Ontological Symmetry in Language: A Brief Manifesto*

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Abstract: In the tradition of quantified modal logic, it was assumed that significantly different linguistic systems underlie reference to individuals, to times and to 'possible worlds'. Various results from recent research in formal semantics suggest that this is not so, and that there is in fact a *pervasive symmetry* between the linguistic means with which we refer to these three domains. Reference to individuals, times and worlds is uniformly effected through generalized quantifiers, definite descriptions, and pronouns, and in each domain grammatical features situate the reference of terms as near, far or 'further' from the actual or from a reported speech act. We outline various directions in which a program of *ontological symmetry* could be developed, and we offer in the Appendix a symmetric fragment developed in a logic that can be seen as a compromise between an extensional and an intensional system.

In the influential tradition of quantified modal logic, it was assumed that significantly different linguistic systems underlie reference to individuals, to times and to possible situations or 'possible worlds'. We argue that a variety of results from recent semantic research suggest that this is not so, and that there is in fact a *pervasive symmetry* between the linguistic means with which we refer to all three domains. We sketch the main arguments in favor of a uniform analysis and we discuss some directions in which a program of 'ontological symmetry' could be developed, as well as some of its broader consequences for cognitive science. One possibility - though not the only one- is that a single abstract cognitive system underlies individual, temporal and modal talk in natural language[1].

1 Three Views

Following the pioneering work of N. Chomsky, *formal syntax* has provided systematic means to predict which sentences are judged by a speaker to be well-formed, and which are not. Following the work of D. Davidson and R. Montague, *formal semantics* has attempted to predict which well-formed sentences are judged by a speaker to be true, false or 'semantically deviant' in any real or imaginary situation. To give an example, syntax seeks to explain why *The King of Moldova is bald* is deemed well-formed, contrary to the sentence **King the of Moldova is bald* (the star indicates syntactic deviance). And semantics tries to explain why the well-formed sentence *The King of Moldova is bald* is typically judged true if Moldova has a King, and he is bald; as false if Moldova has a King, and he is not bald; and as semantically deviant if Moldova -as is in fact the case- has no King at all (the condition that must be satisfied for a well-formed sentence to be true or false but not semantically deviant is called its *presupposition;* thus the fact that Moldova has a King is a presupposition of the above sentence, in fact one that is triggered by the definite description *the King of Moldova*).

Theories that followed Montague's work posited three basic ontological domains: individuals (i.e. objects, broadly construed to include tables and atoms as well as people and dogs and water and gold), moments, and -more controversially- possible worlds (followers of Davidson do not make use of possible worlds, but posit a different kind of entity, events/states, a point to which we return below). Times may variously be analyzed as points or as intervals.

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[1] While I have attempted to cite researchers who have developed related ideas, I have concentrated on the traditions of philosophical logic and formal semantics. I did not attempt a comparison with theories developed in other frameworks (e.g. work by Talmy and Langacker in 'cognitive linguistics'). I leave such a comparison for future research.

Possible worlds are taken to be real or counterfactual situations that each determine the truth value of every conceivable sentence. Information about these three ontological domains is manipulated by different morphological and syntactic elements of language: determiners such as *some* or *all* and person marking provide information about individuals; time adverbials such as *sometimes* and *always* and tense marking provide information about moments; and modal adverbials such as *possibly* and *necessarily* as well as mood marking are taken to provide information about possible worlds[2]. To illustrate the last case, the sentence *Possibly, it will rain* is deemed true just in case in some world that stands in a given relation to the actual world, it rains (e.g. in some world *compatible with our state of knowledge,* it rains).

1.1 An Asymmetric View: The Modal Picture

Some logical similarities between the three domains were observed from the start. Thus the same systematic correspondence or 'duality' can be found between *some* and *all*, between *sometimes* and *always* and between *possibly* and *necessarily*, as illustrated by the following examples, where $\leftrightarrow$ symbolizes logical equivalence:

(1) a. Some man is wise $\leftrightarrow$ It is not the case that every man is not wise.
b. Sometimes it rains $\leftrightarrow$ It is not the case that it always does not rain.
c. Possibly it will rain $\leftrightarrow$ It is not the case that necessarily it will not rain.

These similarities were explained by postulating that the truth conditions of the left-hand sentences in (1)a, b and c are those of an existential statement over men, moments and possible worlds respectively; while those of the right-hand side involve a combination of negation and universal quantification (in the case of possible worlds, just as *Possibly, p* is true if and only if and only if p holds in *some* possible world that stands in relation R to the actual world, so similarly *Necessarily, p* is deemed true just in case p holds in *every* possible worlds that stands in relation R to the actual world). From this perspective, the equivalence between the left-hand side and the right-hand side follows from the logical equivalence between $\exists x_1\ P(x_1)$ and $\neg\ \forall x_1 \neg P(x_1)$.

Despite these limited similarities, it was traditionally thought in philosophical logic that the semantic resources with which we talk about times and possible worlds are syntactically different and semantically less expressive than those with which we talk about individuals. This view, embodied in a particularly elegant form in quantified modal logic, is motivated by the idea that *language can explicitly refer to individuals through pronouns*, which play the role of variables in logic, whereas *no similar device exists to refer explicitly to times and to possible worlds*. Thus we can say that *For every individual, there is some individual that dislikes <u>him</u>,* approximating the logical formula: $\forall x_1\ \exists x_2\ Dislike(x_1, x_2)$; but (so the argument goes) no similar sentence could be constructed to talk about times or possible worlds. To be more specific, the picture offered by quantified modal logic is one in which sentences are always evaluated with respect to one world parameter and one time parameter (called respectively *w* and *t* below), which both remain implicit because they cannot be named by any variables of the object language. By contrast, sentences are evaluated with respect to an arbitrarily long sequence of individuals (called *s* below), each of which is named by a variable of the object language[3]. Thus the variable x_1 evaluated under a sequence John^Mary^Peter^... names the first individual of the sequence, John; x_2 names the second individual, Mary; etc. Quantification over times and worlds is performed in terms of manipulation of the one and only time or world parameter,

[2] The word *mood* is used in a variety of ways. For present purposes we will take this term to refer to verbal affixes that introduce presuppositions on the value of certain world arguments.

[3] One sometimes uses the terminology of *assignment functions* rather than of *sequences*, but the two notions largely boil down to the same thing.

whereas quantification over individuals must specify *which position* of the sequence of evaluation gets manipulated, hence the fact that quantifiers must be indexed with variables. The main rules are given in (2), where the definition of truth is relative to a possible world w, a time t and a sequence of individuals s (the notation $s[x_i \rightarrow d]$ refers to a sequence which is identical to s, except that d is found in the i^{th} position. R is an accessibility relation between worlds, and *wRw'* should be read as *w' is accessible from w*. For simplicity we have also omitted any future operators):

(2) Quantified Modal Logic[4]

a. *Possibly* φ is true at w, t, s iff for some possible world w' satisfying wRw', φ is true at w', t, s

Necessarily φ is true at w, t, s iff for every possible world w' satisfying wRw', φ is true at w', t, s

b. *Some time in the past* φ is true at w, t, s iff for some moment t' satisfying t>t', φ is true at w, t', s

Always in the past φ is true at w, t, s iff for every moment t' satisfying t>t', φ is true at w, t', s

c. $\exists x_i \varphi$ is true at w, t, s iff for some individual d, φ is true at w, t, $s[x_i \rightarrow d]$

$\forall x_i\ \varphi$ is true at w, t, s iff for every individual d, φ is true at w, t, $s[x_i \rightarrow d]$

d. If *P* is a predicate taking n individual arguments (n≥0), $Px_{i_1} \ldots x_{i_n}$ is true at w, t, s iff $s(x_{i_1}), \ldots, s(x_{i_n})$ (in that order) satisfy the interpretation of *P* at w, t.

There is one respect in which this system is symmetric: it involves quantification over individuals, times and worlds. There are four respects in which it is asymmetric:

(i) Predicates can take any number n of arguments, for n≥0. By contrast, all predicates take exactly one time and exactly one world argument.

(ii) Reference to individuals is explicit, while reference to times and worlds is only implicit. Specifically, a predicate can be evaluated with respect to a time and world even though it has no syntactically represented time or world arguments. By contrast, a predicate can be evaluated with respect to certain individuals only if these are explicitly represented in the object language.

(iii) The implicit world or time argument of a predicate is determined by the 'nearest' modal or temporal operator, which fixes the value of the parameter with respect to which the predicate is evaluated. By contrast, the explicit individual argument of a predicate bears an index that determines indirectly which quantifier (if any) controls its value (in general, we distinguish between a *quantifier* (e.g. $\forall x_1$) which comes equipped with an index, from an *operator* (e.g. *always*) which doesn't). To give an example, the formula $\forall x_1\ \exists x_2\ P(x_1)$ ends up being true at w, t, s just in case *every* object d satisfies P at w, t. It is thus equivalent to $\forall x_1\ P(x_1)$: the value of the variable x_1 is entirely controlled by the quantifier $\forall x_1$ rather than by the 'closer' quantifier $\exists x_2$. By contrast, the formula *Necessarily Possibly p* is true at w, t, s just in case for every world w' accessible from w, there is some world w" accessible from w' which satisfies p at t. This is *not* equivalent to *Necessarily p* because the implicit world argument of *p* is controlled by the 'closer' operator *Possibly*.

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[4] For readability, we have replaced the usual operators of propositional modal logic with English words. In traditional presentations,

$\Diamond\varphi$ corresponds to *Possibly* φ

$\Box\varphi$ corresponds to *Necessarily* φ

$P\varphi$ corresponds to *Some time in the past* φ

$H\varphi$ corresponds to *Always in the past* φ.

(iv) Quantification over individuals is unrestricted, whereas quantification over times and possible worlds is implicitly restricted by the relations < and R respectively ('implicitly' because these relations are not represented in the object language).
Before we consider how each of these intuitions fares empirically, let us consider potential alternatives that treat individuals, times and worlds in a uniform fashion.

1.2 Symmetric Alternatives

Let us say that a system is *extensional* if all arguments are represented explicitly and are treated like the individual variables of (2); and let us say that it is *intensional* if all arguments are implicit and are treated like the time and world parameters of (2). There are two obvious ways in which one could seek to make our analysis uniform: by treating all objects intensionally, or by treating all objects extensionally.

1.2.1 *A symmetric intensional analysis*

The first alternative is not particularly promising from a linguistic standpoint, because it is uncontroversial that pronouns may, among others, play the role that variables fulfill in logic[5]. The philosopher A. Prior did suggest applying principles of tense logic to quantification over individuals, but he presented his attempt as an exercise in conceptual analysis rather than in natural language semantics (thus in Prior 1968, he replaced the relation 'is prior to', which is the accessibility relation of tense logic, with 'is inferior to' as applied to individuals, with no obvious linguistic applications[6]). However there is a much more obvious use for accessibility relations in natural language: quantification over individuals is almost always implicitly restricted to those individuals that are relevant in the situation at hand. *Everybody is fine* rarely means that everyone in the entire world is fine. This gives some initial motivation for the semantic rules given in (3), which treat individuals, times and possible worlds in the same way, with a single parameter of each sort and a single accessibility relation in each domain:

(3) a. *Possibly* φ is true at w, t, x iff for some word w' satisfying w R w', φ is true at w', t, x
b. *Some time in the past* φ is true at w, t, x iff for some moment t' satisfying t>t', φ is true at w, t',x
c. *Someone* φ is true at w, t, x iff for some individual x' satisfying x r x', φ is true at w, t, x'
d. If *P* is an atomic predicate, *P* is true at w, t, x iff x satisfies the interpretation of *P* at w, t.

