Dynamic Dido and Commutative Aeneas

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Introduction

To many people nowadays, opera is just an absurd form of art, and admittedly it *is* difficult to sympathize with a promiscuous nobleman who is being swallowed by the flames of hell as his enemies stand by singing, or a simple-minded peasant who somehow manages to sublimate his amorous frustrations into a delicate love aria. We must not forget, however, that the same plays that now seem positively exotic to us once captivated and moved the audiences for whom they were written. In a half-hearted attempt to regain this rapture, theatre makers often decide to place an opera in a 'modern setting': *Cosí fan tutte* is situated in a day nursery, Wagner's *Ring* in a slaughterhouse, and so on. But experience proves, I believe, that changing the scenery and the costumes just isn't enough. More radical measures are called for if a 300 year old play is to enthrall an audience whose mean age is a fraction of that. In my view, an effective transposition will have to involve adapting not only the setting but also the words and the music.

   It is with these considerations in mind that I have begun to adapt Purcell's delightful little opera *Dido and Aeneas* to the needs of our times. What follows is an outline, in prose, of some of the changes that I am considering; fragments of the original libretto by Nahum Tate are interpolated so as to indicate how the new material fits in with the old. I am currently working on the versification of the prose sketch presented here. Any composers who are keen to set my new lines to music (by which I mean *modern* music, of course, such as cool jazz) are kindly requested to contact me at the address above.[1]

Synopsis

Roaming the Mediterranean after the fall and destruction of his home town, the Trojan prince Aeneas lands on the shores of Carthage. A love affair develops

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[1]   For dramatic assistance I am indebted to Colin Brown, Emiel Krahmer, and Rob van der Sandt.

between him and the local queen Dido, which comes to an end when Mercury commands Aeneas to resume his travels. The prince obeys, and takes his leave.

In the original version of the legend, Aeneas was destined by the gods to become the founder of Rome, which is why they sent Mercury to admonish him not to linger in Carthage. According to Tate's libretto, however, Mercury is a dressed-up witch who represents a collective of sorceresses conspiring against happiness and good fortune in general, and against the royal lovers in particular. To this, the following version adds yet another devious twist, for according to it, Aeneas is not exactly traumatized by the prospect of having to part with his loved one, because the harmony of the royal couple's feelings is tainted by deep-rooted intellectual disagreements over the semantics and pragmatics of the natural language connectives.

Dido's sympathies are with what has come to be known as 'dynamic semantics'. Aeneas is a staunch defender of what, in his view, is just plain common sense, but in Dido's eyes is rabid conservatism (and it is true that Aeneas' character evinces some decidedly conservative traits). In the following, Dido will try to explain that natural language conjunction is dynamic and therefore non-commutative. Aeneas will undertake heroic efforts to make sense of Dido's position, and fail.

Act I

The palace. Enter Dido, Belinda, and train.

DIDO:
Ah! Belinda, I am press'd
With torment not to be confess'd,
Peace and I are strangers grown.
I languish till my grief is known,
Yet would not have it guess'd.
BELINDA:
Grief increases by concealing,
DIDO:
Mine admits of no revealing.
BELINDA:
Then let me speak; the Trojan guest
Into your tender thoughts has press'd.

I spoke with Aeneas this morning. He seems really fond of you too, but he complained about your 'dynamic hobbyhorse', as he called it. I asked him to explain, of course, but he refused and somewhat bluntly told me that I should ask you.

DIDO:

He was referring to certain extremely important recent developments in the field of natural language semantics, generally known under the name of 'dynamic semantics'.[2] I will tell you all about it. Let us begin by considering the contrast between the following sentences, supposing that in both cases the pronoun is intended to be anaphoric on the indefinite:

(1) a. A man walks in the garden and he whistles.
     b. He whistles and a man walks in the garden.

(1a) is admittedly somewhat clumsy, since in English, as in other languages, indefinite subjects are extremely rare, but that is nothing compared to (1b), which is downright odd on its intended interpretation. It is generally assumed as a matter of course that in any viable explanation of this type of contrast, linear order will play a crucial role. Intuitively speaking, someone who volunteers (1a) first introduces a new referent into the discourse and then picks it up, while a speaker who utters (1b) somehow tries to first pick up and then introduce a referent. In principle, an explanation along these lines need not make any special assumptions about the semantics of conjunction. It is perfectly coherent to hold that the meaning of *and* is given by the standard truth table, and to maintain at the same time that conjoined sentences are processed from left to right, and that this order matters. But I prefer a different view: it is part of the meaning of *and* that a conjunction must be interpreted sequentially. So I fully agree with the intuitive picture that I have just outlined: when presented with a conjunction of the form 'S_1 and S_2', a hearer first processes S_1 and then S_2. But being a dynamic semanticist I hasten to add that this is not merely a reasonable way to handle conjoined sentences: it is what the meaning of *and* tells the hearer to do.[3]

BELINDA:

I must confess that this doesn't make much sense to me.

