Modal quantification without worlds[1]

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This paper is about avoiding commitment to an ontology of possible worlds with two primitives: a hyperintensional connective like 'in virtue of', and primitive quantification into predicate position. I argue that these tools (which some believe can be independently motivated) render dispensable the ontology of possible worlds needed by traditional anaylses of modality. They also shed new light on the notion of truth-at-a-world.

1 Preliminaries: reductive analyses of modality and quantification

David Lewis's familiar "modal realism" gives an account of the modal operators $\Box$ and $\Diamond$ (understood as expressing metaphysical necessity and possibility, respectively) that takes on additional ontological commitments to achieve a reduction in ideological complexity. It involves, as Lewis says, a trade-off: "[i]t offers an improvement in what Quine calls ideology, paid for in the coin of ontology."[2] For Lewis, the extra ontology consists in a multitude of maximal isolated regions of spacetime,[3] which he calls "worlds". These feature in the following quantificational analysis of '$\Diamond p$' (where the quantifier $\exists w$ ranges over the domain of Lewisian worlds):

1. $\exists w : p$ is true at w.

The advantages of such an analysis go beyond the elimination of $\Box$ and $\Diamond$ from our primitive ideology; with an ontology of worlds in place, Lewis goes on to assemble an impressive array of further explanatory tasks for them.[4]

Many philosophers, however, have been unwilling to agree with Lewis that the ontological cost is justified by the promised elimination of modal idioms. They prefer to complicate their ideology slightly by holding that worlds are not maximal isolated regions of spacetime as Lewis describes them, but are

[1] Thanks to Daniel Fogal, Shen-Yi Liao, Scott Soames, James Van Cleve, the editors at *Oxford Studies in Metaphysics*, and especially David Manley for comments on earlier drafts of this paper.

[2] Lewis (1986, p. 4). Lewis explicitly offers this quote as a description of the justification for the set-theoretic axioms and their accompanying ontology. (In this context, he goes on: "It's an offer you can't refuse. The price is right; the benefits in theoretical unity and economy are well worth the entities.") But his point in describing the set-theoretic axioms in this way is that the justification for an ontology of possible worlds is similar, though presumably Lewis doesn't think that it is as *obvious* that in the modal case the trade-off is worthwhile.

[3] Lewis (1986, pp. 70-72)

[4] These are found in Lewis (1986, Ch. 1).

rather entities that have primitive modal features. '$\Diamond p$' is still analyzed in terms of (1), but now with the notion of a possible world left either as primitive, or analyzed partly in modal terms.[5]

Many of the explanatory benefits of a possible worlds analysis depend not the Lewisian reductive project, but rather on its quantificational character. Formulations of global supervenience and analyses of properties, semantic content, and counterfactuals can all be carried out with non-Lewisian worlds in place—we don't lose all of the explanatory benefits of an ontology of possible worlds simply by retaining 'possible' in our primitive ideology.[6] Many of Lewis's explanatory insights, in other words, rely on the existence of a certain kind of entity to quantify over, and do not rely on the further reductive Lewisian project of giving an account of these entities in wholly non-modal terms. All that matters is that we don't leave the modal operators unanalyzed.[7]

This brings us to the starting point of the present paper. The quantificational analyses we have mentioned so far all employ quantifiers that bind variables in *nominal position*; i.e., the bound variables occur in a syntactic position which can be occupied by names, or other referential expressions.[8] The quantifiers are interpreted in the familiar way, "ranging over" a domain of objects (in this case, worlds). But there is growing interest in a proposal from Arthur Prior (1971) which holds, to a rough approximation, that we can include *second-order quantifiers* among our primitive ideology. These devices are second-order simply in the sense that they bind variables in predicate-position, as $\exists F$ does in (2):

2. $\exists F : a$ is F.

It is worth stressing here that there may be other senses of 'second-order' that I am not appealing to here—one might think, for instance, that the term designates quantifiers ranging over *sets* of objects, or quantifiers interpreted as *plural* quantifiers. These are different meanings for the term 'second-order'

[5]Examples include Soames (2007), Stalnaker (1976), Plantinga (1978) and Adams (1974). Even though these views are not fully reductive, there are differences between them, primarily in what they take worlds to be. I discuss some of these differences below in §3, on truth-at-a-world.

[6]There are exceptions: since Lewis can allow that (unrestricted) objectual quantifiers range over possible objects, there are analyses that quantify over these objects (and not merely worlds, Lewisian or otherwise) which are not available to the non-reductivist. Eli Hirsch (1997) points out that the "imperfect communities" from Goodman (1951) fail to qualify as counterexamples to the thesis that the natural properties are the resemblance-conferring properties, as the resemblance-conferring properties are those properties P such that:

> For any x and y, if x has P and y lacks P, there is a z such that z has P and, for any w, if w has P and w is at least as similar to y as z is, then w is more similar to x than y is. (Hirsch (1997, p. 51))

Those who are not Lewisian realists cannot use mere quantification over worlds to get the same result—the definition essentially relies on the possibility of cross-world comparison. See also Lewis (1986, pp. 13-14) for more on cross-world comparison.

[7]For a development of this latter kind of view, see Forbes (1989, p. 78), who holds that "modal operators provide the fundamental means of expression of modal facts." See Melia (1992) for more discussion of this view.

[8]I.e., they have the following syntactic feature: given a well-formed quantified sentence of the form '$\exists x : \ldots x \ldots$', replacing the bound occurrence of the variable with a proper name like 'Sally' and removing the quantified expression results in the well-formed sentence '... Sally...'.

than the one I am interested in here, since they settle by definition questions about the proper interpretation of quantification into predicate position—questions that I wish to leave open to substantive argumentation. The designation 'second-order', as I will use it, is a purely syntactic one, referring only to the position of bound variables.

This non-semantic characterization is crucial, because in what follows I will take seriously the substantive thesis that second-order quantifiers can be taken as primitive. Such an understanding requires rejecting the idea that (2) is really shorthand for something like (3) or (4):

3. $\exists x : x$ is a property and a instantiates x;

4. $\exists s : s$ is a set and a is a member of s.

Indeed, according to the primitive understanding, *any* interpretation of second-order quantifiers that interprets them as shorthand for quantifiers that bind variables in nominal position (such as (3) or (4)) is unnecessary.[9] They are primitive because they require no further analysis.

I will postpone until §2 consideration of reasons for thinking that (2) does not require analysis in terms of nominal quantification. But here is a preview of what second-order quantification thus understood might buy for us in the metaphysics of modality. Primitive second-order quantificational expressions are not, I will suggest, *ontologically committal*: (2), taken as primitive, is committed to the existence of the thing a names, and nothing else. This suggests the following possibility. We could replace the quantifier in (1) with a primitive second-order quantifier; this amounts (very roughly) to analyzing '$\Diamond p$' in terms of the second-order equivalent of a sentence which says that there is some possible way for things to be, W, and W entails p. Since encoding this kind of analysis in a sentence with a genuine second-order quantifier is not ontologically committal, we would appear to be in a position to give an analysis of $\Box$ and $\Diamond$ that is free of ontological commitments to worlds, but still has the benefits of familiar quantificational analyses.

Working out the details, however, will show that things are not so simple—we will need to help ourselves to further resources that analyses which quantify into nominal position only are not committed

[9] The "plural" analysis of second-order quantifiers in Boolos (1984) also quantifies into a nominal position (with a plural quantifier). Boolos suggests that

$\exists X : Xa$

is to be analyzed as

There are some things such that a is one of them.

The variable ('them') bound by the quantifier in the analysis is in nominal position, as it can be replaced with a (plural) noun, like 'the Italians' or 'the hoarders'. This kind of analysis is then among those we rule out when we say that second-order quantifiers are primitive. For more discussion, see Rayo and Yablo (2001).

to. This is because the notion of *truth-at-a-world* appears in (1), and most of the ordinary accounts which accept that there are possible worlds (of some kind or other) have the resources to say what truth-at-a-world is. But since second-order quantifiers bind variables in different syntactic positions, we are faced with the task of understanding constructions of the form 'is true at F', where grammatical instances are obtained by replacing F with a *predicate*. I will show how we can understand such constructions in a way that helps the second-order analysis. But it will require allowing something like a primitive 'in virtue of' in our ideology, which is another controversial resource, although one many metaphysicians think we need anyway.

