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Advanced modalizing de dicto and de re[1]

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Abstract

Lewis' (1968, 1986) analysis of modality faces a problem in that it appears to confer unintended truth values to certain modal claims about the pluriverse: e.g. 'It is possible that there are many worlds' is false when we expect truth. This is the problem of advanced modalizing. Divers (1999, 2002) presents a principled solution to this problem by treating modal modifiers as semantically redundant in some such cases. However, this semantic move does not deal adequately with advanced de re modal claims. Here, we motivate and detail a comprehensive semantics (a la Lewis 1968) for advanced modalizing de dicto and de re. The generalized semantic feature of the initial solution is not redundancy but absence from counterpart-theoretic translations of world-constrictions.

1. Advanced modalizing and redundancy

The problem of advanced modalizing is how the Lewisian theorist of modality is to deal with the modal modification of the theses of counterpart theory (Lewis 1968) and of genuine modal realism (Lewis 1986). Take the Lewis 1986 conception of unrestricted quantification as ranging over the whole pluriverse and read the following quantificational claims as so unrestricted: 'There are many worlds', 'There are transworld sets', 'There are perfectly natural properties' etc. Now modify the claims, so understood, with expressions of possibility to produce: 'There could be many worlds', 'It is possible that there are transworld sets', 'There might be perfectly natural properties' etc. Now apply to these modal claims the counterpart-theoretic interpretation of Lewis 1968, and the result is, by genuine modal realist lights, falsehood when you would expect (given other Lewisian pronouncements) truth. Thus, for example in claiming the possibility of what she takes to be categorically the case – 'there could be many worlds' – the Lewisian is rendered by the 1968 interpretation as speaking the falsehood that 'there is a world within which there are many worlds'.[2] The root of the problem is as follows. The 1968 interpretation forces the Lewisian to interpret all claims that are regimentable in quantified modal logic, whether in the modal fragment or not, as intra-world claims: claims about what is the case in the actual world, or in some worlds, or in all worlds. But that constriction is reflexively uncharitable. So what is to be done?

Divers' (1999, 2002) contribution to the solution of the advanced modalizing problem is to suggest that the Lewisian may treat certain modal modifications of unrestricted quantificational contents as semantically redundant. Thus, if we begin with a sentence,

[1] The final published version of this paper (with minor editorial corrections and official pagination) is forthcoming in *Analysis*.

[2] See Appendix for all relevant formalizations.

'$\exists x A(x)$' in which the wide scope quantification is read unrestrictedly, it is a self-charitable semantic option to interpret modal modifications as follows:

(AP) 'It is possible that ($\exists x A(x)$)' is true iff $\exists x A(x)$

(AN) 'It is necessary that ($\exists x A(x)$)' is true iff $\exists x A(x)$

(AI) 'It is impossible that ($\exists x A(x)$)' is true iff Not-$\exists x A(x)$

(AC) 'It is contingent that ($\exists x A(x)$)' is true iff [$\exists x A(x)$ and Not-$\exists x A(x)$]

This redundancy interpretation produces felicitous results in a wide range of relevant cases – for example:

(AP1) 'Possibly, there are many worlds' is true iff (unrestrictedly) there are many worlds (i.e. $\exists x \exists y (Wx \mathbin{\&} Wy \mathbin{\&} \neg(x = y))$)

2. The problem of advanced de re modals

Jago (2016: 629–31) objects that the redundancy interpretation generates the wrong truth-values (falsehood where we require truth) in other relevant cases. The cases in question are modalized comparatives of non-worldmates (say, Bill and Anna) – for example:

(X) It is contingent that Anna is taller than Bill

The two planks of the objection then are: (O1) that (X) is true, but (O2) (X) is not true under the redundancy interpretation, which produces the unsatisfiable truth-condition ($Rab \mathbin{\&} \neg Rab$).

