically necessary makes, in some way, an ineliminable appeal to how things actually are? In the present context, the 2D apparatus is naturally read as parceling out the component inputs to our reasoning about metaphysical necessity into *specific facts* and *general principles*—the former component associated with the categorical truths about the ‘contextual’ world (the ‘as-actual’ coordinate), and the latter with a system of categorical-to-modal conditionals (those evaluated as true in every ‘diagonal’ coordinate pair). The overall image is of a sort of ‘bounded naturalism’ in metaphysics, in which the limits of possibility for the world (so to speak) project from the (arbitrary, brute) condition of nature, along (absolutely fixed, principled) vectors of logic. This image finds a middle ground between a pure naturalism, on which questions of metaphysics (when sensible) are handed over to natural science; and the more ‘apollonian’ approach of traditional modal metaphysics, in which actuality is constrained by, but has no reciprocal input into, the limits of possibility.<sup>16</sup>

(V.i.ii) Making sense of this bounded naturalism requires delicate follow-on investigations in philosophy of language, in order to thread between a dilemma of complaints that (D) the true notion of ‘metaphysical’ necessity would better apply to our truth in all worlds as-counterfactual, at all worlds as-actual; and that (E) the categorical-to-modal conditionals required to state ‘general principles’ are inexpressible.

(D) The complaint is developed efficiently using the *undermining* puzzle from (II-A). On the view in [56, sec. 4], the actual world, *a*, induces laws of nature verified at just the worlds in a set *L(a)*; among these is an ‘undermining’ world *u* inducing different laws of nature, verified at just the worlds in a distinct

<sup>14</sup>(A): [83, 86, 90] and, inter alia, [50, 143, 1, 97, 8, 113, 9]. (A + B): [10, 112, 121, 103] (contingentism); [130, 36, 40, 125] (necessitism). (C) [154, 2.02–2.0212]; inter alia, [117, 138], and citations in [44]: Murray describes the RMM treatment in [109].

<sup>15</sup>‘Inner’ and ‘outer’ truth: [Adams, Fine, Einheuser, Stalnaker]; ‘strong’ and ‘weak’ modalities: [Prior; Turner]; ‘worldly’ and ‘unworldly’ truth: [Fine].

<sup>16</sup>This polarity is typically manifest as an ‘ethos’ underlying detailed work, with certain works more representative of an ‘ideal type’: [40, 53, 153] (apollonean); [73, 116] (naturalist). Bounded naturalist sympathies appear in, e.g., the case from quantum entanglement to priority monism in [126].



set  $L(u)$ : suppose that this  $L(u)$  contains a world  $w$  not in  $L(a)$ , and thus verifying some sentence  $\phi$  false at every world in  $L(a)$ : according to the nomological necessitarian, this  $\phi$  is metaphysically impossible. But why say this? The world  $w$  is right there, verifying  $\phi$ , after all. Although the consideration of the actual world  $a$  as actual renders  $w$  unavailable for consideration as counterfactual,  $w$  becomes available for consideration as counterfactual upon consideration of the undermining world  $u$  as actual. On the traditional understanding of metaphysical possibility as the ‘broadest’ variety of possibility, attained by lifting absolutely all restrictions on quantification over worlds, it would seem that  $w$  is metaphysically possible: after all, we are speaking about it, apparently requiring our capacity to quantify over it—jumps among directions of modal perspective notwithstanding.