Thus, the main goal in what follows will be to show how those who have already complicated their ideology with primitive second-order quantification and a hyperintensional 'in virtue of'-like connective can avoid further ontological commitment in their analysis of $\Box$ and $\Diamond$, while still reaping all the benefits of a quantificational analysis. As I introduce these additional resources in greater detail, I will give some indication of why we might think that they are legitimate and perhaps necessary. Arguments for these positions have been presented in greater detail elsewhere, however; my primary aim is to show what we can do in the theory of modality, once these resources are in place.

2 Primitive second-order quantification

As we noted in the previous section, second-order quantifiers, which bind variables in predicate position, are *primitive* when they are not analyzed in terms of sentences containing nominal quantification only. Presumably Quine had a nominal analysis in mind when he accused second-order quantification of being "set theory in sheep's clothing": he thought

2. $\exists F : a$ is F

must quantify, in the final analysis, over sets.[10] Quantification over sets in

4. $\exists s : s$ is a set and a is a member of s

evidently quantifies into a nominal position, as grammatical instances of (4) result from dropping the quantifier $\exists s$ and substituting referring expressions like 'Sally' or 'the set of all red things' for the variable s. And substituting a predicate like 'is red' for s does not produce a grammatical instance. By taking sentences like (2) instead as primitive, we forgo the possibility of explaining what the sentence means by invoking nominal quantification in this way. Not only is the Quinean analysis unavailable; *any* analysis that proceeds by specifying a domain of objects over which the quantifier ranges, plus a relation the referent of a bears to some members of that domain, is inadmissible as an explanation of (2).

[10] Quine (1986)

Some will think that, given this gloss on what primitive second-order quantification is, it cannot even be *intelligible*. One reason, which we should confront at the outset, is that this is due to constraints on what can count as quantification. This line of thought might be expanded by imagining someone who makes the following series of claims: "if primitive second-order quantifiers don't range over any objects, they can't be genuine *quantifiers*. A construction can't be quantificational unless it quantifies *over* some things. Primitive second-order quantifiers by definition don't range over anything. So there is something incoherent in the notion of primitive second-order quantification."

The response to this type of complaint is to give the objector the word 'quantification'. What is important to the view is that second-order expressions like $\exists F$ in (2) don't require nominal interpretations. What is *not* essential is that, in addition, these expressions are *called* the same thing as the familiar constructions which bind variables in nominal positions. We can replace the conventional quantifier expressions $\exists$ and $\forall$ with alternative notation, and call them something else.[11] What does matter, in other words, is that there are intelligible constructions that obey quantifier-like introduction and elimination rules and serve the quantifier-like purpose of allowing us to speak more generally. Just as nominal quantifiers allow us to speak more generally than our practice of naming and referring typically allows, the "quantifiers" binding variables in predicate-position are similarly tools for speaking more generally (though in this instance the devices allow us to speak more generally than we typically speak by using *predicates*).

Of course, there are legitimate questions about whether we really can understand primitive second-order quantifiers, about whether they are ontologically committing, and whether we *need* to complicate our ideology with them. I will address these questions in turn.

2.1 Second-order home languages

Peter van Inwagen (2004) is one philosopher who thinks that second-order quantifiers, taken as primitive, are unintelligible. He says: "[q]uantification into non-nominal positions is meaningless unless (*a*) the non-nominal quantifiers are understood substitutionally [...]; or, (*b*) it is understood as a kind of shorthand for nominal quantification over properties, taken together with a two-place predicate

[11] Here is one suggestion for a new name. Predicates plausibly don't introduce new ontological commitments (see the end of this section for more discussion), but they can still be said to *qualify* how things are—the sentence 'a and b are both red' constrains how things are, even if it introduces no entities beyond the referents of a and b. It carries a new *metaphysical* commitment, though not a new commitment in ontology (see Sider (2011, §6.3) for related discussion). Sentences involving primitive second-order quantifiers impose similar qualifications of how things are, albeit in a more general way. '$\exists F : a$ and b are both F' doesn't require that a and b are both red, but it does impose *some* restrictions on how a and b are qualified. We could then label the constructions that bind predicate-position variables in (2) as 'qualifiers' and name the operation they perform 'qualification' to distinguish it from *quantification*, understood to be restricted to nominal quantification. Qualifiers, like predicates, would carry metaphysical commitments, but introduce no new ontology. Thanks to David Manley for the terminological suggestion.

(corresponding to the 'ε' of set-theory) along the lines of 'x has y' or 'x exemplifies y'."[12] The worry, in short, is that we can't *understand* second-order expressions unless they are analyzed in nominal terms. But Rayo and Yablo (2001) suggest that another means to understanding these sentences shouldn't be very hard to come by, as English contains non-nominal quantificational expressions, and these English idioms can serve in translations of a formal language with second-order quantification. Take a sentence with quantification into predicate-position, as in (5):

5. $\exists X$ John is X.

Rayo and Yablo point out that there is a reading of (6), a sentence of ordinary English, on which it is equivalent to (5) and yet does not contain a nominal quantifier:

6. John is something.

On the relevant (and most natural) reading, 'something' in (6) occurs in predicate position, as replacing it with 'kind' results in an instance that is grammatical in English, while replacing it with a name like 'Steve' is ungrammatical. (Thus 'is' in (6) on this reading is the 'is' of predication.) This is perhaps more apparent when 'something' is fronted to obtain the sentence 'there is something John is'. It seems much more natural to say "there is something John is–kind" than to say "there is something John is–Steve". So (6) can naturally be read as an English-language translation of (5) that doesn't resort to nominal quantification.

The point isn't limited to extremely simple sentences like (5): more complex formal sentences with second-order quantification can be rendered in ordinary English by using 'that' and 'so' in predicate-position in a manner resembling bound variables. The sentences

7. $\exists X$ John is X and Sally is X;
8. $\exists R$ San Francisco Rs Los Angeles and Boston Rs New York

have the following English translations:

9. John is something and Sally is that too;
10. San Francisco is somehow related to Los Angeles and Boston is so related to New York.[13]

There is then a good case that English—a language with which we are already competent—provides the tools to understand sentences with second-order quantification, and to do so without translating

[12] van Inwagen (2004, p. 124)

[13] Rayo and Yablo (2001, pp.80-85). A compositional translation scheme into regimented English is presented on p. 84.

them into sentences that contain only quantification into nominal positions. (Thus, even though this approach provides a *translation* of second-order sentences, they are still primitive in an important sense, as the translations themselves contain second-order expressions.)

This doesn't show that the Rayo and Yablo approach yields a complete understanding of second-order quantifiers by providing translations of occurrences in arbitrarily complex constructions.[14] But it isn't clear that we need translations for every such sentence: in the event that translation into ordinary English is an inadequate tool for acquiring complete understanding, we might treat natural language as a means to acquiring a beginner's grasp of sentences with quantification into predicate-position. We can then move on to the "direct method", as Timothy Williamson explains:

> We may have to learn second-order languages by the direct method, not by translating them into a language with which we are already familiar. After all, that may well be how we come to understand other symbols in contemporary logic, such as $\supset$ and $\Diamond$: we can approximate them by 'if' and 'possibly', but for familiar reasons they may fall short of perfect synonymy, and we certainly do not employ $\supset$ and $\Diamond$ as synonyms for the complex discourses in which we explain how they differ subtly in meaning from 'if' and 'possibly'. At some point, we learn to understand the symbols directly; why not use the same method for $\forall F$? We must learn to use higher-order languages as our home language.[15]

With Rayo and Yablo's natural language translations in hand, plus Williamson's direct method, we should be optimistic that we can *understand* primitive second-order constructions. Van Inwagen's claim that we can't understand them without translations into nominal quantification begins to look unpromising.

2.2 Ontological commitment

The next issue concerns the ontology required by second-order quantificational constructions taken as primitive. Those who claim that they can understand what these expressions mean typically hold that they carry *no* ontological commitments to additional objects. I will canvass below some arguments in the literature for this conclusion, but let us first note how this is not at all surprising once we take the contrast between the semantics for ordinary nominal quantifiers and primitive second-order quantifiers seriously. When second-order quantifiers are taken as primitive, in saying what sentences like '$\exists F : a$ is F' mean, we use *another* second-order quantifier. (Whether it is an English construction like 'somehow' or 'something' or the homophonic formal expression $\exists F$ will depend on whether we are following a Rayo and Yablo-like translation manual or Williamson's direct method.) Thus at no point in our gloss of sentences with second-order quantifiers do we refer to or quantify over entities in virtue of the

[14] Manley (2009, pp. 401-402) suggests that '$\forall X \exists Y (Xa \rightarrow Yb)$' is one sentence which has no translation into the second-order idioms of English.