(As before, R is the relation of accessibility between worlds, < is anteriority in the temporal domain, and r is a relation encoding 'relevance': x r x' is intended, rather vaguely, to mean that x' is relevant to x). The obvious difficulty with this simple system is that it gives every predicate a single individual argument (as specified by (3)d), allowing neither a treatment of *It is raining*, which takes no individual argument, nor of *Everyone likes someone*, which requires two.

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[5]This does not entail that pronouns should literally be analyzed as variables, but only that whatever mechanism is given to analyze their behavior must provide them with the semantic means to imitate the behavior of variables. See for instance Jacobson 1999 for a variable-free treatment of pronouns.

[6] In Prior's system, predicates are true *at* individuals in the same way that propositions are true at moments, and individual arguments are not represented in the object language. Thus *standing* uttered by a speaker S is true just in case S is standing - in the same way that *it is raining* uttered at time T is true just in case it is raining at T. In order to find a formal counterpart of the ordering of moments in time, Prior further assumes that individuals are 'arranged in a scale of comparative perfection'. By analogy with the operators of Tense Logic, Prior defines an existential operator *inferior-to*, with the following semantics: *inferior-to standing* is true at individual S just in case for some S' that S is inferior to, S' is standing. One would be hard pressed to find linguistic applications of this analysis.

1.2.2 A symmetric extensional analysis

Turning 180 degrees, we may achieve a symmetric approach by treating times and possible worlds in the way that we treated individuals in the quantified modal logic we started out with. We now assume that the definition of truth is relativized to three sequences s^w, s^t and s^x which contain an arbitrary number of worlds, times and individuals respectively. The crucial rules are now stated in (4):

(4) a. $\exists w_i \varphi$ is true at s^w, s^t, s^x iff for some possible world d, φ is true at $s^w[w_i \rightarrow d]$, s^t, s^x
b. $\exists t_i \varphi$ is true at s^w, s^t, s^x iff for some moment d, φ is true at s^w, $s^t[t_i \rightarrow d]$, s^x
c. $\exists x_i \varphi$ is true at s^w, s^t, s^x iff for some individual d, φ is true at s^w, s^t, $s^x[x_i \rightarrow d]$
d. If *P* is a predicate taking k world arguments, m time arguments and n individual arguments, (k, m, n≥0), $P\ w_{r_1} \ldots w_{r_k}\ t_{s_1} \ldots t_{s_m}\ x_{t_1} \ldots x_{t_n}$ is true at s^w, s^t, s^x iff $s^w(w_{i_1})$, ..., $s^w(w_{r_k})$, $s^t(t_{s_1})$, ..., $s^t(t_{s_m})$, $s^w(w_{t_1})$, ..., $s^w(w_{t_n})$ (in that order) satisfy the interpretation of *P*.

Of course the first three rules are so similar that we can state them all in one fell swoop. Call D^w, D^t and D^x the domains of possible worlds, moments and individuals respectively, and -to make things simpler - call s the function which for each integer i assigns to w_i, t_i and x_i what s^w, s^t and s^x assign to them respectively. We can then state the first three rules of (4) as in (5):

(5) For each $\xi \in \{x, t, w\}$, $\exists \xi_i \varphi$ is true at s iff for some d in D^ξ, φ is true at $s[\xi_i \rightarrow d]$

It is particularly obvious under this treatment that individuals, times and possible worlds are given exactly the same semantic treatment, since a single rule applies to them all. (This strategy has been systematically followed in the formal fragment offered in the Appendix, where both the syntax and the semantics are defined in this abstract, sortally neutral way.)

1.2.3 Other possibilities

We have just sketched two extreme symmetric accounts, one purely intensional, and the other purely extensional. But there are many ways in which one could combine ideas from extensional and from intensional logic. A symmetric account could still be achieved, provided that these ideas were applied consistently to individuals, to times and to possible worlds alike. In fact, considerable efforts have recently been devoted to the study of formal systems that are intermediate between intensional and extensional logics, as discussed for instance in Blackburn 1994, Blackburn et al. 2001, van Benthem 1996, and Marx 2001. In what follows, we shall (a) argue that a symmetric approach is empirically desirable in almost every respect, and we shall also (b) try to determine which aspects of each system are worth preserving. In particular, we will come to the following conclusions concerning the four 'asymmetric' features of quantified modal logic:
(i) It might be that there is an element of asymmetry between individuals on the one hand and times and worlds on the other in that atomic predicates may take several individual arguments but do not generally take several time or world arguments[7]. (In the Appendix we take the view that this asymmetry is real, though this is largely for reasons of technical convenience.)
(ii) Reference to individuals, times and possible worlds can always be explicit. It is an open question whether it can also be implicit. The fragment developed in the Appendix allows for

[7] Whether this conclusion is justified remains to be determined. One could for instance argue that *after* is a binary predicate of moments.

both options: a predicate can be evaluated as true or false even in the absence of any syntactically represented arguments, but it may also take explicit arguments.
(iii) In many cases the value of the time, world or individual arguments of a predicate need not be determined by the 'closest' operator of the relevant type.
(iv) Quantification over individuals, times and worlds can always be restricted *explicitly*. It is also typically restricted *implicitly*. In the system introduced in the Appendix implicit restrictions on quantifier domains are achieved through an accessibility relation between sequences of evaluation.

In each case except possibly the first one, the overwhelming evidence is that *the semantic differences that were traditionally posited between the three ontological domains are largely imaginary*. We shall consider in turn the main components of natural language semantics, starting with quantifiers, pronouns and implicit restrictions, and continuing with definite descriptions and the systems of coordinates by which the reference of various expressions is classified as near, far or 'further' from the point at which the speech act takes place. In each case we will see that there exists a systematic correspondence between the three ontological domains. The presentation aims to be mostly non-technical, but the Appendix gives an explicit implementation of a part of the analysis, stated within a symmetric syntax and semantics.

2 Quantifiers, Pronouns and Accessibility Relations Across Ontological Domains

2.1 Quantifiers

First, let us consider quantifiers. Classically, there are two respects in which natural language offers a more powerful system of individual quantification than (first-order) mathematical logic: a) some quantifiers that exist in natural language, such as *most things*, have no equivalent in first-order logic, and cannot even be defined within it. In addition, b) natural language quantifiers are explicitly restricted, i.e. we can say that *Most <u>men</u> are wise*, where quantification is restricted to men (here too the truth conditions of *Most men are wise* cannot be defined in terms of a first-order logic to which the quantifier *most things* had been added (Barwise & Cooper 1981)). The analysis of mass quantification is somewhat more complicated. One can take a mass term such as *water* to hold true of all portions of water at a given time and world (Montague 1973). But when one says that *Most of the water in the room is poisoned,* one must still specify according to which *measure* this is the case (is it *most of the water* according to a measure of volume? of weight? etc.) Still, the underlying mechanism is essentially the same, though it must be upgraded to make reference to a notion of measure. A similar system is also available to talk about moments and possible worlds (Lewis 1975): *Most of the time, when John comes, Mary is happy* and *Probably, if John comes, Mary will be happy* can be seen as structures which, like *Most men are wise* or *Most of the water is poisoned,* have three parts: a restricted quantifier akin to *most,* a restrictor that indicates what is the set of objects whose greatest part is supposed to satisfy the relevant condition, and the condition itself (also called the 'nuclear scope'). In the case of probability talk it is particularly obvious that a notion of measure is needed, since there are certainly infinitely many different conceivable worlds in which John comes and in which Mary is happy, and infinitely many different possible worlds in which he comes and she isn't happy. Analyzing *Probably, if John comes, Mary will be happy* as a claim that the first set has a greater cardinality than the second wouldn't give the desired result. Rather, what one intends is that the probability measure of the first set is greater than the probability measure of the second[8]. Accordingly, in the Appendix we have given the same abstract analysis to *Most of the water is poisoned* and *Probably, if it rains, it will pour:* both involve a comparison between the measures of certain sets determined by the restrictor and the nuclear scope.

2.2 Pronouns

Let us now consider pronouns. Individual-denoting pronouns come in two varieties: weak pronouns, which are unstressed and may appear in the pre-verbal ('clitic') position in languages such as French or Spanish (e.g. *Je le regarde,* in French, literally *I him watch*) and may sometimes (and quite productively in Spanish) double a full noun phrase; and strong pronouns, which appear in the position of full noun phrases, and may sometimes co-occur with a weak pronoun (e.g. *Je (le) regarde LUI* [=*I (him-weak) watch HIM-strong*]). Analyses from modal logic posited that there simply are no time- or world-denoting pronouns, but this assumption was shown to be radically incorrect by Partee (1973, 1984), Enç (1987) and Stone (1997), who demonstrated that tense and mood must often be analyzed as time- and world-denoting pronouns. According to them, tense and mood appear to have *each of the uses that pronouns have*.

To take an example, consider the ability of pronouns to refer to entities that have not been mentioned in the preceding discourse but are salient in the extra-linguistic context, as in *He hit me,* uttered by a schoolboy pointing at one of his classmates. Uttering *I was young* when watching an old photograph is naturally interpreted as meaning that I was young at *the time at which the photograph was taken*, a period which is made salient by the extra-linguistic context[9]. Similarly, Stone suggests that if I utter *My neighbors would kill me* when you start raising the volume of my stereo, I am naturally understood to mean that my neighbors will kill me in *the (closest) world(s) in which your action is completed* - a referent which is again provided by the extra-linguistic situation (specifically: by your action).

Tense and mood are always unstressed and are thus naturally analyzed as weak pronouns. Are there also strong world- and time-denoting pronouns? Following insights due to S. Iatridou, we may suggest that a good candidate is the word *then*, not just because it can be stressed, but also because it yields semantic effects that are analogous to those produced by strong individual-denoting pronouns (Iatridou 1994, Izvorski 1996, Bhatt & Pancheva 2001, Schlenker 2004a). To see this, let us observe that although *If p, q* vs. *If p, then q* or *When p, q* vs. *When p, then q* are generally synonymous, this is not unfailingly the case, as shown by the facts in (6)a-b, where the word that follows # triggers a semantic deviance it if is present. The interesting observation is that a similar effect is found when a strong pronoun is placed in French in an analogous position, as in (6)c:

(6) a. If John is alive, we will find him. And if he is dead, (#then) we will find him too.
b. When John comes, Mary is happy. And when he doesn't come, (#then) she is happy too.
c. Les étudiants ont aimé le concert. Et les professeurs, ils /#eux ont aussi aimé le concert
The students liked the concert. And the professors, they-weak /#they-strong liked the concert too.[10]

[8] The analogy between probability measures and measures for mass terms should not come as a complete surprise. The mathematical theory of probability is explicitly founded on a theory of measure, which in turn is a much more sophisticated version of the basic notions we need to measure water and oil.