Our response invokes Kaplan’s famous prohibition on ‘monsters begat by elegance’: intensional sentential operators can shift only *indexical* coordinates (such as an as-counterfactual world); shifts in *contextual* coordinates (such as an as-actual world), are beyond [the power of?] natural language.<sup>17</sup> But the complaint in (D) appeals to ‘monstrous’ metaphysical modal operators: the troublesome world  $w$  is beyond the set  $L(a)$  and so no modal operator can quantify over  $w$  with the contextual world fixed to  $a$ ; [upon consideration of  $a$  as-actual?] it would require a monstrous shift of the contextual world to  $u$  in order to bring  $w$  within the domain of modal quantification. Why bar monsters? Briefly, an empirical motivation sees the Kamp/Lewis discrimination of ‘indexical’ from ‘contextual’ dependence as reflecting a real contrast in semantical argument structure: the former a kind of unsaturatedness amenable to control by compositional, language-internal mechanisms, with the latter reserving control to language-external, contextual factors. For a logical motivation, allowing *all* monsters admits a ‘diagonal necessity’ operator  $\Box$  with  $\Box\phi$  a tautology if  $\phi$  is true down the diagonal, and otherwise a contradiction. However, and drawing upon an observation of Williamson’s, the interaction of  $\Box$  with phenomena of rigidification would collapse natural-language truth conditions into trivialities, short of *ad hoc* restrictions of motivation or expressive power. Securing against such collapse thus requires a general ban on ‘monstrous’ operators like  $\Box$ .<sup>18</sup>

(E) Over to the other horn: barring monsters would seem to bar the categorical-to-modal conditionals articulating ‘general principles’, rendering bounded naturalism inexpressible. After all, we grasp these principles by shifting the world considered as actual; so a conditional apt to state such reasoning would be along such lines as ‘if things are actually such that  $\phi$ , it is metaphysically necessary that  $\psi$ ’. But in order to have the intended result, the *if*-clause must somehow shift the world of the *context* against which the consequent is evaluated; and, having barred monsters, it cannot do so through the ordinary semantic activity of an intensional operator—so unless (indicative) *if*-clauses are somehow semantically extraordinary, the intended result is unobtainable, and bounded naturalism is inexpressible. Our response is that *if*-clauses are semantically extraordinary. An ordinary intensional operator—a modal or temporal operator, or the *if*-clause as analyzed by Stalnaker/Lewis—adjusts a coordinate against which its operand is evaluated during semantic composition. In contrast, the shift of context associated with an *if*-clause does not occur during semantic composition, but is instead a ‘postsemantic’ effect, occurring only once a fully composed semantic value must project a certain propositional content against a specified context  $c$ .<sup>19</sup>

(VI) If the distinction in modal perspective has been widely discussed in epistemology but scarcely noticed in metaphysics, why? (F) Technical barriers include: (1) the logical tools exploited by opponents of STABILITY are all older than double indexation (though, contrastingly, a fully *semantic* counterpart theory is relatively recent development); (2) the various puzzles are themselves old; (3) pivotal figures Lewis and Kripke are, respectively, by admission compartmentalized in thinking about double indexation and largely silent about it; (4) the diagonal conception of consequence coalesced later than double-indexation, and certain metatheoretic oddities render it yet controversial; (5) monster-barring remains controversial,

<sup>17</sup>[67, sec. VIII]; also [82, 60, 127, 124, 119, 139].

<sup>18</sup>Empirical: [82, pp. 31–2]. : [151]. Collapse: compare the [24] ‘slingshot’ against [12]; and more generally [111].

<sup>19</sup>‘Ordinary’: [82, pp. 27–31]. ‘Stalnaker/Lewis’: [132, 80]. ‘Postsemantic’: [99]. ‘Selection’: [132, 11].

with its motivation not generally appreciated; (6) standing theories of the conditional are not adequate to bounded naturalism. (G) Conceptual barriers (more speculatively) include: conceptions of metaphysics as ‘apollonian’, untainted by brute circumstance; or as ‘absolute’, requiring ‘objectivity’ and excluding perspectival input; or as hand in hand with logic, the latter envisaged as in tension with perspective-sensitivity.<sup>20</sup> ii

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<sup>20</sup>This sketch is lightly expanded upon in [56, sec. 5].