[15] Williamson (2003, p. 459)

presence of the second-order construction; any semantic unpacking will not reveal commitments that were hidden in the surface form.[16] Ordinary quantification into the nominal position by sentences like '$\exists x : x$ is G', by contrast, does require the existence of something in virtue of the semantics for $\exists x$. This is revealed in the standard semantics for the quantifier, where an entity which satisfies G must be a member of the domain $\exists x$ ranges over in order for the sentence to be true. In short, the existence of things cannot be read off from the meaning of primitive second-order quantifiers in the way it can be read off from the standard semantics for nominal quantifiers.

The viability of this position depends in large part on a related position concerning the ontological commitments of ordinary predicates. Many philosophers, including Quine and others who do not count as friends of primitive second-order quantification, hold that predication by itself introduces no new ontological commitments. Quine, for instance, says

> [T]he word 'red' [...] is true of each of sundry individual entities which are red houses, red roses, red sunsets; but there is not, in addition, any entity whatever, individual or otherwise, which is named by the word 'redness'.[17]

Against this background, Van Cleve (1994) notes:

> It would be extremely surprising if it were the need to speak generally that first ushered in universals. Could one hold that the specific predication
>
> 11. Tom is tall
>
> makes no commitment to universals, but that as soon as we are forced to generalize and say
>
> 12. $\exists F$ Tom is F
>
> we do recognize the existence of universals? That seems highly unlikely. If the existentially quantified formula (12) is legitimate at all, it follows from (11), and cannot reveal any ontological commitment not already inherent in (11).[18]

[16] As an example of "semantic unpacking" that does reveal hidden commitments, consider the approaches to '$\exists F : a$ is F' that offer nominal analyses in terms of quantification over (for example) sets. Since the superficially second-order sentence claims on this analysis that there is a set that a is a member of, it carries hidden ontological commitments, namely a commitment to the existence of sets. This commitment-inducing analysis disappears when the sentence is taken as primitive; on this view, the only answer to the question "What does '$\exists F : a$ is F' mean?" is "That $\exists F : a$ is F".

[17] Quine (1953a, p. 10). See also van Inwagen (2004).

[18] Van Cleve (1994, p. 587), my numbering. See also Rayo and Yablo (2001, pp. 79-80) for a similar point, as well as Wright (2007):

> [S]tatements resulting from quantification into places occupied by expressions of a certain determinate syntactic type need not and should not be conceived as introducing a type of ontological commitment not already involved in the truth of statements configuring expressions of that type. (Wright (2007, p. 159))

The Quinean position on the ontological commitments of ordinary predication, which Van Cleve takes as a starting point, is not universally accepted. A certain kind of realist about properties holds that they are needed for explaining predication; that is, predications of the form '*a* is *G*' hold because some more basic fact holds—namely, the fact *a* instantiates *G*-ness. This is denied by "Ostrich Nominalists" who, like Quine, hold that there is no need to explain predication at all. That something is red is basic; the predication stands in no need of further explanation.[19]

The friend of primitive second-order quantification adopts a position that is very much at home given Ostrich Nominalism, but is difficult to reconcile with its denial. In particular, the Ostrich Nominalist holds that a surface-level predication is fine as it is, unanalyzed, while her opponent insists that what it is to predicate *G* of an entity needs to be explained in terms a relation (*instantiation*, say) that entity bears to abstracta of some kind (e.g., the property *G*-ness). The question of whether second-order quantification is to be taken as primitive is similarly the question of whether '$\exists F : a$ is F' is fine as it is, unanalyzed, or if it needs to be unpacked in terms of a sentence of the form

13. $\exists x : a\ R\text{s}\ x$,

where *R* in (13) expresses a relation like instantiation and the quantifier ranges over properties such as *G*-ness.

As the quote from Van Cleve suggests, it is very difficult to see why quantification into predicate-position should be ontologically committal in the way (13) is, given Ostrich Nominalism—if the simple predication doesn't need to be analyzed in terms of properties, then second-order generalizations likewise can be free of such an analysis. If, on the other hand, predication by itself *does* bring in commitments to properties, then it is very natural to think that second-order quantification *would* be ontologically committal, ranging over a domain of properties that explain the truth of predications. We haven't said anything to settle the debate in favor of Ostrich Nominalism here, but it is a familiar position, and one which makes it very natural to accept that primitive second-order quantifiers carry no ontological commitments.

2.3 Expressive needs

The previous two subsections detail reasons for thinking that primitive second-order quantifiers are intelligible and ontologically non-committal. But, as we noted in §1, using them in metaphysical

[19]Armstrong (1978) advocates for the realist view. Van Cleve (1994) explores the Ostrich Nominalist view (including the possibility of invoking primitive second-order quantifiers to handle difficulties) which is also defended in Devitt (1980). It is worth noting in this context that Ostrich Nominalists need not be nominalists, full-stop; they just need to hold that ontological commitment to properties doesn't derive from the need to explain predication (since they think there is no such need). They can still hold that there are other needs which introduce the commitment.

theorizing would require a complication of our ideology, and it is worth asking whether there is any reason to do this. There are arguments in the literature that such reasons do exist. According to such arguments, devices of primitive second-order quantification provide the means for expressing important facts in some domain or other: they are well-suited, we can say, to meet our *expressive needs*.

Rayo and Yablo (2001, p. 82) point out that there are important differences between the following two sentences, as (14) is demonstrably false, while (15) is "on one reading quite *true*":

14. Take any objects you like, there's an object containing them and nothing else;
15. Take any objects you like, they are something that the rest of the objects are not.

Of course, a nominal analysis of 'something' in (15) on which it quantifies over sets would render it false for the same reasons that (14) is false. But by treating the 'something' in (15) as an unanalyzed (and hence non-committal) quantifier into the predicate position, it is consistent to give (14) and (15) different truth values.

Williamson (2003) draws a similar conclusion in the face of Russell-like paradoxes that result from defining validity and logical consequence in terms of truth under all interpretations, and allowing interpretations to be among the objects that our quantifiers range over.[20] His preferred solution is to go second-order:

> The underlying assumption is that generalizing always amounts to generalizing into name position, that all quantification in the end reduces to first-order quantification. But that Quinean assumption is not forced on us [...] It is therefore more natural [...] to think of subscript position in ['is true$_I$' and 'is true$_J$'] as predicate position rather than name position [...] In defining logical consequence, we generalize into predicate position in a second- (or higher-)order meta-language. We reject the question 'What are we to generalize over?' because inserting a predicate in the blank in 'We are to generalize over ...' produces an ill-formed string.

Primitive second-order quantifiers, then, have a good claim to be able to meet our expressive needs with respect to articulating intuitive claims about sets and defining logical consequence without inconsistency. Much more deserves to be said about these issues. Of more interest to us here, however, is what we can buy in our theorizing about modality with primitive second-order quantifiers that are (i) intelligible in the absence of further (nominal) analysis, (ii) not ontologically committing, and (iii) promising as a tool for meeting our expressive needs.

[20] Williamson (2003, p. 426)

3 Complications: truth-at-a-world

The forgoing discussion of second-order quantification has, in certain respects, a very straightforward application to modality. In particular, the move from nominal to second-order quantification in modal analyses can be quite natural given views on the proper analysis of $\Box$ and $\Diamond$ like those of Robert Stalnaker (1976, p. 70) and Scott Soames (2007, p. 251). These views emphasize that, strictly speaking, saying that (1) quantifies over *worlds* is misleading:

1. $\exists w : p$ is true at w.

Instead, we should speak of the quantifier in an analysis of '$\Diamond p$' as ranging over *ways* the world might have been. What go by the name 'possible worlds' are really, on this view, maximal properties that might have been instantiated. Letting S range over these possibly instantiated maximal properties, the analysis of '$\Diamond p$' is more perspicuously written as

16. $\exists S : p$ is true at S.