[9] The argument is stronger in French, where the imperfect, unlike the English simple past, can *never* be given an existential interpretation.

[10] The data display an additional twist: both *then* and *eux* become acceptable if they are immediately followed by *too* or *aussi* (... then too we will find him / ... eux aussi ont aimé le concert). See Izvorski 1996 and Schlenker 2004a for discussion.

In (6)c, a weak pronoun is acceptable but a strong one is not, unless people were mentioned in the preceding discourse who did not like the concert. The natural explanation is that the strong pronoun requires an element that it can contrast with (i.e. an element that the predicate *liked the concert* fails to hold of), a condition which is not satisfied in c. because all the people mentioned liked the concert. If (as is motivated below) we analyze *if-* and *when*-clauses as definite descriptions, the sentences in (6)a and (6)b can be given the same semantic analysis, with the same result when no contrasting element is provided: in (6)a *then* is a world-denoting pronoun which needs an element it can contrast with, and fails to find it because all the worlds mentioned in the discourse are worlds in which we find John. Similarly in (6)b *then* is a time-denoting pronoun that wants to contrast with some other time-denoting expression, and fails to do so because all the moments referred to are ones at which Mary is happy.

The fact that language has time- and world-denoting pronouns has important consequences. Like a variable, a pronoun may *but need not* be bound by the 'closest' quantifier that it is in the scope of. But as we noted earlier, in the analysis offered by quantified modal logic, the time and world arguments of a predicate are always controlled by the closest time or world operator. Importantly, this is not always the case in natural language, as illustrated in (7), which is a variation on examples discussed in Cresswell 1990:

(7) a. Some day, each of my students will be on the Editorial Board of *Linguistic Inquiry* (and I'll finally rule Generative Syntax).
b. Some time in the future $\forall x_1$ (student(x_1) $\Rightarrow$ be-on-the-Editorial-Board(x_1))
c. $\forall x_1$ (student(x_1) $\Rightarrow$ Some time in the future be-on-the-Editorial-Board(x_1))

(7)a is naturally interpreted to mean that at some future point t, every individual who is a student of the speaker *right now* will be on the Editorial Board *at t*. But none of the representations offered by classical quantified modal logic can capture this reading: (7)b entails that every person who is the speaker's student at t is also on the Editorial Board at t, which is not what is intended; and (7)c only entails that all the speaker's students will be on the Editorial Board, but *possibly at different times*, which is too weak to license the speaker's optimistic conclusion that he will finally rule the field. By contrast, the reading which is in fact obtained is straightforwardly captured if one countenances time-denoting pronouns[11] (similar facts hold with respect to possible worlds, as discussed in Cresswell 1990).

2.3 *Accessibility Relations and Defaults*

At this point our discussion might suggest that we should adopt the 'symmetric extensional analysis' sketched above. But this conclusion is premature. First, if one is willing to introduce enough new operators, one can imitate perfectly within an operator-based approach (=one that has no variables) the semantic behavior of this extensional system (Quine 1960, Cresswell 1990). What *is* preserved of the extensional approach under this reinterpretation is the fact that the definition of truth is relativized to a *sequence* that contains an arbitrary number of times and worlds, rather than to just one time and one world parameter; but the syntax still looks like that of a modal logic (*modulo* the fact that it contains a greater number of operators).

Second, and more importantly, certain properties of the modal analysis might be worth preserving on empirical grounds. Let us first consider the implicit restrictions on quantifier

[11] Here is an extensional representation that derives the desired truth conditions if t_0 denotes the time of utterance:
(i) $\exists t_1$ ($t_1 > t_0 \wedge \forall x_1$ (student(x_1, t_0) $\Rightarrow$ be-on-the-Editorial-Board(x_1, t_1))).
As discussed extensively in Cresswell 1990, it is possible to enrich quantified modal logic with new operators that make it possible to capture the desired reading, as is done in Kamp 1971. But when all the relevant examples are considered, modal logic must be enriched to the point where it is as expressive as an extensional system, as anticipated in van Benthem 1978.

domains. As was pointed out earlier, natural language quantifiers, which generally contain an explicit restrictor, are also *implicitly* restricted - so that an utterance of *Everybody is fine* does not commit the speaker to a claim of universal well-being. This property was analyzed in terms of accessibility relations in the symmetric intensional system we discussed above. The solution was elegant in that it did not require a complex syntax (since domain restrictions were entirely treated in the meta-language). By contrast, in a symmetric extensional alternative, the implicit restrictions must be made explicit, yielding representations such as $[\forall x_1: person(x_1)\ \&\ D(x_1)]\ fine(x_1)$, where D is the restriction on the domain of quantification (for simplicity I have omitted time and world variables). It could certainly be argued that $D(x_1)$ is syntactically real - after all, contemporary syntax is rife with elements that are unpronounced but are nonetheless believed to have syntactic existence (see Stanley & Szabo 2000 for this view of domain restrictions). But it would be nice to have at one's disposal an alternative in which the elegant syntactic properties of the symmetric intensional analysis are combined with the expressive power of the extensional analysis.

Before we try to achieve such a result, let us see how much is in fact needed to handle implicit restrictions on quantifier domains. As was observed by various researchers, the implicit restrictions are in some cases a function of some variables which may be bound by quantifiers. For instance, if I say that *Every professor flunked every student,* I typically mean that every professor flunked every student *relevant to him*, e.g. every student *of his*. Using the extensional analysis sketched above, we would have to render the sentence as $[\forall x_1: professor(x_1)\ \&\ D(x_1)][\forall x_2: student(x_2)\ \&\ D'(x_1, x_2)]\ x_1\ flunked\ x_2$. But this is not the end of the story. In more complex cases additional variables are needed as well. Suppose that in Los Angeles, which is a large city with many colleges and many part-time instructors, I utter the following sentence (see Breheny 2003a, b for similar examples):

(8) Each Dean forced each part-time instructor to give an A to most students

Clearly, the domain restriction of *part-time instructor* is something like *relevant to x*, where *x* is a variable bound by *each Dean*. But what is the domain restriction of *most students*? Certainly not the students *in Los Angeles* (no instructor could give an A to most of them - there are way too many); nor could any Dean force a part-time instructor to give an A to most students *relevant to the Dean* (there are too many of those too- any part-time instructor teaches only a subset of them). But it also won't do to analyze the sentence as meaning that each Dean forced each part-time instructor to give an A to most students *relevant to the instructor* - because part-time instructors typically work at several institutions, and no Dean has the power to influence what an instructor does to students he instructs at other colleges. The inescapable conclusion is that the domain restriction of *most students* is something like *relevant to* x_1 *and* x_2, where x_1 is bound by *each Dean* and x_2 is bound by *each part-time instructor*. The argument could be extended to show that in sufficiently complex examples an arbitrary number of variables are needed to handle restrictions on quantifier domains.

So if domain restrictions are treated explicitly, variables are bound to proliferate. In the general case any number of variables may be necessary to determine the value of a particular domain restriction. But if so we might as well generalize to the worst case, and assume that in all circumstances *most students* quantifies over those individuals that are relevant *given the sequence of evaluation* (this conclusion is anticipated in Heim 1991), leaving it to an accessibility relation to determine which elements of the sequence are relevant, and how. When we follow this route, we can give all quantifiers a uniform treatment, and thus we have no reason to encode in the object language what the domain restriction of each quantifier is. We may state the restrictions implicitly (i.e. in the meta-language only), as was done in modal logic. The difference is that in this new system the accessibility relation holds between sequences of objects (=assignment functions) rather than simply between objects, as was the case before. This yields a minor revision (printed in bold) to the semantic rule for quantifiers which was given above:

(9) For each $\xi \in \{x, t, w\}$, $\exists \xi_i \varphi$ is true at s iff for some d in D^ξ **satisfying s R s[ξ_i→d]**, φ is true at s[ξ_i→d]

Depending on the constraints that one assumes on the relation R, one may obtain logics that have significantly different mathematical properties from the standard ones. Some of these have been studied from a modal perspective in recent logical investigations (e.g. van Benthem 1996, Blackburn et al. 2001, Marx 2001), but we leave for future research a study of the precise connection between these results and the analysis of domain restriction.

Another property of modal logic may be worth preserving. A bare verb such as *rain* can be evaluated in a modal logic even though it has no syntactically represented time and world arguments. In an extensional system this is impossible, as the representation must be of the form *rain(w, t)*. Now some have thought it desirable to allow predicates to be evaluated semantically even though some of their semantic arguments are not syntactically represented (see Recanati 2002 for this view, and Stanley 2000 for a dissenting opinion); there might even be morphological evidence for such an analysis, as the present and the indicative are sometimes thought to indicate the absence of a particular tense and mood rather than a positive morphological specification. Be that as it may, it is not entirely trivial to reconcile this *desideratum* (if it is indeed one) with the observation that predicates may also take as arguments the equivalent of time- and world-denoting pronouns. A compromise can be found, however. The details are laid out in the Appendix, but the idea is quite simple. By building sequences of evaluation in a rigid fashion, and by always starting from a 'small' sequence that only represents the context of speech (i.e. its speaker, time and world of utterance), we can stipulate that a predicate that takes 1 world argument, 1 time argument and n individual arguments is evaluated as true under a sequence s just in case the last world coordinate of s, the last time coordinate of s and the last n individual coordinates of n satisfy the predicate. In particular, when no time- or world-operators appear in the object language, the time and world of utterance will provide the arguments of the predicate. This yields a highly flexible system in which, in the end, a predicate may but need not have explicitly represented arguments to be evaluated as true or as false.

3 Definite Descriptions and 'Condition C' Effects Across Ontological Domains

3.1 Definite Descriptions

Let us now consider definite descriptions, which provide a common means of reference to individuals. The standard view (due in different forms to Frege and Strawson) is that the singular description *the girl* triggers a presupposition that there exists exactly one girl in the domain of discourse; in case the presupposition is satisfied, *the girl* simply refers to that girl. Similarly, the plural description *the girls* presupposes that there are at least two girls in the domain of discourse, and in case this is indeed the case, the description refers to all the girls in that domain. However this analysis is dubious for the sentence *The dog is barking, but fortunately the neighbor's dog isn't,* which is predicted to be incoherent because it requires that the domain of discourse contain a single dog with contradictory properties - an unfortunate result, since the sentence can certainly be uttered felicitously provided the first dog is sufficiently salient (Lewis 1973, 1979 von Heusinger 1997, Schlenker 2004a).

The problem points to an essential difference between definite descriptions and quantifiers. In a class that includes ten girls, three of whom have raised their hands, and ten boys, none of whom has, I may felicitously tell the speaker: *Wait, the girls need to go to the* *bathroom,* meaning that the three girls with their hands raised need to go to the bathroom. By contrast, if I say: *Wait, every girl needs to go to the bathroom,* I am of necessity speaking about all ten girls[12]. Simplifying somewhat, D. Lewis (1973) suggested that the correct analysis is that *the girls* refers to the *most salient girls* in the domain of discourse, whereas quantifiers such as *every* do not make reference to any notion of salience (to fully explain our example we need the additional assumption, which is rather uncontroversial, that the girls who have raised their hands have thereby increased their level of salience).