The first strategy for responding to this worry is to focus on (O1). In that case, it is important to emphasize that the primary question, given the nature of the bigger dialectic is whether a Lewisian really ought to accept the presented case for (O1).[3] It is not obvious that Jago has taken that point since the case that he makes is for the truth of (X), and as follows. Anna and Bill are ordinary human beings, with 'regular human bodies, embedded within physical environments and subject to physical laws very much like our own' (Jago, 2016: 631). The suggestion is that the only difference between Anna and Bill, on one hand, and us, on the other, is that they do not inhabit the same world as one another. Accordingly, we should expect contingency to characterize comparative relations between them when it does so between us: but applying the redundancy interpretation, not so. However, it is not obvious that there is any supervenience principle that will support the argumentative 'accordingly' here and to which the Lewisian is committed. Moreover, in the absence of any prior commitment to contingency in such a case, the Lewisian might attempt to take what is an admittedly odd non-contingency

[3] The point here is not to sway skeptics who are inclined to reject the Lewisian theory of modality on prior grounds. The point is to convince the reader that given the basic Lewisian theory of modality, advanced modalizing problems can be solved by deploying existing resources and without introducing any further problems. Or, at least, such would be a maximal solution within the remit.

in her theoretical stride here as she does in the case of unrestricted existence, the Lewisian being a necessitist in the sense of Williamson.[4] In both cases the Lewisian might be unmoved by pleas, emerging from metaphysical intuition, about how the intrinsic natures of things compel a verdict of contingency in cases that neither everyday modalizing nor scientific modalizing anticipates: that is, cases in which we modally modify relational predications of individuals who are drawn without restriction from a plenitudinous pluriverse of spatiotemporally disjoint parts. However, we will not pursue that strategy here.[5] Instead, we allow that the truth of (X) is something that, in the first instance at least, the Lewisian would rather accommodate and we accept on her behalf the burden of that accommodation. Accordingly, we adopt the second available strategy and focus on the second plank of the objection, (O2) above. Thus, we explain why the application of the simple redundancy interpretation is inappropriate in such cases and propose a felicitous alternative.

3. Preliminaries

Let us put aside two unfortunate aspects of Jago's example that potentially weaken his case but which are also dispensable. Firstly, the choice of non-modal relational predication, 'taller than' is unfortunate. For such predications are problematic when they are applied to individuals who are supposed to stand (qua non-worldmates) in no spatiotemporal relations to one another (Divers 2014b). But other predications that are not so sensitive to spatiotemporal isolation could be substituted ('happier than', 'the same colour as', etc.). Secondly, the example moots singular reference to non-actual individuals and that is also problematic given the metaphysics of genuine modal realism (see Divers 2002: 77-85). But we could just as easily consider de re modalizing that does not rely on singular reference to non-actuals, suggesting only that there exists human x and there exists human y such that the x and the y are modally thus and so. With their dispensability noted we shall let those features of the example stand: but we shall make a change in the form of a simplification that eliminates unnecessary complexity and length of formulas. Thus we focus on the crucial possibility claim, (X*)

(X*) Possibly Bill is taller than Anna.

Finally, and to locate more precisely our complaint, Jago is right about this much: if we apply, in the manner he envisages, the redundancy interpretation to (X**) we get falsehood where we are committed to finding truth – thus:

(X**) Bill is taller than Anna

For, by hypothesis, we are committed to Anna being taller than Bill and are, thus, one step away from contradiction.

[4] See Williamson (2013: 16-27) and Divers (2014a).

[5] Just as Jago is very confident about what judgments we (or is it the Lewisian?) should make in recherché cases of *de re* modalizing about non-worldmates, so it is with Bigelow & Pargetter (1990: 192-93) in the case of counterfactuals about non-worldmates. For discussion see Divers (2002: 96-98).

The crux of the matter is this: the de re modal (X*) has been treated as if it were appropriately regimented as a formula that has an expression of possibility in position of widest scope. That is why the familiar redundancy rule (AP), above, is supposed to apply. But this is not the Lewisian way. The Lewisian way is to regiment (X*), in its de re reading, as a formula that does not have an expression of possibility – but rather, a quantifier – in position of widest scope.

The procedure envisaged by Lewis 1968 is to represent English sentences in the notation of pure quantified modal logic (QML) – that is name-free QML – and then apply the rules for translation into counterpart theory. Let us begin then with

(X*) Possibly Bill is taller than Anna

The procedure for regimenting (X*) is to apply the Russellian method of descriptions and to register the familiar scope ambiguities discerned by Smullyan (1948). So, imagining that we associate appropriate definite descriptions with 'Bill', 'B*' and with 'Anna', 'A*', we have the two readings:

(X*1) Possibly (the x that is the B* is taller than the y that is the A*)

(X*2) The x that is the B* and the y that is the A* are such that possibly (x is taller than y).