Given this innocuous amendment to (1), it seems that we can apply the forgoing discussion of second-order quantification in a straightforward manner. For most purposes, sentences which are ontologically committed to properties can be replaced by non-committal sentences containing a well-chosen predicate. In a simple case, the sentence 'John is tall' gives the same information about John and his height as 'John has the property being tall' does; the only difference is that the latter does so by making reference to a property.[21] Once primitive second-order quantification is in the picture, there is an analogous way to find sentences that have the same import as *general* statements about properties, but without the same ontological commitments. What the sentence 'there is some property John has' says is captured by '$\exists F$: John is F', or 'John is something'. The only difference is that the latter sentences say something about John without invoking properties, just as the analogy to the pair 'John is tall' and 'John has the property being tall' would predict. By insisting that worlds-based analyses of $\Box$ and $\Diamond$ should be read as quantifying over maximal properties, the views of Stalnaker and Soames make it extremely natural to move to an analysis where the quantification is second-order, binding variables in predicate-position, and leaving properties out of the picture.

There is, however, a major hitch in this seemingly innocuous move; we cannot reap the ontological benefits of a shift to second-order quantifiers while leaving the rest of the theory intact. By going second-order, we alter the grammatical form of sentences containing the expression 'is true at'. On the ordinary analyses, 'is true at' takes a formula and a world-name, or a variable ranging over worlds, as arguments.

[21] Here and throughout I assume the Quinean/Ostrich Nominalist view of predication discussed in §2.

(Here I lump worlds construed as objects, and worlds construed as giant properties in the manner of Soames and Stalnaker, under the single heading of "worlds". These views agree that it is a nominal expression which designates the things at which claims are true or false. They differ over the *nature* of these entities; I will return to this difference below.) But by revising the analysis to incorporate second-order quantifiers, 'is true at' no longer takes nominals as arguments: by replacing a nominal quantifier by a quantifier that binds predicate-position variables and leaving everything else in tact, we arrive that the following "analysis":

17. $\exists F : p$ is true at F.

But now the second argument of 'true at' is filled by a second-order variable, and so is of a type that generates grammatical instances when the variable is replaced by expressions like 'is red'. A change in grammatical or syntactic type is not problematic *per se*, but in this case it isn't clear what sentences like (17) can even *mean* with the second-order variable in place.

The difficulties extend further. Many accounts that take 'is true at' in (1) to be a relation to a world are in a position to give a further analysis of the notion. Plantinga (1978, Ch. 4) and Adams (1974, p. 255) claim that worlds are set-theoretic entities: either sets of states of affairs (for Plantinga) or propositions (for Adams). Worlds, on these views, have a kind of structure. Since p in (1) can be associated with a proposition or state of affairs, it is then very natural to say that for p to be true at a world is just for the relevant proposition or state of affairs to be a *member* of that world.[22] I don't say that these theorists necessarily *accept* these analyses; Plantinga (1978, p. 49) seems to acknowledge the possibility of giving the set-theoretic definition, but officially embraces a definition in counterfactual terms like the one I discuss below.[23] The point here is that such an analysis is *available* on this style of view. Consider also Stalnaker: propositions, on his view, are just sets of possible worlds. The analysis of truth-at-a-world can then go the other way and hold that p is true at w just in case w is a member of the proposition expressed by p.

Once we give up on an account that quantifies over worlds, we lose the possibility of giving an analysis of truth-at-a-world in terms of set-membership or other structural relations. We can't say that worlds are things which can be constituents of sets or propositions, and we can't say that they are things with a set-theoretic structure. This is because there *is* nothing over which we quantify that has the kind of structure that can be useful in analysis. But this is not unique to the second-order view; even some

[22] This at least applies to atomic p if worlds don't contain complex states of affairs or propositions (those expressed by sentences containing negation and other logical operations, as well as modal operators) then truth-at-a-world for the propositions or states of affairs associated with complex sentences must be defined in terms of truth-at-a-world for the atomics, in the usual way.

[23] Thanks to Dean Zimmerman for pointing this out to me.

accounts that do quantify over worlds do not posit enough structure to allow for a set-theoretic analysis. These views also have to say something else about truth-at-a-world.

Consider a view on which worlds are giant properties in the style of Stalnaker and Soames, where these properties have no further structure—they are not "structured properties" composed out of further constituents, and where propositions are not sets of possible worlds.[24] A view of this kind is found in Soames (2007), and it must use alternative resources to explicate truth-at-a-world. Soames (2007, 2011) suggests that the counterfactual locution is suited to the task of providing an account of truth-at-a-world under these conditions. In particular, we can say that for p to be true at w is for the following to hold:

18. If w were to be instantiated, then p would be true.[25]

It is worth noting that, if this is a genuine analysis of the notion of truth-at-a-world, then the counterfactual cannot (as some theorists hold) have an analysis in terms of truth at a possible world. Lewis (1973) and Stalnaker (1968) propose that the truth of a counterfactual depends on what is true at nearby worlds where its antecedent is true. (18) would on these views be true, then, just in case p is true at the nearest world(s) where w is instantiated. This appeals to the notion of truth-at-a-world, though, and so the resulting analysis would be circular.

The point here is not that a Soames-style account of possible worlds and truth-at-a-world is false; rather, it is that once we take his package of views on board, we cannot go in for a particular kind of analysis of the counterfactual. We can, instead, take the counterfactual in (18) as primitive, and this is in fact something Soames explicitly takes on board.[26] Not all theorists will be happy with this last option, however, so it is worth asking whether there are other options for analyzing truth-at-a-world. §4 explores this question in the hope of finding an analysis of truth-at-a-world that can feature in a plausible second-order account of the modal operators.

4 Hyperintensional connectives

The primitive counterfactual, as we have said, has one thing in its favor from the perspective of the second-order view. Since it can be put to use in an analysis of truth-at-a-world even when there is no ontology of worlds to appeal to, the second-order account could in principle analyze '$\Diamond p$' as follows:

19. $\exists F$: if things were F, then it would be the case that p.

[24] Propositions might still be set-theoretic entities of another kind on this view—perhaps Russellian propositions with ordinary objects and properties for constituents. All that matters is that a proposition is not the kind of thing that is guaranteed to have all the worlds with respect to which it is true as constituents; for then a Stalnaker-style analysis on which p is true at w when w is a member of the proposition expressed by p is unavailable.

[25] See, in particular, Soames (2007, p. 267), Soames (2011, p. 126).

[26] See Soames (2011, p. 126 fn. 2).

This works because the primitive counterfactual doesn't require the existence of a world where things are F. But since the counterfactual construction must be taken as primitive in (19), there is some reason to look elsewhere for another resource that can do the same job. This will show that analyzing $\Box$ and $\Diamond$ in second-order terms is not *committed* to a primitive counterfactual connective.

Any alternative resource should be one that is independently motivated—i.e., it should not be a resource we appeal to *simply because* it is needed for an analysis of $\Box$ and $\Diamond$ in second-order terms.[27] For this reason, I will sketch one possible motivation: that adequately expressing the determinate/determinable relationship requires a hyperintensional connective like 'in virtue of' in our primitive ideology. (By 'hyperintensional', I mean simply that substituting co-intensional arguments of the connective does not necessarily preserve truth-value.) Some might not find it compelling that this particular case calls for a hyperintensional connective, but will find it plausible that we need for such a resource for other purposes.[28] The essentials of the second-order account of $\Box$ and $\Diamond$ will not depend on which motivation we accept for a primitive 'in virtue of'-like connective—my primary aim will be to show in §5 that, once we have it, we can use it to do the necessary work in explicating the notion of truth-at-a-world. There are, however, some especially interesting theoretical connections to be made if the notion we use to explicate truth-at-a-world is the same as the one used to analyze the determinate/determinable relationship. I mention these briefly at the end of the present section.

Some things are both blue and colored, or both dogs and mammals, and thereby instantiate what we can call a *determinate* and its corresponding *determinable*.[29] Cases of this kind are ripe for treatment with hyperintensionality—in particular, we should want to use expressions that are not definable in terms of the standard modal resources to capture the determinate/determinable relationship.[30]

Here are two candidate analyses of the determinate/determinable relationship in purely intensional terms:

20. $\Box\forall x\ (x \text{ is blue} \rightarrow x \text{ is colored})$.

21. $\Box\forall x\ (x \text{ is blue} \rightarrow x \text{ is colored}) \land \Diamond\exists y\ (y \text{ is colored} \land y \text{ is not blue})$.