Lewis further suggested that this analysis was structurally analogous to the theory given by earlier researchers for an apparently different problem, that of natural language conditionals. The original problem was that *If p, q* does not obey the most basic ('monotonic') properties of the material or strict implications in logic. For instance, if a material implication $p \Rightarrow q$ is true, so is $(p \,\&\, p') \Rightarrow q$, where the antecedent *p* was strengthened to $(p \,\&\, p')$. But the natural language expression *If p, q* does not behave in this way: from *If John comes tomorrow, Mary will be happy,* one cannot normally infer that *If John comes tomorrow and he is drunk, Mary will be happy*. The solution, due to R. Stalnaker (1968), was to posit that *if p* in effect refers to the p-world highest on a scale of similarity to the actual world. According to this analysis, then, *If p, q* is true just in case the p-world most similar to the actual world is a q-world. Thus *If John comes tomorrow, Mary will be happy* only makes a claim about the *closest* world in which John comes tomorrow, namely that it is a world in which Mary is happy. From this it does not follow that the more far-fetched (and remote) worlds in which John comes *and is drunk* are worlds in which Mary is happy, and the undesirable inference is indeed blocked[13].

Strikingly, in this analysis the *if*-clause is treated quite literally as a definite description, with a hierarchy of similarity replacing the hierarchy of salience (Bittner 2001, Schlenker 2004a): just as *the P* refers to the P-individual that is highest on a scale of salience, so *if p* refers to the p-world that is highest on a scale of similarity to the actual world (note that the analogy is purely structural; we do not claim that there is something intrinsic that salience and similarity have in common, only that they both involve orderings that determine essentially the same logic). A semantic deviance is further obtained if no world satisfies the conditional clause, as in *If John is and isn't sick tomorrow, Mary will be happy,* which is neither true nor false but just weird - in the same way that a semantic deviance is obtained with the expression *the King of Moldova is bald* when it is assumed that there is simply no King in Moldova. Lewis further suggested (cautiously) that the same analysis can to some extent be applied to *when*-clauses as well. *When there is an election, I'll vote for Kerry* doesn't commit me to voting for Kerry in *all* the coming elections, but only in the *next* one. Temporal proximity plays in this case the same structural role as salience in the individual domain and as similarity in the modal one (it should be pointed out for accuracy that the facts are less clear when the *when*-clause is in the past tense, for reasons that I do not understand). The upshot of this discussion is that *the p, if p,* and *when p* can to a large extent be given a unified analysis: they all refer to the highest p-element on a scale of salience/similarity/temporal proximity, if there is such an element; and they yield a presupposition failure otherwise.

This analysis has received suggestive (though preliminary) confirmation from cross-linguistic research. First, in Marathi, an Indo-Aryan language, *if*- and *when*-clauses are morphologically a kind of definite description called 'free relatives' (see Fintel 1994, Lycan

[12] Example due to P. Svenonius, with a modification suggested by D. Büring.
[13] As pointed out by a referee, if it is assumed that John is habitually drunk, it is plausible that the closest world in which John comes is also one in which he is drunk, and we predict that the entailment should in fact go through in this rather special case.

2001, Bhatt & Pancheva 2001[14]). As a result, the sentences *If John comes, then Mary is happy, When John comes, then Mary is happy,* and *The man that comes, he is happy* all involve the same syntactic structure and morphological elements, an unsurprising fact given the present theory. Second, Schuh 2005 observes that several languages of Nigeria allow *if*- and *when*-clauses to take a special marker which turns out to be morphologically related to the definite determiner - a discovery that would appear to support the present approach.

3.2 'Condition C' effects

Taken together, the analyses of *if*- and *when*-clauses as definite descriptions and of *then* as a pronoun lead us to ask whether the relation between the pronoun and its antecedent is formally constrained. Chomsky famously displayed strict syntactic conditions on the interpretation of individual-denoting expressions, summarized in his 'Binding Theory' (e.g. Chomsky 1981). Descriptively, Chomsky's 'Condition C' specifies that a definite description or a proper name should *not* be in the scope of an expression that refers to the same thing, and the effect is known to be strongest when a proper name or definite description is in the scope of a coreferring pronoun. (By definition, an element e_2 is in the scope of [or 'c-commanded by'] an element e_1 if it is contained within the sister of e_1. This notion of scope is a generalization of the one used in logic). In *Because I have heard him on TV, I despise the President,* the pronoun *him* is embedded within the pre-posed clause, and thus *the President* is not in its scope, which makes it possible for the two expressions to refer to the same individual. By contrast, in *He despises people who know the President, the President* is in the scope of *he* and as a result cannot refer to the same individual. Consider now the sentence *Because he would then be fighting in Damas, John wouldn't be happy if there were a war with Syria right now*. The word *then* is included in the pre-posed clause, and can without too much difficulty corefer with the *if*-clause. But things are different if the *if*-clause is in the scope of *then*: *John would then despise people who would be leading the army if there were a war with Syria* - unless some other referent is provided for *then*, the sentence is somewhat deviant, as is expected if Chomsky's condition C applies to *if*-clauses (being a definite description, the *if*-clause cannot be in the scope of the coreferring world-pronoun *then*). The same contrasts would seem to apply to *when*-clauses: *Because he will then be fighting in Damas, John won't be happy when there is a war with Syria* allows coreference between *then* and the *when*-clause, thought the following sentence does not: *John will then despise people who will be leading the army when there is a war with Syria*. The reasoning is the same as with *if*-clauses, and the key is once again Chomsky's Condition C, which is seen to apply to *when*-clauses as well as to *if*-clauses[15]. Although the *explanation* of Condition C is immaterial to our purposes, the fact that it applies uniformly to individual-, time- and world-denoting expressions is consistent with the view that the underlying linguistic system is symmetric between these three domains.

4 Systems of Referential Classification Across Ontological Domains

When we refer to individuals using pronouns, we have to situate them as participants to the speech event (first person for the speaker, second person for the addressee) or as non-

[14] Thanks to R. Bhatt for information about *when*-clauses, which are not discussed in Bhatt & Pancheva 2001. As pointed out by a referee, further tests would be needed to establish that Marathi free relatives display the same properties of non-monotonicity as definite descriptions and conditionals.

[15] It is worth asking whether Conditions A and B of Chomsky's Binding Theory can be shown to apply to time and world variables. The question is currently open, but see Percus 2000 for some locality constraints on world variables. It should also be pointed out in this context that Binding Theory has long been known to apply to expressions of various logical types (e.g. properties and propositions), as was noted in Wasow 1972.

participants (third person). In some languages, for instance Bulgarian, the same system applies to definite descriptions, so that the description *the tall women* may trigger first person plural agreement on the verb if the speaker is herself a tall woman. Interestingly, the system is asymmetric, in the sense that a first or second person pronoun can only be used if it is presupposed that the person referred to is indeed the speaker or addressee; whereas a third person pronoun may in fact turn out to refer to the speaker, though it should not be *presupposed* that the person referred to is a non-speaker. Of course if it is presupposed that the person in question is a non-speaker, then the condition is certainly met; but the condition may also be met because the speaker is simply agnostic as to whether the person referred to is or is not the speaker, as in the situation where, watching a picture of a little boy, I say: *He looks like me when I was a kid... in fact, he is me!* (before coming to the realization that the kid is me, I present myself as agnostic about the kid's identity). This asymmetry also applies to definite descriptions in Bulgarian: watching an old photograph, a woman might say that *The tall women have-3rd nice clothes* even if she herself is one of the women in question; but this is felicitous only if the speaker does not presuppose this fact, and is agnostic as to whether the denotation of *the tall women* includes the speaker[16].

When one goes beyond English and Bulgarian, considerably richer systems of referential classification are displayed in language. *Two dimensions* are particularly important: (i) whether an entity is **near** (e.g. is a participant to) the speech event, **far**, or **further away**, and (ii) whether the point of reference is the **actual speech act** or a **reported speech or thought act**. Concerning the first dimension, English only displays the first two levels of classification, but Algonquian also displays a version of the third, which establishes within third person elements a distinction between a kind of third person 'of reference', marked as 'proximate', which corresponds to the topic of the discourse (Hockett 1966); and other third persons, marked as 'obviative', which are thus presented as less salient than the proximate element. Concerning the second dimension, some languages such as Amharic allow first or second person pronouns to be evaluated with respect to the context of a reported speech act, so that what is literally *John says that I am a hero* can be understood to mean that John says that he, John, is a hero[17]; and some languages, for instance Ewe and Gokana, have specialized ('logophoric') morphemes to indicate that the speaker (or hearer) of a reported speech act is being referred to (Clements 1975, Hyman & Comrie 1981, Roncador 1988). In these languages, *John says that he, John, is a hero* would in essence come out as *John says that he* is a hero*, where *he** is a pronoun specialized for indirect discourse (rather closely related to H.-N. Castañeda's homographous pronoun, invented for philosophical rather than descriptive purposes in Castañeda 1966).

The same two dimensions of referential classification are also at work with respect to tense and mood. Starting with **tense**, the distinction between present, past and pluperfect exemplifies the *first dimension of referential classification* (close - far - further), which is thus formally analogous to that between first/second, third proximate and third obviative in

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[16] Thanks to R. Pancheva for discussion of these data. A referee asks whether the Bulgarian examples do not simply involve a dislocated description and a null first person plural pronoun (e.g. *The tall women, <we> are tall*). However R. Pancheva informs me that this is unlikely to be the right analysis. First, with an *overt* pronoun the construction with a dislocated definite DP is dispreferred, and one would expect that the same should hold with an empty pronoun *[??Visokite zheni, nie imame hubavi drehi*, lit. *the-tall women, we have-1pl nice clothes]*. Second, first person plural agreement can be triggered by a quantified description, but quantifiers cannot normally be left dislocated [e.g. *Povecheto visoki zheni imame hubavi drehi,* lit. *most tall women have-1pl nice clothes*; or *nikoi visoki zheni njamame hubavi drehi,* lit. *no tall women not-have-1pl nice clothes*]. All this suggests that Bulgarian definite descriptions can trigger first person plural agreement *without* the intermediary of a first person plural pronoun, as is claimed in the text.

[17] It can be ascertained that the embedded clause is not quoted (Leslau 1995, Schlenker 2003). See also Anand & Nevins 2004 for a detailed investigation of attitude reports in Zazaki, an Indo-Aryan language that displays related phenomena (note, however, that Anand & Nevins's conclusions agree only in part with those of Schlenker 2003).

Algonquian (the relevant scale is one of closeness to the time of utterance in the case of tense, and of salience in the case of person)[18]. Concerning the *second dimension of referential classification*, the present tense of English can only be evaluated with respect to the time of the actual speech act[19]; the Russian present tense, by contrast, may either be evaluated with respect to the context of the actual speech act or with respect to that of a reported speech or thought act. If Peter said a week ago: *I am crying,* it is possible in Russian but not in English to report this as *Peter said a week ago that he is crying* (Barentsen 1996). It is also noteworthy that to the extent that analogous sentences are acceptable in English, they require a highly special interpretation, called 'Double Access Reading', in which the embedded clause refers to an interval that includes both the time of the speaker's utterance and the time of the agent's thought, as in: *John knew two months ago that Mary is pregnant* (the time of the pregnancy must span the time of utterance and the time of John's thought, as discussed in particular in Abusch 1997).