## References

- [1] Arntzenius, Frank and Ned Hall, 2003. ‘On What We Know About Chance’. *British Journal for the Philosophy of Science*, 54:171–179.
- [2] Barcan, Ruth C., 1946. ‘The Deduction Theorem in a Functional Calculus of First Order Based on Strict Implication’. *Journal of Symbolic Logic*, 11:115–118.
- [3] Barcan, Ruth C., 1946. ‘A functional calculus of first order based on strict implication’. *The Journal of Symbolic Logic*, 11:1–16.
- [4] Barcan, Ruth C., 1947. ‘The Identity of Individuals in a Strict Functional Calculus of Second Order’. *Journal of Symbolic Logic*, 12:12–15.
- [5] Bayart, Arnould, 1959. ‘Quasi-Adéquation de la Logique Modale du Second Ordre S5 Et Adéquation de la Logique Modale du Premier Ordre S5 [Quasi-Completeness of Second-Order S5 Modal Logic and Completeness of First-Order S5 Modal Logic]’. *Logique Et Analyse*, 2:99–121.
- [6] Blackburn, Patrick, Maarten de Rijke, and Yde Venema, 2002. *Modal Logic*. Cambridge: Cambridge University Press.
- [7] Block, Ned and Robert C. Stalnaker, 1999. ‘Conceptual analysis, dualism, and the explanatory gap’. *The Philosophical Review*, 108:1–46.
- [8] Briggs, Rachael, 2009. ‘The Anatomy of the Big Bad Bug’. *Noûs*, 43:428–449.
- [9] Caie, Michael, 2015. ‘Credence in the Image of Chance’. *Philosophy of Science*, 82:626–648.
- [10] Cameron, Ross P., 2007. ‘The Contingency of Composition’. *Philosophical Studies*, 136:99–121.
- [11] Cariani, Fabrizio and Paolo Santorio, 2018. ‘Will done better: Selection semantics, future credence, and indeterminacy’. *Mind*, 127:129–165.
- [12] Carnap, Rudolf, 1942. *Introduction to Semantics*. Cambridge, MA: Harvard University Press.
- [13] Carnap, Rudolf, 1946. ‘Modalities and quantification’. *Journal of Symbolic Logic*, 11:33–64.
- [14] Carnap, Rudolf, 1947. *Meaning and Necessity*. Chicago: University of Chicago Press, second edition.
- [15] Carroll, John W., 1994. *Laws of Nature*. Cambridge: Cambridge UP.
- [16] Chalmers, David J., 1996. *The Conscious Mind*. Oxford: Oxford University Press.
- [17] Chalmers, David J., 2003. ‘On sense and intension’. In James Tomberlin, editor, *Language and Mind*, volume 16 of *Philosophical Perspectives*. Oxford: Blackwell.
- [18] Chalmers, David J., 2006. ‘The foundations of two-dimensional semantics’. In Manuel García-Carpintero and Josep Macià, editors, *Two-Dimensional Semantics: Foundations and Applications*, 55–140. Oxford: Oxford University Press.
- [19] Chandler, Hugh, 1976. ‘Plantinga and the contingently possible’. *Analysis*, 36:106–9.
- [20] Chellas, Brian F., 1980. *Modal Logic: An Introduction*. Cambridge: Cambridge University Press.