[27] This is for two reasons: first, it ensures that the analysis of $\Box$ and $\Diamond$ does not, by itself, bring in an extra ideological commitment. And second, it guarantees that we have a working grasp on the key notion. If our favored locution appears in a wide range of linguistic contexts (i.e., not just those that feature in an analysis of modality), we can arrive at a grasp of the intended meaning of the notion without the help of an explicit definition—*cf.* Williamson's "direct method".

[28] Some discussion of other motivations can be found in Fine (2001) and Schaffer (2009).

[29] See, for instance, Yablo (1992).

[30] There may be other metaphysical phenomena that likewise need hyperintensional expressions to be fully analyzed; the case of Socrates and his singleton from Fine (1994) comes to mind. One reason for not discussing these cases alongside the determinate/determinable relationship is that it would require the (perhaps unwarranted) assumption that the *same* notion should be used to explain both cases—see Manley (2007).

(20) is too weak: necessarily, every blue thing is shaped, but this isn't an instance of the determinate/determinable relationship. (21) is also too weak as someone might think that necessarily, if anything is a tree, then God loves it (because he loves everything he creates) and possibly God loves something that isn't a tree (because God might create more than trees). But plausibly, being a tree and being loved by God isn't a way to instantiate a determinate and its corresponding determinable.

This suggests that purely intensional idioms are not capable of capturing the phenomena, and naturally points toward analysis in *hyper*intensional terms. But before approaching this idea, we should ward off a different direction of thought, according to which a broader analysis in terms of *conceptual* necessity might do the job. This suggestion has some initial plausibility when we consider the present examples, as someone who has the concepts BLUE and COLORED must appreciate the relevant entailments.[31] But there are instances of the same phenomena that are discovered empirically: having atomic number 13 and being a metal seem to be instances of a determinate and corresponding determinable, yet someone could have both concepts and not know the entailment from the former to the latter holds.

Adding a hyperintensional connective to our primitive ideology gives us the resources to make the relevant distinctions. The details of exactly *which* connective we should use here are tricky, but we can introduce the contours of how such a notion would help by starting with 'thereby', as follows:

22. If x is blue, then x is thereby colored;
23. If x is a dog, then x is thereby a mammal.[32]

So long as we don't require the use of 'thereby' to have a further definition in intensional terms, we can rely on our intuitive understanding of the term to capture the relevant relationship. For it is quite natural to say that if something is blue, it isn't *thereby* shaped, even though this follows with necessity. This isn't the place to offer an extended argument that 'thereby' or something similar should appear in our primitive ideology, however. Of more interest is the question of what we might say about truth-at-a-world *if* we capture the determinate/determinable relationship with sentences like (22) and (23).

Before turning to this question, there are some issues about how exactly to proceed, once we go in for use of a hyperintensional connective. The use of 'thereby' in (22) and (23) would appear to be embedded

[31] Conceptual entailment by itself cannot be sufficient for the determinate/determinable relationship, as being a bachelor and being unmarried are not instances of the relationship. And the notion of conceptual entailment that this account appeals to needs to be made more precise, so that it is clear that there is no entailment of the relevant kind between BLUE and SHAPED. We will not pursue these issues further here, however, as the following example in the text suggests that conceptual entailment is not even *necessary* for the determinate/determinable relationship.

[32] See Teichmann (1992) for a similar suggestion.

in a conditional construction, as it occurs in a sentence with 'if' and 'then'. We might, in this case, want to know how this construction is composed from its constituent parts. But it can't contain a material conditional; surely the analogue of (22), 'if x is blue then x is thereby a giraffe', is not true of a non-blue thing.[33] A stronger reading of the conditional component is needed, but natural ways of strengthening it will invoke possible worlds. This would make the conditional ineligible for analyzing truth-at-a-world for the same reasons the counterfactual interpreted along the Lewis-Stalnaker lines was ineligible.[34]

The expression 'in virtue of' is another option:

24. x is colored in virtue of x's being blue
25. x is a mammal in virtue of x's being a dog.

'In virtue of', like 'thereby' appears to have the needed force: it is implausible to say that something is loved by God in virtue of its being a tree, as treehood consists in being a member in a certain phylogenetic group—a biological property. What stands out about the 'in virtue of' construction, however, is that it is grammatically required to be followed by a gerund phrase like 'x's being blue'; ordinary sentential constructions like 'x is blue' are ungrammatical in the second argument place. We might then worry that 'in virtue of' requires an ontology of some kind to supply the referents of these gerund phrases. And it would be disappointing if, in the course of carrying out a project where the ontology of modality is our primary concern, we jettisoned worlds from the ontological commitments of the quantificational expressions, only to introduce some very similar entities elsewhere in the analysis.

There are other options still; perhaps we could use one of the following:

26. For it to be that x is blue just is for it to be that x is colored;
27. For x to be blue is for x to be colored.

Unfortunately, the most natural reading of (26) is one on which it is *exhaustive*, entailing that there is nothing more to being colored than being blue. But of course this is false: red things are also colored (and in the same sense that blue things are colored). (27), moreover, isn't obviously different from (26) in this respect. Perhaps adding a 'thereby' as in (27) removes the feeling of exhaustivity from (26):

[33] I am supposing that claims like (22) and (23) are about a particular object x. If these are instead read as schemas or sentences bound by a wide-scope universal quantifier, then the objection becomes that 'if x is blue then x is thereby a giraffe' should not be true at (or acceptable for) worlds containing no blue things.

[34] This point of contact with the counterfactual analysis suggests another option, which is to hold that (22) and (23) do not involve complex connectives after all, and to take 'if ... then thereby ...' to be a single, unanalyzable connective. As with the primitive counterfactual, this is a legitimate option that is not entirely theoretically satisfactory; the construction certainly *seems* to involve the familiar 'if ... then ...' that appears in other analyzable English constructions without the company of 'thereby'.

28. For it to be that x is blue is thereby for it to be that x is colored.

Adding 'thereby', in other words, removes the suggestion in (26) that being blue is the *only* way to be colored. But some readers may find this construction burdensome, and the use we will put it to in an analysis of $\Box$ and $\Diamond$ will only make the problem worse (as the full analysis would require several embeddings of the 'for it to be that ...' connective, which we quantify into using primitive second-order quantifiers).

There is no obvious answer as to which hyperintensional connective is best: some may prefer the linguistic simplicity of 'thereby' or 'in virtue of' as in (22)-(25). They might be willing to pay for this simplicity by refusing to view the 'if ... then thereby ...' construction as analyzable into further component parts. Or they might insist that, despite its superficial form, the gerund argument for 'in virtue of' has the ontological commitments of an ordinary sentence, and requires no special ontology. Another approach would be to find an accessible reading of (26) or (27) that is not exhaustive. And of course we could work with the length and awkwardness of (28).

Instead of legislating on the issue here, let us instead adopt a piece of notation and introduce the connective $\Rightarrow$ as a stand-in for our favored English expression in the family of hyperintensional connectives that appear in (22)-(28). We can then write:

29. x is blue $\Rightarrow$ x is colored;

30. x is a dog $\Rightarrow$ x is a mammal

to express our hyperintensional analysis of the determinate/determinable relationship. Importantly, the $\Rightarrow$ connective is not interpreted as merely meaning *whatever* has the right properties to capture the determinate/determinable relationship. Rather, it is interpreted in terms of one of the expressions in (22)-(28) that we, as competent speakers of English, are antecedently familiar with. The formalism is simply a shortcut, allowing us to avoid taking a stand on exactly which expression this should be.

If a hyperintensional 'in virtue of'-like connective is needed for an analysis of the determinate/determinable relationship, then it is very natural to think that it can contribute to an analysis of truth-at-a-world. Recall our problem was that of explaining what truth-at-a-world is for a view which takes "possible worlds" to be maximal properties that might be instantiated, without appealing to a primitive counterfactual construction, or to structural features of the words. What is it for p to be *true at* such a property? Take a world-property **S**: for p to be true at **S** is for the following to obtain:

31. **S** is instantiated ⇒ p.