On the de dicto reading, (X*1), and as long as we choose felicitous, height-independent, descriptions, we get by Lewisian lights, truth – for example, (LX*1):

(LX*1) There is a world at which (the x that is the fastest ever runner is taller than the y that is the longest ever jumper).[6]

But on the de re reading we do uncover an advanced modalizing problem. For applying the Lewis (1968) rules for modal operators occurring within the scope of quantifiers, we obtain (LX*2):

(LX*2) In the actual world there is an x that is the B* and there is a y that is the A* and there is a world w in which there is an x-counterpart, z, and there is a y-counterpart, u, such that z is taller than u.

One need not read very far along the regimentation to appreciate that it will often yield (by Lewisian lights) unwanted falsehood: all such claims are false when there is no actual x that is the B* or no actual y that is the A*. So the Lewis 1968 interpretation of de re modal claims does no better than it does in the interpretation of de dicto modal claims in the (then) unintended and unanticipated case where the quantifiers under modal modification are intended to be unrestricted in the first place. But that much is entirely predictable. We now elaborate on this point, bringing to the surface the general principles that ought to govern the search for a solution to advanced modalizing problems and then applying them to the de re case.

[6] We appeal here to intra-world superlatives, see footnote 6 for more detail.

Systematizing and generalizing, we conclude by presenting translation rules, in the style and scope of Lewis 1968, that offer a unified approach to advanced modalizing de dicto and de re.

4. The intended limitations of Lewis 1968 noted and removed

The 1968 interpretation of modal discourse is calculated to be charitable about most modal talk. That is to say, what is said by pre-philosophical modalizers: those knee-jerk actualists whom we want to treat as truth-tellers when they say, 'there are no talking donkeys but there are talkers and donkeys' etc. Swiftly, the effective move in securing such charity is the imposition of truth-conditions that are invariably world-constricted. There is then a further challenge for the Lewisian to meet and which was not addressed in Lewis (1968): that is the challenge of self-charity. There are lots of things that the Lewisian says by way of modalizing about the pluriverse (see Divers 1999: 219). Perhaps all such talk is, somehow, dispensable. But we believe that it is worth asking the question whether its truth can systematically accommodated and answer that this is so. Swiftly, again, the effective move in securing this kind of charity is the removal of world-constrictions on the truth-conditions stated in Lewis 1968. The redundancy interpretation of de dicto modal claims was the result of doing just that. But what is projectable beyond that case to the de re is not (simple) redundancy, as per Jago's objection, but the removal of world-constrictions. The folk believe – or do not disbelieve – that their unrestricted quantification is world-constricted: in fact, actual-world-constricted. That feature of their beliefs is charitably respected when truth-conditions are given for the modal modification of quantifiers so intended. The Lewisians believe that their unrestricted quantification is not world-constricted. That feature of their beliefs should be charitably respected by giving truth-conditions for the modal modification of quantifiers so intended. This is an entirely principled approach to interpretation. Now let us consider what it yields when applied in the most natural and obvious way to (X*2):

> (X*2) The x that is the B* and the y that is the A* are such that possibly (x is taller than y).

Where we had previously, with world-constriction

> (CX*2) In the actual world there is an x that is the B* and there is a y that is the A* and there is a world w in which there is an x-counterpart, z, and there is a y-counterpart, u, and z is taller than u.

we now have, removing all sources of world-constriction

> (AX*2) There is an x that is the B* and there is a y that is the A* and there is an x-counterpart, z, and there is a y-counterpart, u, and z is taller than u.[7]

[7] Here we take the descriptive terms unanalysed for ease of exposition, but ultimately they will be expanded in the Russellian way and our appendix rules will apply, e.g., '*the x that is the B**' is $\exists x(B^{*}x \,\&\, \forall y(B^{*}y \supset (y = x)))$. A referee raises the intriguing question of how we might treat advanced de re modal claims invoking superlatives – e.g. '*Possibly Anna is taller than Bill and taller than anyone else'*. We reply that, on the face of things, it seems that when we quantify over all of the

And there – thanks to plenitude and recombination – we have the Lewisian truth. The move is simple: unconstrict wherever there was world-constriction. But note that in the above case we remove two world-constricting expressions. The first of these is the initial, widest scope, actual-world-constrictor of (CX*2). The second of these is the, inner, some-world restrictor ('there is a world w in which…') that required the subsequently introduced counterparts to be worldmates.[8]

In the Appendix we state and apply translation principles a la Lewis 1968 that we hypothesise to be adequate in order to solve advanced modalizing problems in general (which is to say, for advanced modalizing de dicto and de re).