- [21] Chisholm, Roderick M., 1967. 'Identity through possible worlds: Some questions'. *Noûs*, 1:1–8.
- [22] Chisholm, Roderick M., 1973. 'Parts as Essential to Their Wholes'. *Review of Metaphysics*, 26:581–603.
- [23] Chisholm, Roderick M., 1975. 'Mereological Essentialism: Some Further Considerations'. *Review of Metaphysics*, 28:477–484.
- [24] Church, Alonzo, 1943. 'Carnap's *introduction to semantics*'. *The Philosophical Review*, 52:298–304.
- [25] Copeland, B. Jack, 2002. 'The genesis of possible worlds semantics'. *Journal of Philosophical Logic*, 31:99–137.
- [26] Cresswell, M. J. and G. E. Hughes, 1996. *A New Introduction to Modal Logic*. Routledge.
- [27] Crossley, J. N. and Lloyd Humberstone, 1977. 'The logic of 'actually''. *Reports on Mathematical Logic*, 8:11–29.
- [28] Davidson, Donald and Gilbert Harman, editors, 1972. *Semantics of Natural Language*. Dordrecht: D. Reidel.
- [29] Davies, Martin and Lloyd Humberstone, 1981. 'Two notions of necessity'. *Philosophical Studies*, 58:1–30.
- [30] Dorr, Cian, John Hawthorne, and Juhani Yli-Vakkuri, forthcoming. *The Structure of Possibility*. Oxford: Oxford University Press.
- [31] Evans, Gareth, 1979. 'Reference and contingency'. *The Monist*, 62:161–189.
- [32] Fara, Delia Graff, 2008. 'Relative-sameness counterpart theory'. *Review of Symbolic Logic*, 1:167–189.
- [33] Fara, Delia Graff, 2009. 'Dear Haecceitism'. *Erkenntnis*, 70:285–297.
- [34] Fara, Delia Graff, 2012. 'Possibility relative to a sortal'. In Karen Bennett and Dean W. Zimmerman, editors, *Oxford Studies in Metaphysics*, volume 7. Oxford: Oxford University Press.
- [35] Fara, Michael and Timothy Williamson, 2005. 'Counterparts and Actuality'. *Mind*, 114:1–30.
- [36] Fine, Kit, 1994. 'Essence and modality'. *Philosophical Perspectives*, 8:1–16.
- [37] Fine, Kit, 2005. *Modality and Tense*. Oxford: Oxford University Press.
- [38] Fine, Kit, 2005. 'Necessity and nonexistence'. In *Modality and Tense*. Oxford: Oxford University Press.
- [39] Fine, Kit, 2005. 'Varieties of necessity'. In *Modality and Tense*. Oxford: Oxford University Press.
- [40] Fine, Kit, 2011. 'What is Metaphysics?' In Tuomas E. Tahko, editor, *Contemporary Aristotelian Metaphysics*, 8–25. Cambridge University Press.
- [41] Forbes, Graeme, 1984. 'Two solutions to chisholm's paradox'. *Philosophical Studies*, 46:171–87.

- [42] Fritz, Peter, 2011. ‘Matrices and modalities: On the logic of two-dimensional semantics’.
- [43] Fritz, Peter, 2014. ‘What is the correct logic of necessity, actuality and apriority?’ *Review of Symbolic Logic*, 7:385–414.
- [44] Fritz, Peter, 2016. ‘Propositional Contingentism’. *Review of Symbolic Logic*, 9:123–142.
- [45] Furtado, Fernando, 2020. ‘S5-Denying Approach to Relativized Metaphysical Modality’. *Manuscrito*, 43:1–40.
- [46] Garson, James W., 1984. ‘Quantification in modal logic’. In Dov Gabbay and Franz Guenther, editors, *Handbook of Philosophical Logic*, volume II. Dordrecht: Kluwer.
- [47] Garson, James W., 2005. ‘Unifying Quantified Modal Logic’. *Journal of Philosophical Logic*, 34:621–649.
- [48] Garson, James W., 2006. *Modal Logic for Philosophers*. Cambridge University Press.
- [49] Gendler, Tamar Szabo and John Hawthorne, editors, 2002. *Conceivability and Possibility*. Oxford: Oxford University Press.
- [50] Hall, Ned, 1994. ‘Correcting the Guide to Objective Chance’. *Mind*, 103:505–518.
- [51] Hanson, William H., 2006. ‘Actuality, necessity, and logical truth’. *Philosophical Studies*, 130:437–459.
- [52] Hanson, William H., 2014. ‘Logical truth in modal languages: Reply to nelson and zalta’. *Philosophical Studies*, 167:327–339.
- [53] Hawthorne, J. and G. Uzquiano, 2011. ‘How Many Angels Can Dance on the Point of a Needle? Transcendental Theology Meets Modal Metaphysics’. *Mind*, 120:53–81.
- [54] Hawthorne, John, 2006. *Metaphysical Essays*. Oxford University Press.
- [55] Hazen, Allen, 1979. ‘Counterpart-Theoretic Semantics for Modal Logic’. *Journal of Philosophy*, 76:319–338.
- [56] Hellie, Benj, Adam Russell Murray, and Jessica M. Wilson, 2020. ‘Relativized metaphysical modality: Index and context’. In Otávio Bueno and Scott Shalkowski, editors, *Handbook of Modality*. London: Routledge.
- [57] Hintikka, Jaakko, 1957. ‘Quantifiers in Deontic Logic’. *Societas Scientiarum Fennica, Commentationes Humanarum Literarum*, XXIII.
- [58] Hintikka, Jaakko, 1961. ‘Modality and Quantification’. *Theoria*, 27:119–128.
- [59] Ishii, Teresa Robertson, 2022. ‘Everything but the Kitchen Sink: How (Not) to Give a Plenitudinarian Solution to the Paradox of Flexible Origin Essentialism’. *Philosophical Studies*, 179:133–161.
- [60] Israel, David and John Perry, 1996. ‘Where Monsters Dwell’. In Jerry Seligman and Dag Westerstaahl, editors, *Logic, Language and Computation*, 1–303. Csl Publications, Stanford.
- [61] Jackson, Frank, 1994. ‘Armchair metaphysics’. In John O’Leary-Hawthorne and Michaelis Michael, editors, *Philosophy in Mind*. Dordrecht: Kluwer.