Turning to **mood** (which in English largely shares the morphology of the past tense), the same dimensions of classification can be seen to be at work as well. Starting with *the first dimension*, studied from this perspective by Iatridou 2000, we may observe a three-way contrast between the following sentences (uttered to a tennis player right one day before competition):

(10) a. If you play tomorrow, you will win.
b. If you played tomorrow, you would win.
c. If you had played tomorrow, you would have won. (cf. also Dahl 1997)

Because the time of the event is tomorrow, it is plausible that the past tense morphology in (10)b and (10)c is interpreted with a modal meaning, to situate with respect to the world of utterance the world(s) picked out by the *if*-clause. Stalnaker 1975 suggested that a world counts as 'close' if it is compatible with what the speaker presupposes. Analyzing the indicative mood of (10)a as triggering a presupposition that the world picked out by the *if*-clause is 'close' to the world of utterance, we obtain the result that this world should be compatible with what the speaker presupposes. This entails that some world compatible with what the speaker takes for granted is one in which the addressee plays tomorrow; this is intuitively the correct result, as (10)a certainly implies that the speakers considers it to be possible that the addressee will play tomorrow. If this condition fails to be satisfied, (10)b or (10)c must be used. In addition, (10)b can be used in a situation in which the speaker presents himself as agnostic as to whether the world picked out by the *if*-clause counts as close or not. This case may for instance arise if one wishes to argue that a person suffers from SARS, and says: *If Smith had SARS at this very moment, he would display exactly the symptoms that he in fact does. Therefore he certainly does have SARS* (modified from Anderson 1951 and Stalnaker 1975). Even though the closest world in which Smith has SARS is the actual world itself, this fact is not presupposed, and thus it is licit to mark the verb with a modally interpreted past tense (as we saw earlier, a similar condition holds in the semantics of individual-denoting expressions: a third person pronoun or definite description [in Bulgarian] is regularly used when the speaker is simply *agnostic* as to whether it does or does not refer to the speaker himself; in this respect the semantics of subjunctive mood parallels that of third person features). Turning to the difference between (10)b and (10)c, we observe that only (10)c can be used felicitously if I am speaking to a tennis player who has a broken arm and thus can definitely *not* play tomorrow. It appears that the world picked out by the *if*-clause is presented as *very* remote, and in particular as more remote

[18] Future tense marking behaves in many respects autonomously, according to rules that are not particularly well understood, and which do not follow from the present remarks

[19] This generalization holds only if some cases involving a present embedded under a future operator are analyzed in terms of morphological agreement, as in *In twenty years, little Johnny (now 2 years of age) will probably marry a woman who loves him dearly.* See for instance Ogihara 1996, Abusch 1997 and Schlenker 1999 for discussion. In any event, the contrast between English and Russian with respect to the past tense is unaffected by this point.

than some salient world (or worlds) that already counts as 'far' (i.e. as incompatible with what the speaker presupposes), namely one in which the player had not been injured. An analogous effect is obtained with pluperfects that are interpreted temporally: the sentence *When Smith had left, Mary had been greatly relieved* is felicitous only if it is presupposed that the time denoted by the *when*-clause is more remote than (=anterior to) another salient past moment made available by the discourse or the extra-linguistic situation. In other words, the modally interpreted pluperfect in (10)c appears to do with modal distance what a temporally interpreted pluperfect does with temporal distance: it situates the element denoted by the definite description (the *if*- or *when*-clause) as more remote than some other entity of the same type which itself counts as remote (however see Ippolito 2003 for a different analysis).

Turning now to the *second dimension of referential classification*, it would appear that the context that serves as a point of reference in English is only the context of the actual utterance. In fact, the peculiar effect we observed earlier when a present tense is embedded under a past tense attitude verb can be replicated in purely modal examples. *If John learned that Mary were pregnant, he would be devastated* does not imply that Mary is in fact pregnant; but in the sentence *If John learned that Mary is pregnant, he would be devastated,* we obtain a peculiar ('Double Access') reading in which the worlds referred to in the embedded clause must include both the counterfactual world(s) picked out by the *if*-clause and the world of utterance (this was the effect we saw in the temporal domain in: *John knew two months ago that Mary is pregnant;* see Schlenker 2004b for a comparison between temporal and modal 'Double Access' readings*)*. In addition, there are moods (the 'Konjunktiv I' in German) which can exclusively be evaluated with respect to the context of a reported speech act - they are the direct counterpart of the 'logophoric' pronominal elements of Ewe and Gokana that were discussed earlier (Roncador 1988, Schlenker 2003, Stechow 2003, Fabricius-Hansen & Saebø 2004).

5 Individuals, Times and Worlds or Individuals and Events/States?

Summarizing at this point, we find that there is a systematic correspondence between the semantic rules we use to refer to individuals, to moments and to possible worlds. However there appears to be a closer morphological connection between time-referring and world-referring expressions than there is between either of these and individual-denoting expressions. As we saw earlier, the very same word *then* has both time-denoting and world-denoting uses; furthermore, the present, past and pluperfect morphemes of English can be interpreted either temporally or modally, a situation which, according to Iatridou 2000, is quite common across languages[20]. There are at least two ways to account for this observation. We may postulate that there is a closer connection between the cognitive system responsible for reference to times and that responsible for reference to worlds than there is between either of those and the system that underlies reference to individuals. Alternatively, we may try to modify our basic ontology, replacing times and possible worlds with a single kind of entity, more fine-grained than either of those - call them events/states[21].

Davidson and his followers suggested on independent grounds that the semantics of verb phrases should be analyzed in terms of events (Davidson 1967, Parsons 1990). Their basic observation was that *Brutus stabbed Caesar at midnight with a knife* entails that *Brutus stabbed*

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[20]In addition, the future also has both temporal and modal uses. Thus *would*, which in many languages is the past tense of a future morpheme, can be used to refer to a counterfactual event or to a future event relative to a past perspective.

[21] If we adopt this hypothesis, we may have to explain why, say, *then* is sometimes understood as purely temporal, and sometimes as purely modal. This could in principle be done in terms of 'pragmatic enrichment' (e.g. Carston 2002), but it is more likely (given that other expressions are unambiguously temporal or modal) that the grammar includes the resources to single out those events/states that occur at a given time or in a given world.

Caesar and that *Brutus stabbed Caesar with a knife,* although the conjunction of the latter two sentences does not suffice to entail the first because two different stabbings may have occurred (with one taking place at midnight and the other being performed with a knife). This asymmetric pattern of entailment is easily derived if each sentence is analyzed as an existential quantification over events: from *∃e (stabbing(e) & agent(e)=Brutus & at_midnight(e) & with_a_knife(e))*, it follows straightforwardly that *∃e (stabbing(e) & agent(e)=Brutus & at_midnight(e))* and that *∃e (stabbing(e) & agent(e)=Brutus & with_a_knife(e))*, although the conjunction of the last two formulas does not suffice to entail the first one, just as is desired. (In effect, this analysis makes verbal modification analogous to nominal modification in existential statements. From *A smart American student attended,* one can infer that *A smart student attended* and that *An American student attended,* though the conjunction of the last two sentences does not suffice to entail the first one). Neither times nor worlds are sufficiently fine-grained to allow for such an analysis.

But there might also be independent grounds for postulating that the linguistic ontology contains more fine-grained entities than times and worlds. Consider the sentence *Mostly, when a Frenchman meets an American, they argue about politics*. Suppose the sentence meant that at most *moments* at which a Frenchman meets an American, they argue, and suppose further that at times t_1 and t_2 one Frenchman met an American and failed to argue with him, while at t_3 one hundred Frenchmen met one hundred Americans in various parts of the globe, and on each occasion argued with them. Because in two moments out of three the main clause failed to hold, we predict that the sentence should be judged as false - an entirely incorrect result. The problem disappears if what gets counted are meeting *events* rather than moments at which some meetings took place[22]. The same argument can be replicated with *if*-clauses, replacing in the above example the word *when* with the word *if*. If we now adopt an ontology of individuals and events/states rather than an ontology of individuals, times and possible worlds, we obtain a strictly more fine-grained ontology than before because (a) to each moment there corresponds a state of existing at that moment and to each possible world there corresponds a state of existing in that possible world, while (b) different events/states may exist at the same time and in the same possible world, as shown by the meeting example discussed above. The theory we developed earlier in terms of times and possible worlds can thus be restated in terms of events/states (see for instance Ludlow 1994, Lycan 2001, Schein 2001 for an event-based analysis of conditionals).

An important advantage of the revised analysis is that it can be connected to two additional strands of contemporary research.

(i) First, in the semantic literature on *verbal classes* it has been observed that the distinction between *telic* verbs *(die, build a house)* and *atelic verbs* (*be happy*, *run)* can be insightfully related to the count/mass distinction in the nominal domain. Classically, telic verbs are compatible with the adverbial *in an hour* and not with the adverbial *for an hour (John ran/was happy for two hours / #in two hours),* whereas atelic verbs display the opposite pattern (*John died / built a house #for two hours / in two hours)*. Researchers found that this distinction was connected to a logical property reminiscent of the nominal domain (Bach 1986). *Atelic verbs*, like mass terms, satisfy a property of *cumulative reference:* put together, two events that satisfy the predicate *running* still satisfy the same predicate, just like two samples of *water* that have been put together still count as being *water*. By contrast, *telic verbs*, like *count terms,* fail the test: put together, two events of *building a house* may in general amount to an event of *building two houses* but not of *building a house*; and similarly two chairs put together do not fall under

[22] There are alternative analyses, however. In the tradition of Discourse Representation Theory, we could postulate that what gets counted are pairs or assignment functions rather than events. See Lewis 1975 for the original idea, and Dekker 1997 for an insightful comparison between the event-based and the DRT approaches.

the predicate *chair,* but rather under the predicate *chairs*. The details of the analysis are still the object of active debate (Rothstein 2004), but there is general agreement that some systematic semantic correspondence between the nominal and the verbal domain is indeed quite real, and that is should be accounted for in a framework that countenances events.
(ii) Second, in the syntactic literature on noun phrases and verb phrases some analogies between the two domains are generally assumed, in particular with respect to the syntactic behavior of adjectives and adverbs. Cinque 1999 showed that, when various extrinsic factors are controlled for, the ordering of adverbs across languages is remarkably rigid and stable. Cinque 2002 further showed that adjectives obey exactly the same hierarchy. Given an event-based analysis of verb phrases, this correspondence makes good sense: adjectives and adverbs alike are modifiers of certain predicates (of individuals and events respectively), and it is not entirely surprising that they should display the same syntactic behavior.