5. Word-free analyses (WFA)

Finally, we deal with the apparent anticipation of, and objections to, analyses in such a 'world-free' spirit. This involves applying, swiftly, elements of the justification already given and which appear to be absent from Jago's appreciation of the advanced modalizing problematic.

Firstly, Jago (2016: 633-34) suggests that the following de dicto claim is a (prima facie) counterexample to the general adequacy of the world-free modal interpretations in general. He states that: 'by ordinary standards' a truth is expressed by (17):

(17) There could have been no penguins

But a world-free analysis treats (17) as having the false content:

(18) (Unrestrictedly:) there are no penguins.

So, '…this is bad news for the [WFA], for there is clearly some sense in which there might have been no penguins.' We respond as follows. It is indeed true that by ordinary standards (17) is true. It is indeed the case that a world-free interpretation (18) produces falsehood. But (18), qua world-free interpretation, is not the right (charitable) interpretation of (17), the modal modification of a restricted content if true. So what is required for a charitable interpretation of (17) is the application of the (1968) translation procedure to give (the formal analogue of):

(19) There is a world in which there are no penguins.

This is not an ad hoc solution. Rather, it is the principled response to discerning the 'ordinary' conception of unrestricted quantification that must be read into (17) in order that it should express the truth that we detect.

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pluriverse many such superlative descriptions will fail to denote: there is no tallest human in the pluriverse. Subsequently, a la Russell, sentences taking such descriptions as subjects will turn out to be false – sentences such as '*Possibly Anna is taller than Bill and taller than anyone else*'. But this is not obviously a problem. If there is an intuition of truth it is tied to the presumption that the domain of quantification is world-constricted and no longer holds sway when that constriction is removed. And such superlatives have no special role to play in the (notional) denotation of possibilia by description.

[8] In fact the removal of the second restrictor is not required to produce a Lewisian truth in this particular case. But, as Jago (2014: 113) shows, the full range of cases cannot be handled by such partial deconstriction.

Secondly, Jago (2016: 634, 636-37) suggests that the Lewisian cannot, as it were, have it both ways. She cannot maintain, in full generality the commitment that truth simpliciter (for a token sentence) is truth relative to the world in which it is uttered, and that some of the things that she wants to assert (qua genuine modal realist) are true simpliciter while not being true relative to any world or worlds. We respond as follows. It is indeed true that no-one is entitled to this conjunction of claims. But we are nonplussed by Jago's claim that the Lewisian is committed to the first claim. What may be true, of course, is that when certain fragments of the language are under study – in particular non-modal sub-languages – then there will be no effective difference between truth simpliciter and truth at the world of utterance. But that falls far short of (commitment to) a general equivalence which is – in any case, on the face of it – perverse. Why would one think that truth-simpliciter were inevitably coincident with truth relative to any kind of index? But perversity aside, and even if a Lewisian were incautious enough to make this commitment, an opportunity to abandon it and gain a generalized solution to advanced modalizing problems in the process should be welcome. So, let it go hang!

In conclusion, then, we offer a solution to the problems of advanced modalizing in the de re case. We hypothesize further that a general solution to these problems is codifiable in translation procedures that are just as general as those of Lewis (1968). We have also tried to show a solution in this word-free spirit is robust in the face of apparent objections.

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Appendix

i. Lewis (1968) World-Constricted Translations of QML Formulas into those of Counterpart Theory[9]

T1: The translation of φ is $\varphi^{@}$ (φ holds in the actual world); that is, in primitive notation, $\exists\beta(\forall\alpha(I\alpha\beta \equiv A\alpha)\ \&\ \varphi^{\beta})$. We then have the following recursive definition of φ^{β} (φ holds in world β)

T2a: φ^{β} is φ, if φ is atomic

T2b: $(\neg\varphi)^{\beta}$ is $\neg\varphi^{\beta}$

T2c: $(\varphi\ \&\ \psi)^{\beta}$ is $\varphi^{\beta}\&\ \psi^{\beta}$

T2d: $(\varphi\ \vee\ \psi)^{\beta}$ is $\varphi^{\beta}\ \vee\ \psi^{\beta}$

T2e: $(\varphi\ \supset\ \psi)^{\beta}$ is $\varphi^{\beta}\ \supset\ \psi^{\beta}$

T2f: $(\varphi\ \equiv\ \psi)^{\beta}$ is $\varphi^{\beta}\ \equiv\ \psi^{\beta}$