- [62] Jackson, Frank, 1998. *From Metaphysics to Ethics*. Oxford: Oxford University Press.
- [63] Jónsson, Bjarni and Alfred Tarski, 1951. ‘Boolean Algebras with Operators. Part I’. *American Journal of Mathematics*, 73:891–939.
- [64] Jónsson, Bjarni and Alfred Tarski, 1952. ‘Boolean Algebras with Operators’. *American Journal of Mathematics*, 74:127–162.
- [65] Kamp, Hans, 1968. *Tense Logic and the Theory of Linear Order*. Ph.D. thesis, UCLA.
- [66] Kamp, Hans, 1971. ‘Formal properties of ‘now’’. *Theoria*, 37:227–274.
- [67] Kaplan, David, 1977. ‘Demonstratives’. In Joseph Almog, John Perry, and Howard Wettstein, editors, *Themes From Kaplan*. Oxford: Oxford University Press. Published 1989.
- [68] Kleinschmidt, Shieva, 2014. *Mereology and Location*. Oxford University Press.
- [69] Kripke, Saul Aron, 1959. ‘A completeness theorem in modal logic’. *Journal of Symbolic Logic*, 24:1–14.
- [70] Kripke, Saul Aron, 1963. ‘Semantical Analysis of Modal Logic I. Normal Propositional Calculi’. *Zeitschrift für mathematische Logik und Grundlagen der Mathematik*, 9:67–96.
- [71] Kripke, Saul Aron, 1963. ‘Semantical considerations on modal logic’. *Acta Philosophica Fennica*, 16:83–94.
- [72] Kripke, Saul Aron, 1980. *Naming and Necessity*. Cambridge, MA: Harvard University Press. Reprinted from Davidson and Harman 28, with new preface.
- [73] Ladyman, James and Don Ross, 2007. *Every Thing Must Go: Metaphysics Naturalized*. Oxford University Press.
- [74] Leslie, Sara-Jane, 2011. ‘Essence, Plenitude, and Paradox’. *Philosophical Perspectives*, 25:277–296.
- [75] Lewis, Clarence Irving and Cooper Harold Langford, 1932. *Symbolic Logic*. New York: Century Company.
- [76] Lewis, David, 1968. ‘Counterpart theory and quantified modal logic’. *Journal of Philosophy*, 65:113–26. Reprinted in Lewis 85.
- [77] Lewis, David, 1970. ‘Anselm and actuality’. *Noûs*, 4:175–88. Reprinted in Lewis 85.
- [78] Lewis, David, 1970. ‘General semantics’. *Synthese*, 22:18–67. Reprinted in Lewis 85.
- [79] Lewis, David, 1971. ‘Counterparts of persons and their bodies’. *Journal of Philosophy*, 68:203–211. Reprinted in Lewis 85.
- [80] Lewis, David, 1973. *Counterfactuals*. Cambridge, MA: Harvard University Press.
- [81] Lewis, David, 1975. ‘Languages and language’. In Keith Gunderson, editor, *Minnesota Studies in the Philosophy of Science*, volume VII. Minneapolis: University of Minnesota Press. Reprinted in Lewis 85.