The introduction of ⇒ in terms of the determinate/determinable relationship suggests an important connection between truth-at-a-world claims and the determinate/determinable relationship. **S** is a *maximal* property, which roughly means that its instantiation determines *all* of the (non-modal) facts about the world which instantiates it. (See §5 for more on the notion of maximality.) And for the most part, sentences like p that are true at a world are *less* than fully maximal in this way: there are multiple world-properties with respect to which p is true. In these cases, we might think of the claim that **S** is instantiated as the determinate to the corresponding determinable of p's being true. Being blue is one of many ways to be colored, and likewise the instantiation of **S** is one of many ways for p to be true. In the special case where p is itself equivalent to the claim that some world-state property is instantiated, we can treat sentences like (31) as trivially true if p is equivalent to the antecedent, and false otherwise. Truth-at-a-world claims are then special cases of claims about a determinate and a corresponding determinable.[35]

5 A second-order analysis of □ and ◇

The pieces are now in place for giving a fully worked-out analysis of □ and ◇ in terms of primitive second-order quantification and the hyperintensional ⇒. We noted in the beginning of §3 that simply inserting second-order quantifiers into the traditional analysis of '◇p' to obtain (17) will not do:

17. $\exists F : p$ is true at F.

We need to make revisions in other parts of the analysis to accommodate the move to second-order quantifiers. ⇒ is helpful for nominal analyses that similarly lack structure to define truth-at-a-world, and it can also help with understanding the grammatical form of (17), a problem unique to the second-order view. Begin with the notion of truth-at-a-world: (17) contains a construction of the form

32. p is true at G,

[35] The connection between these two cases might fall apart if we adopt a different motivation for an 'in virtue of'-like hyperintensional connective. Whether this is so depends on the details; other motivations for such connectives *may* permit structurally similar analyses of both determinate/determinables and truth-at-a-world, but are not guaranteed to do so. The cases of *metaphysical dependence* from Fine (1994), exemplified by Socrates and his singleton give another candidate motivation for a hyperintensional connective. Using 'depends' to capture the relevant relationship between Socrates and his singleton, it is plausible that the fact that p is true does not depend on **S**'s being instantiated, but rather that **S**'s being instantiated depends (in part) on the fact that p is true. In this case, we should interpret the connective ⇒ in our analysis of truth-at-a-world to mean something like 'depends partly on', and take truth-at-a-world claims to be special cases of claims about this kind of partial dependence. (One exception: given the the "monism" of Schaffer (2010), p's being true depends on the global fact that **S** is instantiated, and so the original direction of explanation would be preserved.)

where G is a predicate.[36] Following the analysis of truth-at-a-world when world-properties are in play, we can say that (32) is to be analyzed in the following terms:

33. things are $G \Rightarrow p$.

That is, on one way of interpreting $\Rightarrow$, (32) claims that for it to be that things to be G is thereby for it to be that p is true.

Quantificational analyses of $\Box$ and $\Diamond$ are simply generalizations on truth-in-a-world claims like (33), where the predicate is replaced with a bound variable (and where the quantifier is appropriately restricted—see below). This gives us an analysis of '$\Diamond p$' in terms of (34):

34. $\exists F$: things are $F \Rightarrow p$.

'$\Box p$' is similar, with the existential second-order quantifier replaced with a universal second-order quantifier:

35. $\forall F$: things are $F \Rightarrow p$.

This is a step toward showing that traditional quantificational analyses can be given in second-order terms, but there is more to be done. In ordinary possible worlds analyses of $\Box$ and $\Diamond$ that quantify in a nominal position, the quantifiers are *restricted* to range over possible worlds. Exactly how this restriction is to be accomplished depends on the nature of the worlds in question (whether they are sets of states of affairs, or sets of propositions, etc.) but, with one exception, the restriction is accomplished in part by the use of a modal language, claiming that the relevant entities are all *possible*. The exception is a "realist" view of the Lewisian variety, where the quantifiers are supposed to range over maximal isolated regions of spacetime.[37] The prospects for a complete reduction of this kind seem dim, however, so the

[36] (17) itself doesn't contain a predicate, but merely a second-order variable, which occurs in predicate position. To separate issues, we will first consider the kind of claim made sentences containing 'true at' followed by a predicate. We will then consider the more general case when the predicate is replaced by a bound variable as in (17).

[37] Forrest (1986) claims to put forward a quantificational analysis over world-properties (in the style of Stalnaker and Soames) that does not require a modal notion like 'possible' to restrict the range of the quantifiers (Forrest (1986, p. 24)). We should question whether he genuinely succeeds at this, however. There are lots of abstract objects which are not world-properties; the Forrest analysis requires that the quantifiers in the analysis of $\Box$ and $\Diamond$ do not range over these; otherwise the theory would predict the wrong truth-conditions for modal sentences. What in his analysis guarantees this? What Forrest has in mind is that we could, in principle, restrict the quantifiers simply by enumerating all of the properties we wish to quantify over, and thus enumerate all and only world-properties. '$\Diamond p$' would then be analyzed as follows:

$\exists x$ [$x = w_1$ or $x = w_2$ or ...]: p is true at x

(where w_1, w_2, etc. are all of the possible world-natures, though the analysis doesn't *say* this). Very briefly, I think the problem with this approach is that it fails to explain why the modal notions expressed by the operators $\Box$ and $\Diamond$ are metaphysically significant. For example, the Forrest analysis does not explain why possibility so defined is more metaphysically fundamental than (for example) the highly gerrymandered and metaphysically inconsequential notion that defined in the same way except that it is missing the first disjunct in the restriction. See also Forbes (1989, pp. 80-82) for a related discussion.

question for the second-order analysis should be whether we can use the predicate 'possible' to restrict the second-order quantifiers in (34) and (35) in a manner that approximates its use in standard non-Lewisian analyses.

The notion of *maximality* is also present in the quantifier restrictions of standard quantificational analyses of $\Box$ and $\Diamond$. If, for instance, worlds are sets of states of affairs, the quantifiers don't range over *every* possible state of affairs; just those that are "maximal" in some appropriate sense. There is one difference between the notions of possibility and maximality when they are used in restrictions on second-order quantifiers, however: in the standard nominal analyses, 'possible' and 'maximal' are predicates that apply to names for the world-like entities in the domain of the quantifiers. In the present setting, these are plural predicates that take plural arguments like 'things' and plural variables. These predicates convey how things are—i.e., whether they are maximal or possible. And together with the hyperintensional $\Rightarrow$, they can be used to formulate the following restriction on the quantifiers in (34) and (35):

36. things are possibly $F \wedge$ (things are $F \Rightarrow$ they are maximal)

Roughly, then, using (36) as a quantifier restriction makes instances that generate truths when plugged into (36) the admissible substitution instances for the bound variables in (34) and (35). This is only a rough explanation—we will return to give the official non-substitutional explanation of quantifier restriction in a second-order setting at the end of this section.

We should also note that it is possible to reduce the number of primitives in (36) by defining 'maximal' in terms of other primitives we are already committed to, namely possibility, primitive second-order quantification and $\Rightarrow$, as follows:

37. $\forall G$: things are possibly $G \rightarrow$ ((things are $F \Rightarrow$ they are G) $\vee$ (things are $F \Rightarrow$ things are not G)).

Informally, maximality on this understanding takes a stand on any possible way for things to be (maximal or otherwise). By substituting (37) for the conjunct containing 'maximal' in (36), we arrive at a restriction on the quantifiers $\forall F$ and $\exists F$ that appeals to one less primitive.

The final question is how to incorporate the condition (36) rigorously as a restriction on the quantifiers in (34) and (35). Of course, we cannot adopt a simple notion of restrictions on which they characterize the entities in a domain of quantification—there are no domains that the quantifiers in (34) and (35) range over. But so long as the quantifiers in question are second-order $\forall$ and $\exists$, we can use familiar truth-functional connectives to restrict the quantifiers in the desired way. To start, suppose that the quantifiers in

38. $\exists x : x$ is in the room;
39. $\forall x : x$ is in the room,

are restricted to range over people with red hair. (37) and (38) are then equivalent to the more complex sentences (39) and (40), where the quantifiers are unrestricted:

40. $\exists x : x$ has red hair $\wedge$ x is in the room;
41. $\forall x : x$ has red hair $\rightarrow$ x is in the room.