Let us assume for a moment that there is indeed a syntactic and a semantic correspondence between verb phrases and noun phrases. Can this correspondence be extended to larger structures that are built out of these categories? In the syntactic literature, there have been attempts to analogize the structure of tense phrases (i.e. categories of the form $[_{TP}$ T VP], where T is a tense whose complement is a verb phrase) to that of determiner phrases (i.e. categories of the form $[_{DP}$D NP], where D is a determiner whose complement is a noun phrase). From the present perspective, however, tense should be thought of as a pronoun, which is an argument of the verb; this makes it difficult to see which *semantic* correspondence there could be between a tense phrase and a determiner phrase. More promising, on the other hand, is an analogy pursued by Szabolcsi 1994, who suggested on the basis of Hungarian data that complementizer phrases (=*that*-clauses) display the same structure as definite descriptions, which are a particular sort of determiner phrases. If the verb phrase is taken to include a tense/mood argument, the complementizer phrase can be taken to be of the form $[_{CP}$ C VP] (where C is a complementizer taking a verb phrase as a complement), while a definite description has the structure $[_{DP}$ D NP] (where D is a definite determiner). Szabolcsi's suggestion can be given a semantic basis if we modify slightly the analysis sketched above, in which *if-* and *when*-clauses are definite descriptions of events. Let us say instead that *that* is the definite description operator as it applies to (plural) descriptions of events, and that *if* and *when* express the combination of an event preposition *in* with *that* [this is consistent with data that suggest that the element found inside an *if*-clause is a complementizer phrase, which can be made to appear explicitly in conjunctions, e.g. in French *Si Jean vient et qu'il est saoûl* (lit. *If Jean comes and that he is drunk*) or *Quand Jean viendra et qu'il sera saoûl* (lit. *When Jean will-come and that he will be drunk)*]. In effect, this analyzes *If p, q* and *When p, q* as *In the event(s) that p, q*, as suggested in Lycan 2001 and Schein 2001 (of course something must be added to account for the difference between *if* and *when*, say a presupposition that the events picked out are real in the second case, and simply no such presupposition in the first.) At this point this is a rather speculative reinterpretation, whose details remain to be worked out. But it suggests an appealingly simple picture: nouns and verbs are predicates, which take various arguments and can optionally be modified by adjectives and adverbs. And *the* and *that* can be applied to noun phrases and verb phrases respectively to form (plural) definite descriptions of individuals and events.[23]

[23] I cannot do justice in this context to the large body of research on the correspondence between the syntax of clauses and of verb phrases. See Ogawa 2001 for a systematic investigation and a recent bibliography. It should be added that a completely different line of research is currently being pursued by R. Larson, who explores the view that the structure of DPs should be compared neither to that of TPs nor of CPs, but rather to that of VPs. Part of Larson's motivation is semantic: in generalized quantifier theory, determiners can be seen as higher-order transitive predicates, which makes them somewhat similar to transitive verbs.

6 Concluding remarks

Let us step back. The picture that emerges is miles away from the asymmetric view of semantics that was offered in quantified modal logic. Two things should be striking. The first is the sheer expressive power offered by natural language to talk about times, possible worlds and/or events/states - a surprising result given that one usually feels that times/possible worlds/events/states are not perceived in anything like the way we perceive objects, and that the kinds of things we might want to say about them in daily life are much less complex than what one typically wishes to say about individuals (*everyone is protected by someone* might be a useful statement in quite a few human situations; it is not quite clear how statements involving several world quantifiers can be useful in the same way). Common sense might well turn out to be wrong, but if it is not it is worth asking *how a process of natural selection could have lead to the expressive power we find in the time/world/event/state domain.*

The second striking result is the systematic symmetry we find between the individual domain and the time/world/event/state domain. This raises a question: why should such a symmetry hold? One possible view is that all ontological domains are governed by a single abstract cognitive system. This makes it a bit puzzling why the syntactic resources used to refer to these domains are clearly distinct even though they display systematic correspondences. But this hypothesis is coherent, and it makes predictions that should be tested, in particular that in language breakdown entire modules of language that each apply across ontological domains could break down as units (for instance there could be a simultaneous breakdown of all anaphoric abilities, be they related to individuals, times, worlds, or events/states)[24]. An alternative possibility is that the systems that underlie reference to individuals and to times/possible worlds/events/states are in fact synchronically distinct, but have a common evolutionary origin. This has rather different implications, relating to language evolution. One possible view (clearly a speculative one) is that a rich semantic system was originally selected to talk about individuals, and was then exported ('exapted') to talk about other entities such as times, worlds or events/states. This might explain why an expressive power that is hardly useful in day to day life is found in the latter domains. A further -and still wilder- speculation is that the basic categories that are found in language, and in particular those of count/mass and of referential classification as near, far or 'further', originated in perception, were then applied to a module talking about individuals, and were later extended to times/worlds/events/states (see Soja et al. 1991 for an argument that the count/mass distinction exists in perception independently of language). We can only conclude with the hope that these highly speculative issues will be addressed in future semantic and psychological research.

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[24] Thanks to J. Mehler for raising this point.

Appendix. Ontological Symmetry in a Mixed Fragment

The fragment included below has the following general properties:
(i) It treats in a completely symmetric way individuals, times and worlds (more precisely, the six semantics rules that are defined below applied in identical fashion to individuals, times and worlds). The only element of asymmetry is the fact that atomic predicates take a single world and a single time argument, but may take n individual arguments for $n \geq 0$.
(ii) When the accessibility relation R is trivial (i.e. every sequence is accessible from every sequence), this system has the expressive power of a first-order logic with explicit quantification over individuals, times and possible worlds. In particular, a straightforward treatment of example (7) is offered ('Some day, each of my students will be on the Editorial Board of *Linguistic Inquiry*').
(iii) Predicates can be evaluated even when they do not have any syntactically represented arguments.
(iv) Domain restriction is analyzed in the meta-language as an accessibility relation between sequences of evaluation.
(v) The logic is 3-valued because grammatical features and definite descriptions are presupposition triggers.
The modal treatment of quantification makes this system syntactically reminiscent of Ben-Shalom 1994 and semantically close to the 'guarded fragments' studied in Blackburn et al. 2001, van Benthem 1996, and Marx 2001.

The phenomena that are dealt with are:
(a) the non-monotonic behavior of *if*-clauses and definite descriptions (the system also includes an application to *when*-clauses, whose empirical validity is less clear).
(b) generalized quantification over individuals, times and possible worlds, including quantification over mass terms and 'probabilistic' quantification (both of which require a measure function)
(c) referential classification of terms (be they variables or definite descriptions) as denoting objects 'near', 'far' or 'further' from the context of evaluation. The relevant features are analyzed as presuppositions on the value of terms, written below between curly brackets (thus $\tau\{<local^{\xi}\}$ is the term τ with the presupposition that it denotes something non-local or 'far'; the analysis of 'further' is done in terms of a double presupposition, of the form $\tau\{<^{\xi}\tau'\{<local^{\xi}\}\}$, where τ is presupposed to denote something more remote than what τ' denotes, where τ' is itself presupposed to be non-local). A more elaborate version of this analysis can be found in Schlenker 2004a, which implements the theory in a dynamic semantics (this is essential to analyze the fine-grained semantics of third person or subjunctive features).

<u>Vocabulary</u>
Predicates: for each integer n, for each integer i, a predicate P^n_i of type n [=predicate taking 1 world argument, 1 time argument and n individual arguments] (in the examples below, English words are used in lieu of P^n_i)
Definite Description Operator: for each $\xi \in \{x, t, w\}$, ι^{ξ}
Variables of type ξ: for each $\xi \in \{x, t, w\}$, for each positive integer i, ξ_{-i}
Quantifiers of type ξ: for each $\xi \in \{x, t, w\}$, some$^{\xi}$, all$^{\xi}$, most$^{\xi}$
Negation: ¬
Conjunction: &
Square Brackets: [,] (=punctuation)
Curly Brackets: {,} (=presuppositions)

Features: for each $\xi \in \{x, t, w\}$ (i) 2 unary features: $local^{\xi}$, $<local^{\xi}$ (ii) 1 binary feature: $<^{\xi}$

Syntax

Terms of type ξ: (i) for each $\xi \in \{x, t, w\}$, ξ_i
(ii) for each formula F, $[\iota^{\xi} F]$ is a definite description of type ξ
(iii) for all terms t, t' of type ξ, $t\{local^{\xi}\}$, $t\{<local^{\xi}\}$, $t\{<t'\}$ are terms of type ξ

Formulas: (i) P^n_i is a formula.
(ii) if F is a formula, if t is a term, t F is a formula
(iii) if q is a quantifier of type ξ, t is a term of type ξ and F is a formula, [q t] F is a formula.

Semantics

Domains: three non-overlapping domains D^x, D^t and D^w (=individuals, times and worlds respectively), whose members are said to be of type *x*, *t*, and *w* respectively. Each domain D^{ξ} contains a distinguished element $\#^{\xi}$ [=referential failure of type ξ]. $D^{x}*$, $D^{t}*$ and $D^{w}*$ are the sets of non-empty subsets of D^x, D^t and D^w respectively. Following Schwarzschild 1996, we identify an element with the corresponding singleton set [hence for each $\xi \in \{x, t, w\}$, $D^{\xi} \subseteq D^{\xi}*$]

Interpretation Function: the interpretation function I satisfies: $I(P^n_i) \subseteq D^{w}* \times D^{t}* \times (D^{x}*)^n$
and for each $\xi \in \{x, t, w\}$, $I(local^{\xi}) \subseteq D^{\xi}*$, $I(<local^{\xi}) \subseteq D^{\xi*}$, $I(local^{\xi}) \cap I(<local^{\xi}) = \emptyset$
$I(<^{\xi}) \subseteq D^{\xi*} \times D^{\xi*}$
-$I(<^{\xi})$ is a partial ordering of D^{ξ} such that for every subset E of D^{ξ}, the set of its maximal elements $Max(<^{\xi})E$ is well-defined.
-Furthermore, we assume that the following conditions are satisfied:
for all d, $d' \in D^{\xi*}$: (i) if $d \in I(local^{\xi})$ and $d\hat{\ }d' \in I(<^{\xi})$, then $d' \in I(local^{\xi})$
(ii) if $d \in I(<local^{\xi})$ and $d'\hat{\ }d \in I(<^{\xi})$,then $d' \in I(<local^{\xi})$

Convention: We assume that the initial sequence $w\hat{\ }t\hat{\ }x$ with respect to which each sentence is evaluated satisfies $w \in I(local^w)$, $t \in I(local^t)$, $x \in I(local^x)$.

Note: In a more sophisticated implementation, the extension of *local, <local* and < would functionally depend on the context of evaluation, i.e. on the first three elements of the sequence of evaluation.

Σ is the set of finite sequences of elements of elements of $D^{x}* \cup D^{t}* \cup D^{w}* \cup \{\#^x, \#^t, \#^w\}$.