- [82] Lewis, David, 1980. 'Index, context, and content'. In Stig Kanger and Sven Öhman, editors, *Philosophy and Grammar*. Dordrecht: Reidel. Reprinted in Lewis 92.
- [83] Lewis, David, 1980. 'A subjectivist's guide to objective chance'. In Richard C. Jeffrey, editor, *Studies in Inductive Logic and Probability*, volume II. Berkeley: University of California Press. Reprinted, with postscripts, in Lewis 88.
- [84] Lewis, David, 1980. 'Veridical hallucination and prosthetic vision'. *Australasian Journal of Philosophy*, 58:239–49. Reprinted, with postscripts, in Lewis 88.
- [85] Lewis, David, 1983. *Philosophical Papers*, volume I. Oxford: Oxford University Press.
- [86] Lewis, David, 1986. 'Introduction'. In Lewis 88.
- [87] Lewis, David, 1986. *On the Plurality of Worlds*. London: Blackwell.
- [88] Lewis, David, 1986. *Philosophical Papers*, volume II. Oxford: Oxford University Press.
- [89] Lewis, David, 1993. 'Counterpart theory, quantified modal logic and extra argument places'. *Analysis*, 53:69–71.
- [90] Lewis, David, 1994. 'Humean supervenience debugged'. *Mind*, 103:473–90. Reprinted in Lewis 93.
- [91] Lewis, David, 1994. 'Reduction of mind'. In Samuel Guttenplan, editor, *Companion to the Philosophy of Mind*. Oxford: Blackwell. Reprinted in Lewis 93.
- [92] Lewis, David, 1998. *Papers in Philosophical Logic*. Cambridge: Cambridge University Press.
- [93] Lewis, David, 1999. *Papers in Metaphysics and Epistemology*. Cambridge: Cambridge University Press.
- [94] Linsky, Bernard and Edward N. Zalta, 1994. 'In defense of the simplest quantified modal logic'. In James Tomberlin, editor, *Logic and Language*, volume 8 of *Philosophical Perspectives*, 431–458. Atascadero: Ridgeview.
- [95] Linsky, Bernard and Edward N. Zalta, 1996. 'In defense of the contingently nonconcrete'. *Philosophical Studies*, 84:283–94.
- [96] Loewer, Barry, 1996. 'Humean supervenience'. *Philosophical Topics*, 24:101–127.
- [97] Loewer, Barry, 2004. 'David Lewis's Humean Theory of Objective Chance'. *Philosophy of Science*, 71:1115–25.
- [98] Loewer, Barry, 2012. 'Two accounts of laws and time'. *Philosophical Studies*, 160:115–137.
- [99] MacFarlane, John, 2014. *Assessment-sensitivity: Relative Truth and Its Applications*. Oxford: Oxford University Press.
- [100] Mackie, Penelope, 2006. *How Things Might Have Been: Individuals, Kinds, and Essential Properties*. Oxford University Press.
- [101] McKinsey, J. C. C. and Alfred Tarski, 1948. 'Some theorems about the sentential calculi of Lewis and heyting'. *Journal of Symbolic Logic*, 13:1–15.

