Rini, A.A and Cresswell, M.J., *The World-Time Parallel: Tense and Modality in Logic and Metaphysics*, Cambridge:Cambridge University Press, 2012, xvii+260, $125.00 AUD (Hardback)

The World-Time Parallel is perhaps best seen as a book on the metaphysical applications of indexical semantics. Rini and Cresswell use these tools to argue that there is a 'structural parallel' between tense and modality, in the sense that for every argument in the metaphysics of modality (resp. time) there is a corresponding argument in the metaphysics of time (resp. modality), with both arguments having the same structure. To the extent that the validity of arguments is a structural matter these parallel arguments will fare the same as far as validity is concerned. What is meant to follow from this parallel is not, in general, made clear. There are some questions, such as the ontological status of worlds and times, where such a parallel would seem to rule out some possible positions (such as being an eternalist and an actualist). We will put this issue to one side in this review, though, preferring to focus on more specific issues.

The book itself is split into four parts followed by five technical appendices. Parts I and II set up the required technical background on indexical semantics for mixed modal and temporal languages, as well as introducing the particular formal languages which are used throughout the rest of the book. These first two parts argue that there is a logical parallel between temporal and modal languages, in the sense that adequate modal and temporal languages will have equivalent expressive power. These initial chapters offer quite a gentle introduction to philosophically motivated indexical semantics, chapter 7 being a particularly pleasant discussion of linguistic motivations for enhancing the expressive power of modal and temporal languages by introducing analogues of Hans Kamp's 'now' and 'then' operators. Parts III and IV of the book go on to make use of the logical parallel established in Parts I and II in order to deal with various issues which threaten the world time parallel. These chapters are far more heterogeneous, covering topics including various forms of primitivism

concerning modal/temporal operators (ch.9-10), the argument against the world-time parallel presented in Evans[1985] (ch.12) and the connections between supervenience and causation (ch.17). The chapters in the second half of the book can quite easily be read independently of one another once one is familiar with the formal machinery introduced in the first half of the book. The logical material throughout is moderately technical, but most of the overt technicalities have been relegated to the appendices (where the few formal proofs in the book appear). Furthermore, the authors have made an admirable effort to make the purpose of the various technical machinery deployed in the text as clear as possible.

Given the diverse subject matters of the chapters in the latter half of the book we will restrict our attention in the remainder of this review to one of the main arguments presented in part I and II: the structure of our modal and temporal talk commit us to worlds and times. This argument is implicit in chapter 4 of Cresswell [1990], a book which is one of a few conspicuous absences from the bibliography. Interestingly, the argument there is concerned with the fragment of $\mathscr{L}_{multi}$ mentioned below rather than the full language. It would be interesting to know how important Rini and Cresswell take this difference to be.

The argument in question has two main parts: a notion of quantificational structure, and an adequacy constraint on any reasonable temporal/modal language. Before going on to look at these two parts of the argument it will be necessary for us to be clear about the key players in this argument, the formal languages used by Rini and Cresswell. In chapter 7 Rini and Cresswell introduce three formal languages, giving translations between them in chapter 8 (and appendix 1) to show that these languages are expressively equivalent— i.e. for every sentence of one language there is a sentence of the other with the same truth-conditions. All three of these are first-order languages with quantifiers over individuals, and are summarised below.

-     $\mathscr{L}_{\text{multi}}$ contains the modal operator $\Diamond$ ('possibility'), the temporal operators P ('it was the case that') and F ('it will be the case that'), as well as temporal and modal cross-reference devices in the form of a denumerable supply of operators Ref_i and $Ref_i{}^m$ and nominal constants **$then_i$** and **$actual_i$**.

-     $\mathscr{L}_{x\text{tw}}$ is a three-sorted language with the modal operator $\Diamond$, the temporal operators P and F, as well as quantifiers over worlds and times and special distinguished predicates N ('now') and A ('actual').

-     $\mathscr{L}_i$ is a three-sorted first-order language with quantifiers over worlds and times, as well as the special predicate $<$ ('later than').

In both $\mathscr{L}_{x\text{tw}}$ and $\mathscr{L}_i$ identity is restricted to variables of the same sort. Approximately speaking, formulas of the form '$Ref_i\ \alpha$'/'$Ref_i{}^m\ \alpha$' store the time/world they're evaluated at, with the constants **$then_i$** and **$actual_i$** true only at the time/world stored by the most recent '$Ref_i\ \alpha$'/'$Ref_i{}^m\ \alpha$' within whose scope they lie (precise definitions appear on p.199f). Note that the official languages which Rini and Cresswell use also contain a counterfactual conditional, restricted modalities, and a knowledge operator. As these do not effect the points made below (and rarely show up in the text generally) we have simplified the languages below for readability.