Things can go similarly when the quantifiers are second-order: a restriction-condition can be embedded in the antecedent of a material conditional to restrict $\forall$, and can be embedded in a conjunction to restrict $\exists$.[38] Using the restriction (36) (or its more complicated cousin with 'maximal' defined away) to restrict (34) and (35), we then arrive at the following final analysis of '$\Diamond p$' and '$\Box p$':

42. $\exists F$: (things are possibly F $\wedge$ (things are F $\Rightarrow$ they are maximal)) $\wedge$ (things are $F \Rightarrow p$).
43. $\forall F$: (things are possibly F $\wedge$ (things are F $\Rightarrow$ they are maximal)) $\rightarrow$ (things are $F \Rightarrow p$).[39]

One lesson to take from the last two sections is that primitive second-order quantification is not a device that gives us a cheap and easy way to reduce our ontological commitments. In spite of their ontological innocence, there are many settings where second-order quantifiers are not themselves sufficient to accomplish the tasks that ordinary quantification into the nominal position (with its attendant ontology) is well-suited to do. This is for two reasons: first, these quantifiers bind variables in places that

[38] Thus, if Φ is a formula with a free second-order variable F, '$\exists F$:[Φ] ...' (where Φ functions as a second-order restriction) is equivalent to

$\exists F : \Phi \wedge \ldots$,

and '$\forall F$:[Φ] ...' is equivalent to

$\forall F : \Phi \rightarrow \ldots$.

[39] It is well-known that there is no truth-functional operation that can accomplish the effects of restriction on natural language quantifiers like 'most', 'few', etc. So, if there are second-order analogues of these quantifiers, the present strategy for second-order quantifier restriction cannot be extended to these cases. Two options would then be available: one is to add an additional primitive restriction construction for second-order quantification. (Perhaps we can begin to grasp this primitive construction by understanding that its function, in the case of $\exists$ and $\forall$, is equivalent to a construction containing $\wedge$ and $\rightarrow$, as in the move from (38-39) to (40-41). Of course, these cases would fall short of a definition.) Another alternative, which is consistent with the needs of our present project, is to deny that quantifier restriction can be extended to second-order 'most'.

are syntactically distinct from the variables bound by ordinary quantifiers into the nominal position, and so we often need to re-work other aspects of our analysis to accommodate the syntactic changes that accompany a move to bound predicate-position variables. Moreover, the reduction in ontology brings with it a potential loss of structure (set-theoretic or otherwise) that is useful in formulating analyses. We can handle these complications, but this requires some substantial re-working of the original analyses containing nominal quantifiers, plus an extra resource in the form of a hyperintensional connective. The benefits of primitive second-order quantifiers are therefore part of a more expensive package—a package some philosophers will not be willing to pay the extra costs for. It should be clear, however, that *if* we are willing to countenance the extra constructions in our primitive ideology, there is a non-obvious yet substantial benefit in ontology to be had.[40]

6 Re-formulating global supervenience

Our main concern has been to develop a second-order quantificational analysis of $\Box$ and $\Diamond$. But there is a reason why an analysis in quantificational terms is to be preferred over taking $\Box$ and $\Diamond$ as primitive: even though quantificational analyses in their typical form take on additional ontological commitments, they are also potent explanatory tools. Lewis (1986, Ch. 1) makes the case that, in addition to providing an analysis of $\Box$ and $\Diamond$, quantification over worlds is needed for formulating other metaphysical claims. Global supervenience theses are one example:

> For a case where the distortion is more serious, take my second example: the supervenience of laws. We wanted to ask whether two worlds could differ in their laws without differing in their distribution of local qualitative character. But if we read the 'could' as a diamond, the thesis in question turns into this: it is not the case that, possibly, two worlds differ in their laws without differing in their distribution of local qualitative character. In other words: there is no world wherein two worlds differ in their laws without differing in their distribution of local qualitative character. That's trivial—there is no world wherein two worlds do anything. At any one world W, there is only one single world W. The sentential modal operator disastrously restricts the quantification over worlds to something that lies within its scope. Better to leave it off. But we need *something* modal—the thesis is not just

[40] At this point a potential criticism should be mentioned: the goal eliminating the ontological commitments of modality seems extremely narrow-minded, since we will need propositions and/or properties as tools of analysis in other areas.The fact that these entities are unneeded for an analysis *of modality* is of little interest; since we will need entities of a certain kind elsewhere, we might as well help ourselves to them here.

There are two ways to respond to this line of thought. The first is to hold out hope that the tools we use to eliminate ontological commitments in our analysis of modality will also make available a reduction in ontology in other domains. (To take one example: so-called "indispensibility" arguments for the existence of properties of the kind found in van Inwagen (2004) are suspect once primitive second-order quantification is in the picture—see Manley (2009) for discussion.) Second, even if we are in the end saddled with the existence of *abstracta*, we might nonetheless hold that they are low-grade entities are are not very fundamental. By avoiding an analysis of modality that requires the existence of these things, we can consistently hold that the modal idioms express highly fundamental notions without upgrading the metaphysical status of *abstracta*. Thanks to Daniel Fogal for discussion of this issue.

> that the one actual world, with its one distribution of local qualitative character, has its one system of laws![41]

If Lewis is right, there is a significant theoretical benefit to quantifying over possible worlds: by refusing to analyze $\Box$ and $\Diamond$, we deprive ourselves of important resources for capturing the supervenience of laws on local qualitative character.[42] But suppose we avoid commitment to worlds in our analysis of the operators by using second-order quantifiers: will commitment to worlds arise again once we turn our attention to global supervenience theses? No, for the second-order analysis is a *quantificational* analysis, and we can use the quantificational apparatus to capture the relevant supervenience theses without commitment to worlds.

We need, however, to be careful about what exactly the benefit in formulating global supervenience theses is. In many cases, global supervenience claims have been put forward to capture a kind of *dependence* relation between two domains.[43] But with the resources of a hyperintensional connective in place, global supervenience claims are plausibly dispensable for this purpose.[44] Still, other jobs remain for global supervenience. First: there might be domains globally supervene on others *without* former depending on the latter or *vice versa*. (As an example, we might take a Leibnizian who thinks that the mental globally supervenes on the physical owing to a "pre-established harmony", or a Moorean about the normative who holds that rightness supervenes on, but is importantly independent of, the natural. Such theorists plausibly reject the presence of any dependence between the domains in question.) In this case, we need global supervenience claims to capture modal covariation between domains without dependence. This leads to a second point: even when we are dealing with domains related by a kind of dependence—such as, perhaps, the laws and local qualitative character—it is nonetheless still *true* that the two domains bear a weaker relation of global supervenience. In short, once we relinquish the claim that global supervenience captures an interesting sort of metaphysical dependence, it still captures a theoretically interesting relation between domains, and we should like to have the resources to express this relation.

[41] Lewis (1986, p. 16).

[42] Nothing in what follows will hinge on the assumption that Lewis is right about the supervenience between laws and distribution of local qualitative character. I will work with the example here, but readers who disagree with Lewis on this count might accept other global supervenience theses (such as the supervenience of the moral on the descriptive, or of the mental on the physical) and are free to substitute their favored examples in the rest of this section, without loss of substance. Use of quantification in formulating global supervenience theses is common outside of Lewis; see also Kim (1984, p. 168) and Sider (1999, p. 915).

[43] See Kim (1984, p. 175), Stalnaker (1996, p. 230), and Bennett (2004, p. 507 ff).

[44] Thanks to Karen Bennett for raising this question.

To formulate Lewis's claim of the global supervenience of laws on local qualitative character, we can begin with the following canonical statement of the thesis, which uses nominal quantifiers ranging over worlds:[45]

GS $\forall w_1, w_2$: if w_1 and w_2 are the same in distribution of local qualitative character, then w_1 and w_2 do not differ in their laws.

Can we use the resources of §§2-5 to formulate a second-order equivalent for **GS**? I will not spell out precisely what "equivalence" amounts to here, but our earlier discussion highlights one *desideratum* for a second-order replacement of **GS**: it should not commit us to holding that laws obtain *in virtue of* a particular distribution of local qualitative character. For even if we share Lewis's views about laws and wish to claim in addition that laws depend on distribution of local qualitative character, the statement of global supervenience should not commit her to this; it should entail a kind of modal covariance between the two domains and nothing more.

We know how to simulate quantification over possible worlds using second-order quantifiers and $\Rightarrow$; I will use the subscripted second-order variables F_1 and F_2 under the assumption that they are appropriately restricted. To replace the notion of two worlds having the same distribution of local qualitative character, let us first introduce a second-order variable Q, and restrict it so that, in effect, its admissible instances allow for only one way for things to have a maximal local qualitative character. In other words:

44. things are $Q \Rightarrow$ things have a particular maximal local qualitative character.