DIDO [*not heeding Belinda's remark*]:

Basically, this is what I mean when I claim that the semantics of natural language is dynamic; for as Groenendijk and Stokhof put it:

> A semantics is dynamic if and only if its notion of conjunction is dynamic, and hence non-commutative.[4]

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[2] This is the first of a whole series of anachronisms, which are inherent to the genre, of course.

[3] In some circles, the notion that conjunction is dynamic, as it is usually put, has attained the status of a veritable dogma. Dynamic semanticists may disagree amongst each other over the meaning of natural language negation, disjunction, conditionals, or quantification, but to the best of my knowledge, nobody has ever bothered to *argue* that conjunction is dynamic. It is a complete mystery to me why this notion has come to be so widely accepted with no resistance to speak of.

[4] Groenendijk and Stokhof (1989).

If you want to do some reading, the bibliography of dynamic semantics is already quite impressive (which, incidentally, testifies to the importance of the movement), but the main landmarks are Heim's file change semantics and Groenendijk and Stokhof's dynamic predicate logic and dynamic Montague grammar.[5] Note however that despite an unmistakable family resemblance, discourse representation theory (or DRT for short)[6] lies outside the dynamic semantics camp as Groenendijk and Stokhof and I see it.[7]

In order to elucidate the last point and prepare the grounds for a more detailed exposition of what it is that makes a semantics dynamic, let us consider the standard DRS language, rendered here in a slightly idiosyncratic notation.

Dido draws aside a velvet curtain, revealing a blackboard on which the following definition is written:

(2) *DRSs and DRS-conditions*
   a. If R is an n-place predicate, and $x_1, ..., x_n$ are reference markers, then

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[5] See Heim (1982), Groenendijk and Stokhof (1989, 1991), and Groenendijk and Stokhof (1990), respectively.

[6] Kamp (1981), Kamp and Reyle (1993).

[7] A peculiarity of dynamic semantics is that to many of its practitioners the notion of semantics has acquired a rather broader interpretation than it used to have (and still has) to many people. This is clear, for example, from Groenendijk and Stokhof's (1991: 94) remark that,

> Like most authors, we start from the assumption that co-reference and anaphora are, by and large semantic phenomena. ('By and large' in view of the fact that sometimes certain syntactic features are involved in pronoun resolution as well. A case in point is syntactic gender in languages like German and Dutch.)

Now although there is nothing remotely like a consensus about where the boundary between semantics and pragmatics should be drawn, it is doubtful that most authors would say that anaphora is by and large a semantic phenomenon; rather, they would agree that it is a pragmatic phenomenon (by and large). So the passage cited only makes sense on the assumption that Groenendijk and Stokhof have decided to give up on the traditional semantics/pragmatics borderline even in a case in which it is fairly clear cut. This isn't particularly helpful, because such terminological licence tends to engender confusion, and in this instance it certainly has. Be that as it may, the foregoing remarks are not to imply that Groenendijk and Stokhof are alone in using the term *semantics* rather loosely, or are the first ones to have done so. But their case is of special interest: Groenendijk and Stokhof's terminology is programmatic because their agenda is to treat as many pragmatic phenomena as possible with 'formal semantic' techniques (their attempts at applying the notion of compositionality at discourse level is an integral part of this project). In this sense, dynamic semantics is an engineering programme. Aeneas' main complaint will be that it is just that.

Rx_1 ... x_n is a DRS-condition.

b. If x and y are reference markers, then $x = y$ is a DRS-condition.

c. If   is a DRS, then ¬   is a DRS-condition.

d. If   and   are DRSs, then   and   are DRS-conditions.

e. A DRS   is pair ⟨U , Con ⟩, where U   is a set of reference markers and Con   is a set of DRS-conditions.

If U = {x_1, ..., x_n} and Con = { $_1$, ..., $_m$}, then   may be written as

[x_1, ..., x_n : $_1$, ..., $_m$].

DIDO:

Conspicuously absent from this language is any form of overt conjunction. Coordination with *and* is not explicitly represented at DRS level. Instead, sentences of the form 'S$_1$ and S$_2$' are handled by merging the DRSs correlated with S$_1$ and S$_2$. In Kamp and Reyle's version of DRT[8] this is done sequentially. Their construction rule for *and* is formulated in such a way that the first conjunct is processed before the second is, and thus the contrast illustrated by (1) is accounted for. But it is not inherent to DRT that conjunctions are treated like this. We wouldn't renounce an essential feature of the theory if we said (as Aeneas believes we must, by the way) that the construction rule for *and* merely entails that the component DRSs of a conjunction are to be merged. This would imply that neither the DRS language nor the DRS construction algorithm will account for any effects having to do with the order in which the members of a conjunction arise.[9] At any rate, whereas dynamic semantics is committed to the claim that conjunction is non-commutative, DRT is not thus committed, and therefore it is not a dynamic semantics as I, together with Groenendijk and Stokhof and many others, understand that term.

BELINDA [*slightly bored*]:

I see.

DIDO:

Although DRT isn't a dynamic theory, it can be turned into one by adding a conjunction operator to the DRS language, and giving it a dynamic interpretation. For instance, we can extend the syntax defined in (2) as follows:

(3) If   and   are DRSs, then   ;   is a DRS.