T2g: $(\forall a\varphi)^{\beta}$ is $\forall a(Ia\beta\ \supset\ \varphi^{\beta})$

T2h: $(\exists a\varphi)^{\beta}$ is $\exists a(Ia\beta\ \&\ \varphi^{\beta})$

T2i: $(\Box\varphi a_1 \ldots a_n)^{\beta}$ is
$\forall\beta_1\forall\gamma_1 \ldots \forall\gamma_n\big(W\beta_1\ \&I\gamma_1\beta_1\ \&C\gamma_1 a_1\ \&\ldots\&\ I\gamma_n\beta_1\ \&\ C\gamma_n a_n\ \supset\ \varphi^{\beta_1}\gamma_1 \ldots \gamma_n\big)$

T2j: $(\Diamond\ \varphi a_1 \ldots a_n)^{\beta}$ is
$\exists\beta_1\exists\gamma_1 \ldots \exists\gamma_n\big(W\beta_1\ \&I\gamma_1\beta_1\ \&\ C\gamma_1 a_1\ \&\ldots\ \&I\gamma_n\beta_1\ \&C\gamma_n a_n\ \&\ \varphi^{\beta_1}\gamma_1 \ldots \gamma_n\big)$

If we take the ordinary claim “There is an F” and its de dicto and de re modalizations, then we get the following translations from QML to the Lewis (1968) interpretation:

$$(\exists xFx)^{@}\ \leftrightarrow\ \exists x(Ix@\ \&\ F^{@}x)$$

$$(\exists x\ \Diamond\ Fx)^{@}\ \leftrightarrow\ \exists x(Ix@\ \&\ \exists\beta\exists y\big(W\beta\ \&Iy\beta\ \&\ Cyx\ \&\ F^{\beta}y\big))$$

$$(\Diamond\ \exists xFx)^{@}\ \leftrightarrow\ \exists\beta(W\beta\ \&\ \exists x\big(Ix\beta\ \&\ F^{\beta}x\big))$$

The de dicto modalization of $\exists xFx$ is entailed by T2j as a limit case where the modal operator has widest scope, meaning that counterparts are not invoked. In this case, the explicit rule for de dicto limit cases is:

T2j$_{\downarrow}$: $(\Diamond\ \varphi)^{@}$ is $\exists\beta(W\beta\ \&\ \varphi^{\beta})$

[9] Adapted from Lewis (1968: 118) with operator symbols modified for consistency with this paper.

The following is a full list of canonical translations of the relevant claims in this paper on the rules of Lewis (1968):

'There are many worlds'

$$(\exists x \exists y(Wx \& Wy \& \neg(x = y))^{@} \leftrightarrow \exists x \exists y(Ix@ \& Iy@ \& Wx \& Wy \& \neg(x = y))$$

'There could be many worlds'

$$(\Diamond \exists x \exists y(Wx \& Wy \& \neg(x = y))^{@} \leftrightarrow \exists \beta(W\beta \& \exists x \exists y\big(Ix\beta \& Iy\beta \& Wx \& Wy \& \neg(x = y)\big))$$

'Anna is taller than Bill'

$$(\exists x \exists y(A^{*}x \& B^{*}y \& \forall z\big((A^{*}z \supset (z = x)\big)\&\big(B^{*}z \supset (z = y)\big))\& Rxy)^{@} \leftrightarrow \exists x \exists y(Ix@ \& Iy@ \& A^{*}x \& B^{*}y \& \forall z\big(((A^{*}z \& Iz@) \supset (z = x)\big)\&\big((B^{*}z \& Iz@) \supset (z = y)\big))\& Rxy))$$

'Possibly, Bill is taller than Anna'

$$(\exists x \exists y(A^{*}x \& B^{*}y \& \forall z\big((A^{*}z \supset (z = x)\big)\&\big(B^{*}z \supset (z = y)\big))\& \Diamond Ryx)^{@} \leftrightarrow \exists x \exists y(Ix@ \& Iy@ \& A^{*}x \& B^{*}y \& \forall z\big(((A^{*}z \& Iz@) \supset (z = x)\big)\&\big((B^{*}z \& Iz@) \supset (z = y)\big))\& \exists \beta(W\beta \& \exists u \exists v(Iu\beta \& Iv\beta \& Cux \& Cvy \& Rvu))))$$

ii. World-Free Translations of QML Formulas into those of Counterpart Theory[10]