Accessibility relation: $R \subseteq \Sigma \times \Sigma$

Notation: (i) We write sequence concatenation as ^ and we identify a one-membered sequence with its only element.
(ii) For each $s \in \Sigma$, s_n^{ξ}=the sequence of the last n elements of s of type ξ if such elements exist, and $s_n^{\xi} = \#^{\xi}$ otherwise.
(iii) For each $s \in \Sigma$, s_{-n}^{ξ}=the n^{th} element of s of type ξ counting from the end, if such an element exist, and $s_{-n}^{\xi} = \#^{\xi}$ otherwise.
(iv) When there is no ambiguity, if s is a sequence and d is an object, we write *s R d* instead of *s R s^d.*

Measure function on subsets of $D^{x}*$, $D^{t}*$, $D^{w}*$: μ (for present purposes we leave the properties of the measure function unspecified)

Rules

1. $[[\xi_{-i}]]s=s_{-n}^{\xi}$
2. $[[P^n_i]]s=\#$ iff for some $\xi\in\{x, t, w\}$ $s_1^{w}\hat{}s_1^{t}\hat{}s_n^{x}$ contains $\#^{\xi}$. If $\neq\#$, $[[P^n_i]]s=\#$ iff $s_1^{w}\hat{}s_1^{t}\hat{}s_n^{x}\in I(P^n_i)$
3. $[[\,[\iota^{\xi}F]\,]]s=\#^{\xi}$ iff for no element $d\in D^{\xi}$ satisfying s R d, $[[\,F]]s\hat{}d=1$. If $\neq\#^{\xi}$, $[[\,[\iota^{\xi}F]]]s$ $=Max(<^{\xi})\{d\in D^{\xi}$: sRd and $[[F]]s\hat{}d=1\}$
4. If t is a term of type ξ,
   $[[\,t\{local^{\xi}\}]]s=\#^{\xi}$ iff $[[t]]s\notin I(local^{\xi})$. If $\neq\#^{\xi}$, $[[\,t\{local^{\xi}\}]]s=[[t]]s$
   $[[\,t\{<local^{\xi}\}]]s=\#^{\xi}$ iff $[[t]]s\notin I(<local^{\xi})$. If $\neq\#^{\xi}$, $[[\,t\{<local^{\xi}\}]]s=[[t]]s$
   $[[\,t\{<^{\xi}t'\}]]s$ iff $[[t]]s\hat{}[[t']]s\notin I(<^{\xi})$. If $\neq\#^{\xi}$, $[[\,t\{<^{\xi}t'\}]]s=[[t]]s$
5. If t is a term and if F is a formula, $[[\,t\ F]]s=[[F]]s\hat{}[[t]]s$
6. If t is a term of type ξ and F is a formula[25, 26],
   $[[\,[some^{\xi}\ t]F\,]]s=\#$ iff for some $d\in D^{\xi}$ satisfying sRd and $d\in[[t]]s$, $[[F]]s\hat{}d=\#$.
   If $\neq\#$, $[[\,[some^{\xi}\ t]F\,]]s=1$ iff for some $d\in D^{\xi}$ satisfying sRd and $d\in[[t]]s$, $[[F]]s\hat{}d=1$
   $[[\,[all^{\xi}\ t]F\,]]s=\#$ iff (i) $[[t]]s=\#^{\xi}$ or (ii) for some $d\in D^{\xi}$ satisfying sRd and $d\in[[t]]s$, $[[F]]s\hat{}d=\#$.
   If $\neq\#$, $[[\,[all^{\xi}\ t]F\,]]s=1$ iff for all $d\in D^{\xi}$ satisfying sRd and $d\in[[t]]s$, $[[F]]s\hat{}d=1$
   $[[\,[most^{\xi}\ t]F\,]]s=\#$ iff (i) $[[t]]s=\#^{\xi}$ or (ii) for some $d\in D^{\xi}$ satisfying sRd and $d\in[[t]]s$, $[[F]]s\hat{}d=\#$.
   If $\neq\#$, $[[\,[most^{\xi}\ t]F\,]]s=1$ iff
   $\mu((\{d\in D^{\xi}:sRd\}\cap[[t]]s)\cap\{d\in D^{\xi}: [[F]]s\hat{}d=1\}) > \mu((\{d\in D^{\xi}:sRd\}\cap[[t]]s)-\{d\in D^{\xi}: [[F]]s\hat{}d=1\})$

<u>Examples</u>

In the examples below, we use English words in lieu of the predicates P^n_i, with obvious choices, e.g. *rain* is of type 0, as it takes 1 world argument, 1 time argument, and 0 individual argument *smoke* is of type 1, as it takes 1 world argument, 1 time argument, and 1 individual argument, etc.
It should be noted that the Logical Forms are very simple but the truth- and failure-conditions are quite complicated. The simplicity of the syntax is largely the result of the modal approach adopted here, which allows important aspects of the semantics to remain implicit (i.e. not to be encoded syntactically).

(i) a. It is raining *(can be interpreted without syntactically represented time and world arguments)*
a'. rain
b. $[[(a')]]w\hat{}t\hat{}x\neq\#$. Furthermore, $[[(a')]]w\hat{}t\hat{}x=1$ iff $[s_1^{w}(w\hat{}t\hat{}x)]\hat{}[s_1^{t}(w\hat{}t\hat{}x)]\in I(rain)$, iff $w\hat{}t\in I(rain)$.

(ii) a. The students smoke [disregarding all features] *(means: the most salient relevant students smoke)*
a'. $[\iota^{x}$ student] smoke

[25] There is a systematic redundancy in the definition when the restrictor is a definite description, since its value is itself computed by restricting attention to those elements that are accessible from the sequence of evaluation. However the restrictor may also be a simple variable, in which case there is no redundancy.
[26] When the restrictor is a definite description, it plays very much the role of a λ-operator, and may thus bind variables that are in the restrictor. This makes it unnecessary to evaluate the restrictor (which is a term rather than a formula) under an extension of the original assignment function.

b. [[(a')]]w^t^x=[[smoke]]w^t^x^s with s=[[ι^x student]]w^t^x.
s=$\#^x$ iff there is no element x'$\in D^x$ satisfying (i) w^t^x R x' and (ii) [[student]]w^t^x^x'=1, i.e. w^t^x'∈I(student). If ≠$\#^x$, s=Max($<^x$){x'$\in D^x$: w^t^x R x' & w^t^x'∈I(student)}
Thus [[(a')]]w^t^x=# iff there is no element x'$\in D^x$ satisfying w^t^x'∈I(student). If ≠#, [[(a')]]w^t^x=1 iff w^t^s∈I(smoke) with s=Max($<^x$){x'∈X: w^t^x R x' & w^t^x'∈I(student)}

Note: On the natural assumption that *smoke* is distributive with respect to its individual argument, the final truth conditions simplify to: [[(a')]]w^t^x=1 iff w^t^s'∈I(smoke) for each s'∈Max($<^x$){x'∈X: w^t^x R x' & w^t^x'∈I(student)}

(iii) a. Everyone knows everyone *(*given an empty restrictor denoting a set of individuals D, may mean roughly: *every individual x in D relevant to the context knows everyone in D relevant to the context <u>and to x</u>).*
a'. [all^x x_{-1}][all^x x_{-2}] know
b. We assume that the initial sequence of evaluation is w^t^x^x', with x' a salient set of individuals.
[[(a')]]w^t^x^x'≠#. Furthermore, [[(a')]]w^t^x^x'=1 iff for all y$\in D^x$ satisfying w^t^x^x' Ry and y∈[[x_{-1}]]w^t^x^x', i.e. y∈x', [[[all x_{-2}] know]]w^t^x^x'^y=1,
iff for all y$\in D^x$ satisfying w^t^x^x' Ry and y∈x', for all y'$\in D^x$ satisfying w^t^x^x'^y Ry' and y'∈x', [[know]]w^t^x^x'^y^y'=1,
iff for all y$\in D^x$ satisfying w^t^x^x' Ry and y∈x', for all y'$\in D^x$ satisfying w^t^x^x'^y Ry' and y'∈x', w^t^y^y'∈I(know).

(iv) a. Most of the water is poisoned *(can be interpreted provided a measure is given)*
a'. [$most^x$ [ι^x water]] poisoned
b. [[(a')]]w^t^x=# iff o=$\#^x$ with o=[[ι^x water]]w^t^x.
o=$\#^x$ iff there is no element x'$\in D^x$ satisfying (i) w^t^x R x' and (ii) [[water]]w^t^x^x'=1, i.e. w^t^x'∈I(water). If ≠$\#^x$, o=Max($<^x$){x'$\in D^x$: w^t^x R x' & w^t^x'∈I(water)}
Thus [[(a')]]w^t^x=# iff there is no element x'$\in D^x$ satisfying (i) w^t^x R x' and (ii) w^t^x'∈I(water).
If ≠$\#^x$, [[(a')]]w^t^x=1 iff μ((a∩o)∩b) > μ((a∩o)-b)
with a={x'$\in D^x$:w^t^x R x'}, o=Max($<^x$){x'$\in D^x$: w^t^x R x' & w^t^x'∈I(water)}, b={x'$\in D^x$:w^t^x'∈I(poisoned)}. Since o⊆a, this simplifies to: [[(a')]]w^t^x=1 iff μ(o∩b) > μ(o-b)

(v) a. If it rains, it pours [disregarding all features] *(is interpreted in the same way as (ii))*
a'. [ι^w rain] pour
b. [[(a')]]w^t^x=[[pour]]w^t^x^r with r=[[ι^w rain]]w^t^x.
r=$\#^w$ iff there is no element w'$\in D^w$ satisfying (i) w^t^x R w' and (ii) [[rain]]w^t^x^w'=1, i.e. w'^t∈I(rain). If ≠$\#^w$, r=Max($<^w$){w'$\in D^w$: w^t^x R w' & w'^t∈I(rain)}
Thus [[(a')]]w^t^x=# iff there is no element w'$\in D^w$ satisfying (i) w^t^x R w' and (ii) w'^t∈I(rain).
If ≠#, [[(a')]]w^t^x=1 iff r^t∈I(pour) with r=Max($<^w$){w'$\in D^w$: w^t^x R w' & w'^t∈I(rain)}

Note: On the natural assumption that *pour* is distributive with respect to its world argument, the final truth conditions simply to: [[(a')]]w^t^x=1 iff r'^t∈I(pour) for each r'∈Max($<^w$){w'$\in D^w$: w^t^x R w' & w'^t∈I(rain)}

(vi) a. Probably, if it rains, it pours [disregarding all features] *(is interpreted in the same way as (iv))*

a'. [most^w [ι^w rain]] pour

b. ⟦(a')⟧w^t^x=# iff r=#^{w} with r=⟦ι^w rain⟧w^t^x.

r=#^{w} iff there is no element w'∈D^w satisfying (i) w^t^x R w' and (ii) ⟦rain⟧w^t^x^w'=1, i.e. w'^t∈I(rain). Otherwise, r=Max(<^{w}){w'∈D^w: w^t^x R w' & w'^t∈I(rain)}

If ≠#, ⟦(a')⟧w^t^x=1 iff $\mu((a\cap r)\cap p) > \mu((a\cap r)-p)$

with a={w'∈D^w:w^t^x R w'}, r=Max(<^{w}){w'∈D^w: w^t^x R w' & w'^t∈I(rain)},

p={w'∈D^w:w'^t∈I(pour)}. Since r⊆a, this simplifies to: ⟦(a')⟧w^t^x=1 iff $\mu(r\cap p) > \mu(r-p)$

Note: One probably needs a stipulation to the effect that with quantifiers such as 'probably' and with precise measures, (a) the accessibility relation is trivial, so that all worlds are accessible, and (b) the ordering <^{w} is trivial, so that all the worlds are equally ranked. With this stipulation, r takes the value: {w'∈D^w: w'^t∈I(rain)}.