Using a clause like (44) as a restriction (indicated here by square brackets—*cf.* fn. 39.), the second-order equivalent of a condition requiring that w_1 and w_2 are identical in distribution of local qualitative character is the following:

Same LQC $\exists Q$ [things are $Q \Rightarrow$ things have a particular maximal local qualitative character] : (things are $F_1 \Rightarrow$ things are Q) $\wedge$ (things are $F_2 \Rightarrow$ things are Q).

We next need a second-order equivalent for the condition that w_1 and w_2 are governed by the same laws, and this can be accomplished by using a restriction structurally similar to (44) (where L is a second-order variable and $l_1, l_2 \ldots$ are variables ranging over specific laws):

[45] More could be said about what it is for two worlds to be the same in distribution of local qualitative character and the same in laws; I will briefly address these complications in fn. 46, below.

Same Laws $\exists L\ \exists l_1, l_2 \ldots$ [things are $L \Rightarrow$ things are governed by the laws $l_1, l_2 \ldots$ and there are no other laws] : (things are $F_1 \Rightarrow$ things are L) $\wedge$ (things are $F_2 \Rightarrow$ things are L).

We now have the resources to state a second-order equivalent of **GS**: we just need to add universal second-order quantifiers to bind F_1 and F_2 and a material conditional, to say that for any two "worlds", *if* they satisfy **Same LQC** *then* they satisfy **Same Laws**. The result is **GS**$^+$:

GS$^+$ $\forall F_1, F_2$: ($\exists Q$ [things are $Q \Rightarrow$ things have a particular maximal local qualitative character] : (things are $F_1 \Rightarrow$ things are Q) $\wedge$ (things are $F_2 \Rightarrow$ things are Q)) $\rightarrow$ ($\exists L\ \exists l_1, l_2 \ldots$ [things are $L \Rightarrow$ things are governed by the laws $l_1, l_2 \ldots$ and there are no other laws] : (things are $F_1 \Rightarrow$ things are L) $\wedge$ (things are $F_2 \Rightarrow$ things are L)).

Crucially, **GS**$^+$ doesn't entail that the laws depend on local qualitative character—**GS**$^+$ uses only a material conditional to connect a claim about the local qualitative character at a pair of worlds and a claim about the laws at those worlds. There are further questions about whether **GS**$^+$ is an adequate substitute for **GS** in every respect.[46] But we have a promising start, and it is an open question whether other discrepancies between **GS**$^+$ and **GS** would reflect metaphysical shortcomings of **GS**$^+$, or whether they would serve to bring out mere artifacts of **GS**.

7 Conclusion: the place of worlds in a hyperintensional setting

§§2-5 show how someone who accepts the resources of primitive second-order quantification and an 'in virtue of'-like connective can analyze $\Box$ and $\Diamond$ without committing to an ontology of possible worlds.

[46]One of these further questions is the following: in formulations of global supervenience that quantify over worlds, what it is for two worlds to be the same in some respect can be given a further gloss. In particular, we can follow the characterization Stalnaker (1996, p. 227) gives of what it is for two worlds to be the same (or indiscernible) with respect to some class of properties:

> [T]wo worlds w and z are *B-indiscernible* iff there is a 1-1 correspondence between the domains of w and z, and any individual in the domain of w has the same B-properties in w as the corresponding individual from the domain of z has in z.

This gives rise to different versions of global supervenience, which are often called "strong" and "weak" global supervenience (for more on these notions, see Sider (1999), Shagrir (2002) and Bennett (2004)). Can clauses like **Same LQC** be adapted to accommodate this rendering of what it is to be the same in some respect? Here is one (admittedly sketchy) suggestion. Let μ be a 1:1 mapping from the domain of one "world" to the domain of another. We can then introduce a variable "ranging over" local qualitative characteristics of individuals as follows:

$\forall x$: if x is $Q \Rightarrow x$ has a local qualitative character.

Two "worlds" that preserve local qualitative characteristics, then, satisfy the following:

$\exists \mu\ \forall y\ \forall Q$ [$\forall x$: x is $Q \Rightarrow x$ has a local qualitative character] : (things are $F_1 \Rightarrow y$ is Q) $\wedge$ (things are $F_2 \Rightarrow \mu(y)$ is Q).

This re-formulation of **Same LQC** is not without questions: for instance, the presence of a nominal quantifier outside the scope of a hyperintensional connective raises the question of whether it requires an ontology of *possibilia.* Answering this question while remaining faithful to the ontological aims of the present paper is a further project, which I cannot undertake here. Thanks to Karen Bennett for raising this question.

When we take into account considerations that might motivate a hyperintensional ideology, however, this result is not entirely surprising, and perhaps even to be expected.

The motivations for theorizing with a primitive hyperintensional connective often derive from the inadequacy of reference to possible worlds as an analytical tool. We have already encountered several examples of this: the discussion of determinates and determinables in §4 is one. Global supervenience claims, of the kind discussed in §6, provide another example; modal claims like **GS** (or $\mathbf{GS}^+$) plausibly *need* explanations and do not provide them.[47] We saw how determinate/determinable claims can be captured with hyperintensional devices. And hyperintensional notions as they appear in some recent work in metaphysics seem ready-made to explain global supervenience claims.[48]

There are other examples which fit the same pattern. Here is one: some philosophers have suggested that what distinguishes *realist* ethical theories from their irrealist counterparts is their consequences for the modal profile of ethical facts. Since irrealists typically accept that the ethical is mind-dependent in some way, one might think that the distinctive feature of the irrealist view is that it entails that in possible worlds where the mental facts are different (say, worlds where everyone endorses murdering), the ethical facts are likewise different (and so in these worlds murdering is permissible). The realist, according to this line of thought, rejects that ethical facts have this modal profile.[49] Such a proposal runs into trouble when we note that sophisticated expressivist views like that of Gibbard (2003) do not entail that the ethical counterfactually depends on facts about the mental states of agents, yet expressivism of this kind does not seem to be a realist view. In light of considerations like these, Fine (2001) goes hyperintensional, holding that what separates these views is that the ethical realist alone holds that ethical facts hold "in Reality". This kind of proposal at least has the right structure to explain the difference between the realist and Gibbard-style expressivist: even if they agree on the distribution of ethical facts across the space of metaphysical possibility, they might disagree over the Reality of these facts.[50]

Thus it might be that an ontology of possible worlds is not the explanatory paradise that Lewis and others took it to be; talk of worlds instead provides a rough approximation of deeper and more powerful explanatory notions which are hyperintensional. If this is right—and I have not provided here anything more than a few examples that gesture in this direction—then we could hope that, just as explanations

[47] See Kim (1984, p. 174) for discussion.

[48] For instance, the notion of *ground* in Schaffer (2009)) can do the job: it is plausible to say that if A is grounded in B, then it follows that A supervenes on B.

[49] This seems to be the position in Dworkin (1996).

[50] See Dunaway (MS, Chs. 1 & 2) for discussion and refinement of this idea.

in terms of possible worlds are supplanted by hyperintensional explanations, the work done by possible worlds might *itself* be grounded in the hyperintensional. §§2-6 give one idea of how this might go.

Of course, we needed an extra resource in the form of primitive second-order quantification to do away with the worlds. This is another resource that some philosophers will be reluctant to accept on the grounds that they don't understand it well enough to use it in philosophical theorizing.[51] I have tried to show in §2 that there are legitimate avenues for understanding these quantifiers, and to indicate the work they can do. But we can't argue someone into acquiring a grasp of the relevant concepts, and some might still complain that they haven't been sufficiently helped—after all, by taking second-order quantifiers to be *primitive*, we thereby refuse to define the notion in familiar terms involving quantification into nominal positions. In this respect, the situation is similar to the original move away from the kind of skepticism about modality voiced in Quine (1953b). The movement in this case was plausibly not a result of wholly new explanations of the meaning of 'possible'; rather it came about as philosophers saw modal notions prove fruitful in providing rigorous analyses of a wide range of further phenomena. Languages bereft of modal force are too impoverished to do the work of metaphysics; new tools for analysis were needed. Expanding our conceptual resources to include primitive second-order quantifiers and hyperintensional connectives might represent a similar improvement in our analytical toolbox.

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[51] This is the sentiment expressed by the earlier quote from van Inwagen (2004).

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