T1*: The translation of φ is φ (φ holds unrestrictedly)[11]

T2a*: φ is φ, if φ is atomic

T2b*: $(\neg\varphi)$ is $\neg\varphi$

T2c*: $(\varphi \ \& \ \psi)$ is $\varphi \ \& \ \psi$

T2d*: $(\varphi \lor \psi)$ is $\varphi \lor \psi$

T2e*: $(\varphi \supset \psi)$ is $\varphi \supset \psi$

T2f*: $(\varphi \equiv \psi)$ is $\varphi \equiv \psi$

T2g*: $(\forall\alpha\varphi)$ is $\forall\alpha\varphi$

T2h*: $(\exists\alpha\varphi)$ is $\exists\alpha\varphi$

T2i*: $(\Box\varphi a_1 \dots a_n)$ is $\forall\gamma_1 \dots \forall\gamma_n(C\gamma_1 a_1 \ \& \dots \& \ C\gamma_n a_n \supset \varphi\gamma_1 \dots \gamma_n)$

T2j*: $(\lozenge\, \varphi a_1 \dots a_n)$ is $\exists\gamma_1 \dots \exists\gamma_n(C\gamma_1 a_1 \ \& \dots \ \& \ C\gamma_n a_n \ \& \ \varphi\gamma_1 \dots \gamma_n)$

So, if we repeat the taking of the ordinary claim "There is an F" and its de dicto and de re modalizations, then we get the following translations:

$$(\exists xFx) \leftrightarrow \exists xFx$$

$$(\exists x \lozenge Fx) \leftrightarrow \exists x\exists y(Cyx \ \& \ Fy)$$

$$(\lozenge \exists xFx) \leftrightarrow \exists xFx$$

The de dicto modalization of $\exists xFx$ is entailed by T2j* as a limit case where the modal operator has widest scope, meaning that counterparts are not invoked. In this case, the explicit rule for de dicto limit cases is:

T2j*$_{\downarrow}$: $(\lozenge\, \varphi)$ is φ

These rules entail truth-yielding (by Lewisian lights) interpretations for the claims in Appendix (i) in the following ways:

[10] We note that a similar set of rules is presented by Marshall (2016) in the context of an anti-Lewisian argument that it is not our business to discuss here. But we note, further, that our rationale for implementing our rules does not leave us open to whatever charges follow from postulating 'ambiguity' in modal expressions.

[11] We could, instead, give these rules whilst preserving the exact form of the Lewis 1968, giving schematic translations whereby each φ is relativised to a certain index, e.g., φ^U. In this context, however, we contend that since the relativized index *U* is invariably the domain of all individuals, the suppression of this notation illustrates a more felicitous interpretation, whereby there is effectively no relativization taking place.

‘There are many worlds’

$$(\exists x \exists y(Wx \,\& Wy \,\& \neg(x = y)) \leftrightarrow \exists x \exists y(Wx \,\&\, Wy \,\& \neg(x = y))$$

‘There could be many worlds’

$$(\Diamond\, \exists x \exists y\big(Wx \,\& Wy \,\& \neg(x = y)\big) \leftrightarrow \exists x \exists y\big(Wx \,\& Wy \,\& \neg(x = y)\big)$$

‘Anna is taller than Bill’

$$(\exists x \exists y(A^{*}x \,\& B^{*}y \,\&\, \forall z\big((A^{*}z \supset (z = x)\big) \& \big(B^{*}z \supset (z = y)\big)) \& Rxy) \\ \leftrightarrow \exists x \exists y(A^{*}x \,\& B^{*}y \,\& \forall z\big((A^{*}z \supset (z = x)\big) \& \big(B^{*}z \supset (z = y)\big)) \& Rxy))$$

‘Possibly, Bill is taller than Anna’

$$(\exists x \exists y(A^{*}x \,\& B^{*}y \,\& \forall z\big((A^{*}z \supset (z = x)\big) \,\&\, \big(B^{*}z \supset (z = y)\big)) \&\, \Diamond\, Ryx) \leftrightarrow \\ \exists x \exists y\left(A^{*}x \,\&\, B^{*}y \,\& \forall z\big((A^{*}z \supset (z = x)\big) \,\&\, \big(B^{*}z \supset (z = y)\big)\right) \&\, \exists u \exists v(Cux \,\&\, Cvy \,\&\, Rvu))$$ [12]

[12] For results and discussion of theorems and implications for various standard modal principles see Parry, J. J. (2017).

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