(vii) a. At some point, each of my students will be on the Editorial Board of *Linguistic Inquiry* [disregarding tense features and treating *each of my students* as *all the students*; we assume that a salient time restriction t' is given in the sequence of evaluation] *(is not a contradiction)*

a'. [some^t t_{-1}] [all^x [ι^x [t_{-3} student]] be-on-the-Editorial-Board

b. We assume that the initial sequence of evaluation is w^t^x^t', with t' a salient non-empty set of moments.

⟦(a')⟧w^t^x^t'=# iff for some t''∈D^t satisfying w^t^x R t'' and t''∈⟦t_{-1}⟧w^t^x^t', i.e. t''∈t', ⟦ι^x [t_{-3} student]⟧w^t^x^t'^t''=#, iff for some t''∈D^t satisfying w^t^x R t'' and t''∈t', there is no x'∈D^x satisfying w^t^x^t'^t'' R x' and ⟦t_{-3} student⟧w^t^x^t'^t''^x'=1, i.e. ⟦student⟧w^t^x^t'^t''^x'^t=1, i.e. w^t^x'∈I(student).

If ≠#, ⟦(a')⟧w^t^x^t'=1 iff for some t''∈D^t satisfying w^t^x R t'' and t''∈t', for each x''∈D^x satisfying x''∈Max(<^{x}){ x'∈D^x: w^t^x^t'^t'' R x' and w^t^x'∈I(student)}, x'' satisfies ⟦be-on-the-Editorial-Board⟧w^t^x^t'^t''^x'', i.e. w^t''^x∈I(be-on-the-Editorial-Board)[27].

(viii) a. I smoke [with an explicitly represented first person pronoun]

a'. x_{-1}{local^x} smoke

b. ⟦(a')⟧w^t^x=⟦smoke⟧w^t^x^x' with x'=⟦x_{-1}{local^x}⟧w^t^x

x'=#^{x} iff x∉I(local^x) [which by the Convention above is not the case]. If ≠#^{x}, x'=⟦x_{-1}⟧ w^t^x=x

Thus ⟦(a')⟧w^t^x=# iff x∉I(local^x). If ≠#, ⟦(a')⟧w^t^x=1 iff w^t^x∈I(smoke)

Note: In a slightly more sophisticated system, we would give an indexical account of *local,* so that in a context w^t^x the extension of *local^x* is simply {x}.

(ix) a. He smokes [English third person, or pseudo-Algonquian proximate pronoun]

a'. x_{-1}{<local^x} smoke *(evaluated in a context in which a salient individual different from the speaker is given)*

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[27] If the accessibility relation R is trivial (i.e. every sequence is accessible from every sequence), the failure and truth conditions simplify to:
⟦(a')⟧w^t^x^t'=# iff there is no x'∈D^x satisfying w^t^x'∈I(student). If ≠#, ⟦(a')⟧w^t^x^t'=1 iff for some t''∈D^t satisfying t''∈t', for each x''∈D^x satisfying x''∈Max(<^{x}){x'∈D^x: w^t^x'∈I(student)}, x'' satisfies w^t''^x∈I(be-on-the-Editorial-Board).

b. [[(a')]]w^t^x^x'=[[smoke]]w^t^x^x'^x" with x"=[[x$_{-1}${<local^{x}}]]w^t^x^x'
x"=#^{x} iff x'∉I(<local^{x}). If ≠#^{x}, x"=[[x$_{-1}$]] w^t^x^x'=x'
Thus [[(a')]]w^t^x^x'=# iff x'∈I(local^{x}). If ≠#, [[(a')]]w^t^x=1 iff w^t^x∈I(smoke)

Note: In a more sophisticated system, one would account for the fact that *he* can be used to refer to the speaker, as long as it is not *presupposed* that *he* denotes the speaker. See the Appendix of Schlenker 2004a for an analysis of this sort, framed within a dynamic semantics.

(x) a. He-obv. smokes [pseudo-Algonquian, with an obviative pronoun]
a'. x$_{-1}${<^{x} x$_{-2}${<local^{x}}} smoke *(evaluated in a context in which two individuals different from the speaker are given)*
b. [[(a')]] w^t^x^x'^x"=[[smoke]]w^t^x^x'^x"^y with y=[[x$_{-1}${<^{x} x$_{-2}${<local^{x}}}]]w^t^x^x'^x"
y=#^{x} iff ([[x$_{-1}$]] w^t^x^x'^x")^([[x$_{-2}${<local^{x}}]] w^t^x^x'^x")∉I(<^{x}), iff (i) x'∉I(<local^{x}) or (ii) x'∈I(<local^{x}) [hence [[x$_{-2}${<local^{x}}]] w^t^x^x'^x"=x'], but x"^x'∉I(<^{x}).
If ≠#^{x}, y=[[x$_{-1}$]]w^t^x^x'^x"=x".
Thus [[(a')]] w^t^x^x'^x"=# iff (i) x'∉I(<local^{x}) or (ii) x'∈ I(<local^{x})but x"^x'∉I(<^{x}). If ≠#, [[(a')]] w^t^x^x'^x"=1 iff w^t^x"∈I(smoke)

(xi) a. It's raining [with an explicitly represented present tense] *(is analyzed in the same way as (viii))*
a'. t$_{-1}${local^{t}} rain
b. [[(a')]]w^t^x=[[rain]]w^t^x^t' with t'=[[t$_{-1}${local^{t}}]]w^t^x
t'=#^{t} iff t∉I(local^{t}) [which by the Convention above is not the case]. If ≠#^{t}, t'=[[t$_{-1}$]] w^t^x=t
Thus [[(a')]]w^t^x=# iff t∉I(local^{t}). If ≠#, [[(a')]]w^t^x=1 iff w^t∈I(rain)

Note: As mentioned in the text, it is sometimes thought that the present tense is morphologically vacuous. If so the Logical Form *t$_{-1}${local^{t}} rain* should be replaced with: *rain*

(xii) a. It was raining [with a deictic past tense] *(is analyzed in the same way as (ix))*
a'. t$_{-1}${<local^{t}} rain *(evaluated in a context in which a moment different from the time of speech is salient)*
b. [[(a')]]w^t^x^t'=[[rain]]w^t^x^t'^t" with t"=[[t$_{-1}${<local^{t}}]]w^t^x^t'
t"=#^{t} iff t'∉I(<local^{t}). If ≠#^{t}, t"=[[t$_{-1}$]] w^t^x^t'=t'
Thus [[(a')]]w^t^x^t'=# iff t'∉I(<local^{t}). If ≠#, [[(a')]]w^t^x^t'=1 iff w^t'∈I(rain)

(xiii) a. It had been raining [with a deictic pluperfect tense] *(is analyzed in the same way as (x))*
a'. t$_{-1}${<^{t} t$_{-2}${<local^{t}}} rain (evaluated in a context in which two moments different from the time of speech are salient)
b. [[(a')]]w^t^x^t'^t"=[[rain]]w^t^x^t'^t"^u with u=[[t$_{-1}${<^{t} t$_{-2}${<local^{t}}}]]w^t^x^t'^t"
u=#^{t} iff [[t$_{-2}${<local^{t}}]] w^t^x^t'^t"=#^{t}, i.e. t'∉I(<local^{t}), or (t'∈I(<local^{t}) and t"^t'∉I(<^{t}). If ≠#^{t}, u=t'.
Thus [[(a')]]w^t^x^t'^t"=# iff t'∉I(<local^{t}), or (t'∈I(<local^{t}) and t"^t'∉I(<^{t}). If ≠#, [[(a')]]w^t^x^t'^t"=1 iff w^t'∈I(rain)

(xiv) a. If I play, I will win [disregarding tense and person features, but with indicative features on the *if*-clause]
a'. [ι^{w} play]{local^{w}} win
b. [[(a')]]w^t^x=[[win]]w^t^x^w' with w'=[[[ι^{w} play]{local^{w}}]]w^t^x
w'=#^{w} iff [[[ι^{w} play]]]w^t^x∉I(local^{w}), iff there is no element w"∈D^{w} satisfying w^t^x R w" and w"^t^x∈I(play), or else (Max(<^{w}){w"∈D^{w}: w^t^x R w" and w"^t^x∈I(play)})∉I(local^{w}). If ≠#^{w},

w'= Max($<^w$){ w"∈D^w: w^t^x R w" and w"^t^x∈I(play)}
Thus [[(a')]]w^t^x=# iff there is no element w"∈D^w satisfying w^t^x R w" and w"^t^x∈I(play), or else (Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)}) ∉I($local^w$). If ≠#, [[(a')]]w^t^x=1 iff w'^t^x∈I(win) with w'=Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)})

(xv) a. If I played, I would win [disregarding tense and person features, but with subjunctive features on the *if*-clause]
a'. [ι^w play]{$<local^w$} win
b. [[(a')]]w^t^x=[[win]]w^t^x^w' with w'=[[[ι^w play]{$<local^w$}]]w^t^x
w'=$\#^w$ iff [[[ι^w play]]]w^t^x∉I($<local^w$), iff there is no element w"∈D^w satisfying w^t^x R w" and w"^t^x∈I(play), or else (Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)})∉I($<local^w$). If ≠$\#^w$,
w'= Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)}.
Thus [[(a')]]w^t^x=# iff there is no element w"∈D^w satisfying w^t^x R w" and w"^t^x∈I(play), or else (Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)})∉I($<local^w$).
If ≠#, [[(a')]]w^t^x=1 iff w'^t^x∈I(win) with w'=Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)})

Note: This analysis incorrectly predicts that the sentence presupposes that I will not play. As mentioned in the text, this need not be the case - the sentence is felicitous if it is not presupposed that the closest world in which I play is one that counts as 'local'. A better analysis requires a dynamic treatment, offered in Schlenker 2004a.

(xvi) a. If I had played, I would have won [disregarding tense and person features, but with double subjunctive features on the *if*-clause]
a'. [ι^w play]{$<^w w_{-1}$ {$<local^w$}} win [interpreted in a context in which some world other than the world of utterance is salient]
b. [[(a')]]w^t^x^w'=[[win]]w^t^x^w'^v with v=[[[ι^w play]{$<^w w_{-1}$ {$<local^w$}}]]w^t^x^w'
v=$\#^w$ iff (i) there is no element w"∈D^w satisfying w^t^x^w' R w" and w"^t^x∈I(play), or else (ii) w'∉I($<local^w$), or else (iii) v'^w'∉I($<^w$) with v'=Max($<^w$){w"∈D^w: w^t^x^w' R w" and w"^t^x∈I(play)}. If ≠$\#^w$, v= Max($<^w$){w"∈D^w: w^t^x R w" and w"^t^x∈I(play)}
Thus [[(a')]]w^t^x^w'=# iff (i) there is no element w"∈D^w satisfying w^t^x^w' R w" and w"^t^x∈I(play), or else (ii) w'∉I($<local^w$), or else (iii) v'^w'∉I($<^w$) with v'=Max($<^w$){w"∈D^w: w^t^x^w' R w" and w"^t^x∈I(play)}. If ≠#, [[(a')]]w^t^x^w'=1 iff v'^t^x∈I(win), with v'=Max($<^w$){w"∈D^w: w^t^x^w' R w" and w"^t^x∈I(play)}

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