Rather than show directly that the tensed modal language $\mathscr{L}_{\text{multi}}$ is expressively equivalent to the untended non-modal language $\mathscr{L}_i$, chapter 8 instead focuses on the relationship between $\mathscr{L}_{\text{multi}}$ and $\mathscr{L}_{x\text{tw}}$, with the appendix showing the equivalence of $\mathscr{L}_{x\text{tw}}$ and $\mathscr{L}_i$ (and thus $\mathscr{L}_{\text{multi}}$ and $\mathscr{L}_i$). Frustratingly, the authors use τ and τ^* for both the translations between $\mathscr{L}_{\text{multi}}$ and $\mathscr{L}_{x\text{tw}}$ given on p. 89f as well as for the translations in the technical appendix between $\mathscr{L}_{x\text{tw}}$ and $\mathscr{L}_i$, hindering discussion and comparison between these results.

In chapter 9 we are given a characterisation of quantification (and thus ontological commitment) in terms of how a language structures its truths. The idea here is that a language has quantificational structure whenever it has the same structure as a language with explicit variable-binding quantifiers, and it is in cashing out this notion of 'sameness of structure' which the notion of expressive equivalence is employed. Using this account of what it takes for a language to be quantificational Rini and Cresswell argue that, despite lacking explicit variable-binding quantifiers over times and worlds, languages like $\mathscr{L}_{\text{multi}}$ quantify over times and worlds. This conclusion follows from the expressive equivalence of $\mathscr{L}_{\text{multi}}$ and $\mathscr{L}_i$ (a canonical example of a language which explicitly quantifies over worlds and times), along with the plausible assumption that expressively equivalent languages have the same structure. This proposal for what it takes for a language to be quantificational deserves further investigation.

So far we just have an (interesting) claim concerning formal languages. In part II Rini and Cresswell argue that a language at least as expressive as $\mathscr{L}_{\text{multi}}$ is required in order to provide an adequate account of the truth conditions of natural language modal and temporal sentences. Combining this result concerning adequate semantic treatments of modal and temporal talk, with the aforementioned claim that $\mathscr{L}_{\text{multi}}$ quantifies over worlds and times we end up with the conclusion that English itself has quantificational structure of the appropriate kind. On the basis of this argument Rini and Cresswell claim that modal (and temporal) operators are quantifiers, and that 'worlds' (resp. 'times') are whatever these quantifiers quantify over. This argument implies that positions which deny the existence of worlds or times are false due to the very nature of our language, making them, in a somewhat non-standard sense, *analytically* false.

There is a lacunae in the adequacy condition appealed to be Rini and Cresswell, though. In chapter 7 they argue that, in order to give anything approaching an adequate semantic treatment of tense and modality (sufficient, at the very least, to look at inferential relations between different sentences) we need to enrich standard modal and temporal languages with devices which allow us to make rigid reference to part of an index in order to do the job which 'now' and 'actually' do in natural language. So, for example, we need a language which can give truth conditions for sentences like (1) (given on p.75)

(1)   In the future everyone now miserable will be happy.

Standard treatments of 'now' and 'actually' treat them as sentential operators. On p.77 we are instead told that we are to take ***now*** to be a propositional constant (technically, a nominal constant) true only at the present time, with the standard operator '***now*** α' being defined as '$\oplus$(***now*** $\supset$ α)', where '$\oplus$' means 'at all times' (or 'is, was and will be'). In the primitive notation of $\mathscr{L}_{\text{multi}}$, (1) would thus be represented as

(1*) $F \ \forall x(\ \oplus(\textbf{now} \supset \textbf{\textit{miserable}}(x)\ ) \supset \textbf{\textit{happy}}(x))$,

where the '***now***' constant only occurs in the defined operator. Similar sentences are then used to show that we need to enrich our language with countably many constants ***then***$_i$ and ***actual***$_i$, and all such sentences given only require the constants to appear as part of their defined operator. So the evidence which Rini and Cresswell provide justifies only a language with the corresponding ***then***$_i$ and ***actual***$_i$ *operators* and such a language will not be expressively equivalent to ones like $\mathscr{L}_{x\textbf{tw}}$ or $\mathscr{L}_i$, the nominal constants playing a vital part in translating claims involving N and A in the case of

$\mathscr{L}_{x\mathbf{tw}}$ and of identity between worlds or times in the case of $\mathscr{L}_i$. This is problematic for the world-time parallel, though, as one can make a prima facie case that any adequate language for capturing our temporal talk and thought must have such nominal constants, due to the fact that it seems we can name and refer to times (something which is dubious in the modal case, as noted on p.88).

One of the conclusions which Rini and Cresswell draw over the course of the book is that many of the purported disanalogies between worlds and times are only present because they have been put there by metaphysicians. Equally one must make sure that analogies between worlds and times are not put in place by an unmotivated choice of semantic theory. This is not to say that Rini and Cresswell are wrong that there is a strong parallel between the metaphysics of tense and modality, just that this book does not quite seem to establish it. Despite the misgivings voiced above, though, the book opens up a interesting areas for further research.

REFERENCES

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