- [102] Meredith, C. A. and Arthur Prior, 1956/1996. ‘Interpretations of different modal logics in the ‘property calculus’’. In Jack Copeland, editor, *Logic and Reality: Essays on the Legacy of Arthur Prior*. Oxford: Clarendon Press.
- [103] Miller, Kristie, 2009. ‘Defending Contingentism in Metaphysics’. *Dialectica*, 63:23–49.
- [104] Montague, Richard, 1960. ‘Logical necessity, physical necessity, ethics, and quantifiers’. *Inquiry*, 3:259–69. Reprinted in Montague 107.
- [105] Montague, Richard, 1968. ‘Pragmatics’. In *Contemporary Philosophy: A Survey*. Florence: La Nuova Italia Editrice. Reprinted in Montague 107.
- [106] Montague, Richard, 1970. ‘Pragmatics and intensional logic’. *Synthese*, 22:68–94. Reprinted in Montague 107.
- [107] Montague, Richard, 1974. *Formal Philosophy*. New Haven: Yale University Press. Edited and with an introduction by Richmond H. Thomason.
- [108] Murray, Adam Russell, 2017. *Perspectives On Modal Metaphysics*. Ph.D. thesis, University of Toronto.
- [109] Murray, Adam Russell, forthcoming. ‘Propositional dependence and perspectival shift’. In Chris Tillman and Adam Russell Murray, editors, *The Routledge Handbook of Propositions*. London: Routledge.
- [110] Murray, Adam Russell and Jessica M. Wilson, 2012. ‘Relativized metaphysical modality’. In Karen Bennett and Dean W. Zimmerman, editors, *Oxford Studies in Metaphysics*, volume 7, 189–226. Oxford.
- [111] Neale, Stephen, 2001. *Facing Facts*. Clarendon Press.
- [112] Parsons, Josh, 2013. ‘Conceptual Conservatism and Contingent Composition’. *Inquiry: An Interdisciplinary Journal of Philosophy*, 56:327–339.
- [113] Pettigrew, Richard G., 2013. ‘What Chance-Credence Norms Should Not Be’. *Noûs*, 47:177–196.
- [114] Plantinga, Alvin, 1974. *The Nature of Necessity*. Clarendon Press.
- [115] Plantinga, Alvin, 1975. ‘On Mereological Essentialism’. *Review of Metaphysics*, 28:468–476.
- [116] Price, Huw, 2007. ‘Quining Naturalism’. *Journal of Philosophy*, 104:375–402.
- [117] Prior, Arthur, 1967. *Past, Present and Future*. Oxford: Clarendon Press.
- [118] Prior, Arthur, 1968. “Now”. *Noûs*, 2:101–119.
- [119] Rabern, Brian, 2013. ‘Monsters in Kaplan’s Logic of Demonstratives’. *Philosophical Studies*, 164:393–404.
- [120] Roberts, Alexander, 2020. ‘Two Morals About a Modal Paradox’. *Synthese*, 198:9873–9896.
- [121] Rosen, Gideon, 2006. ‘The Limits of Contingency’. In Fraser MacBride, editor, *Identity and Modality*, 13–39. Oxford University Press.

- [122] Salmon, Nathan U., 1981. *Reference and Essence*. Princeton: Princeton University Press.
- [123] Salmon, Nathan U., 1989. 'The logic of what might have been'. *The Philosophical Review*, 98:3–34.
- [124] Santorio, Paolo, 2012. 'Reference and monstrosity'. *The Philosophical Review*, 121:359–406.
- [125] Schaffer, Jonathan, 2007. 'From Nihilism to Monism'. *Australasian Journal of Philosophy*, 85:175–191.
- [126] Schaffer, Jonathan, 2010. 'Monism: The Priority of the Whole'. *Philosophical Review*, 119:31–76.
- [127] Schlenker, Philippe, 2002. 'A Plea for Monsters'. *Linguistics and Philosophy*, 26:29–120.
- [128] Segerberg, Krister, 1973. 'Two-dimensional modal logic'. *Journal of Philosophical Logic*, 2:77–96.
- [129] Shoemaker, Sydney, 1980. 'Causality and properties'. In Peter van Inwagen, editor, *Time and Cause*. Dordrecht: D. Reidel.
- [130] Sider, Theodore, 1993. 'Van Inwagen and the Possibility of Gunk'. *Analysis*, 53:285–289.
- [131] Sider, Theodore, 2001. *Four-dimensionalism*. Oxford: Oxford University Press.
- [132] Stalnaker, Robert C., 1968. 'A theory of conditionals'. In Nicholas Rescher, editor, *Studies in Logical Theory*. Oxford: Blackwell. Reprinted in Stalnaker 140.
- [133] Stalnaker, Robert C., 1978. 'Assertion'. *Syntax and Semantics*, 9:315–32. Reprinted in Stalnaker 135.
- [134] Stalnaker, Robert C., 1994/2003. 'The interaction of modality with quantification and identity'. In Stalnaker 137.
- [135] Stalnaker, Robert C., 1999. *Context and Content*. Oxford: Oxford University Press.
- [136] Stalnaker, Robert C., 2001. 'On considering a possible world as actual'. *Aristotelian Society Supplementary Volume*, 75:141–156. Reprinted in Stalnaker 137.
- [137] Stalnaker, Robert C., 2003. *Ways A World Might Be*. Oxford: Oxford University Press.
- [138] Stalnaker, Robert C., 2012. *Mere Possibilities*. Princeton: Princeton University Press.
- [139] Stalnaker, Robert C., 2014. *Context*. Oxford: Oxford University Press.
- [140] Stalnaker, Robert C., 2019. *Knowledge and Conditionals: Essays on the Structure of Inquiry*. Oxford: Oxford University Press.
- [141] Steen, Mark, 2008. 'Chisholm's Changing Conception of Ordinary Objects'. *Grazer Philosophische Studien*, 76:1–56.
- [142] Teitel, Trevor, 2019. 'Contingent Existence and the Reduction of Modality to Essence'. *Mind*, 128:39–68.
- [143] Thau, Michael, 1994. 'Undermining and Admissibility'. *Mind*, 103:491–504.

- [144] Thomason, Richmond, 1969. 'Modal logic and metaphysics'. In Karel Lambert, editor, *The Logical Way of Doing Things*. New Haven: Yale University Press.
- [145] Van Inwagen, Peter, 1990. *Material Beings*. Ithaca: Cornell University Press.
- [146] Vlach, Frank, 1973. 'Now' and 'Then': *A Formal Study in the Logic of Tense Anaphora*. Ph.D. thesis, University of California Los Angeles.
- [147] von Wright, Georg Henrik, 1953. *An Essay in Modal Logic*. New York: Humanities Press.
- [148] Wiggins, David, 1979. 'Mereological Essentialism: Asymmetrical Essential Dependence and the Nature of Continuants'. *Grazer Philosophische Studien*, 7:297–315.
- [149] Williamson, Timothy, 1990. *Identity and Discrimination*. Oxford: Blackwell.
- [150] Williamson, Timothy, 1998. 'Bare possibilia'. *Erkenntnis*, 48:257–73.
- [151] Williamson, Timothy, 2009. 'Conditionals and actuality'. *Erkenntnis*, 75:135–50.
- [152] Williamson, Timothy, 2013. *Modal Logic as Metaphysics*. Oxford: Oxford University Press.
- [153] Williamson, Timothy, 2013. *Modal Logic as Metaphysics*. Oxford: Oxford University Press.
- [154] Wittgenstein, Ludwig, 1921. *Tractatus Logico-philosophicus*. Atlantic Highlands, NJ: Humanities Press. Translated by David F. Pears and Brian F. McGuinness.
- [155] Woollaston, Lin, 1994. 'Counterpart Theory as a Semantics for Modal Logic'. *Logique Et Analyse*, 37:255–263.
- [156] Yagisawa, Takashi, 2017. 'From S4 to 5D'. *Argumenta*, 2:241–261.
- [157] Zalta, Edward N., 1988. *Intensional Logic and the Metaphysics of Intentionality*. Cambridge, MA: The MIT Press.
- [158] Zimmerman, Dean Wallace, 1992. *An Argument for Mereological Essentialism*. Ph.D. thesis, Brown University.