This is in fact what Krahmer and Muskens propose, and I shall now outline the semantics they have devised for the language defined by (2)+(3). In order to

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[8] Kamp's (1981) fragment doesn't include any form of conjunction.

[9] According to Aeneas, this is just as well, for, as we will see in a moment, he believes that such ordering effects have nothing to do with conjunction per se. These effects are much more general (they also occur between the members of a disjunction, for example, and even within clauses), and therefore Aeneas argues that they are better explained at another level.

emphasize the fact that their interpretation turns a non-dynamic semantics into a dynamic one, I will not call this language 'DRT', as Krahmer and Muskens do, but refer to it as 'KM$_1$' instead ('KM$_2$' is the name I will give to variation on KM$_1$ which is due to the same authors, and which I will present later on).

Traditionally, the semantics of the DRS language is specified by stating the conditions under which an embedding function can be extended to one that verifies a given DRS in a standard first-order model. Given a specification along these lines, we may say that, relative to a given model M, each DRS denotes the set of pairs ⟨f, g⟩, where f and g are embedding functions, g extends f, and g verifies in M; that is to say, DRSs are construed as relations between embedding functions. This is how Krahmer and Muskens define the semantics of KM$_1$. Within such a relational framework there are various ways of interpreting conjoined DRSs. One way, the old-fashioned one, would be to say that the meaning of ; is just the meaning of the merge of and , DRS merging being defined as follows:

(4) *DRS-merge*

If and are DRSs, then = U U , Con Con

Another way is to construe conjunction in terms of relational composition. This is the dynamic interpretation of *and* that is favoured by dynamic semanticists in general, and myself in particular:

(5) *Semantics of* KM$_1$

     a. $\|\mathbf{R}\,x_1, ..., x_n\| = \{f : f(x_1), ..., f(x_n)$ are defined & ⟨$f(x_1), ..., f(x_1)$⟩ I(R)$\}$

     b. $\|x = y\| = \{f : f(x)$ and $f(y)$ are defined & $f(x) = f(y)\}$

     c. $\|\neg\ \| = \{f : \neg\ g$ such that ⟨f, g⟩ $\|\ \|\}$

     d. $\|\quad\ \| = \{f : g$ such that ⟨f, g⟩ $\|\ \|$ or ⟨f, g⟩ $\|\ \|\}$

     e. $\|\quad\ \| = \{f : g,$ if ⟨f, g⟩ $\|\ \|,$ h such that ⟨g, h⟩ $\|\ \|\}$

     f. $\|\ ;\ \| = \{⟨f, g⟩ : h$ such that ⟨f, h⟩ $\|\ \|$ & ⟨h, g⟩ $\|\ \|\}$

     g. $\|[x_1, ..., x_n : {}_1, ..., {}_m]\| = \{⟨f, g⟩ : f\ g$ & $\mathrm{dom}(g) = \mathrm{dom}(f)$ $\{x_1, ..., x_n\}$ & $g\ \|{}_1\|\ \cdots\ \|{}_m\|\}$

There is an important difference between conditions and DRSs. The latter are, one might say, 'externally dynamic', in the sense that they may be construed as operations on embedding functions.[10] Conditions are mere tests: when given any embedding function they just accept or reject it; such tests are 'externally static'.

Conjunctions are not only externally dynamic; they are internally dynamic as well, because, in order to establish that ⟨f, g⟩ $\|\ ;\ \|$, an embedding function h must be found such that ⟨f, h⟩ $\|\ \|$ and ⟨h, g⟩ $\|\ \|$. As a consequence, in the DRS [x: tomato x] ; [: red x], for example, the occurrence of x in the second conjunct is bound in the first. The meaning of the KM$_1$ conditional is internally dynamic,

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[10] The terminology is Groenendijk and Stokhof's (1991).

too, although it is externally static. Disjunctions, however, are static internally as well as externally. As in orthodox DRT, the antecedent of a conditional is accessible to the consequent, whereas the members of a disjunction are not accessible to one another. In KM_2, as we will see later on, alternative interpretations of negation and disjunction are adopted, which to some extent make the former externally dynamic and the latter internally dynamic.

Due to the dynamic properties of KM_1, we can represent (1a) as follows:

(6)   [x: man x, walk in the garden x] ; [: whistle x]

This is equivalent to:

(7)   [x: man x, walk in the garden x, whistle x]

More generally,   ;   will be equivalent to   provided none of the reference markers in   occur free in any of the conditions in   .[11]

BELINDA:

Sorry to interrupt you, but I'm afraid I have missed something. What is the *point* of defining ';' dynamically if it turns out that, practically speaking, there isn't much of a difference between   ;   and   ?

DIDO:

Don't you see? (6) is a *compositional* rendering of (1a), whereas a representation in terms of ' ' would be non-compositional, because the meaning of   is not determined by the meanings of its parts. And since compositionality is a Very Nice Property indeed, (6) is Vastly Superior to the DRT account.

BELINDA:

Well, I admit that the standard definition of ' ' is not a compositional one, but that doesn't prove that a strictly compositional definition is impossible, does it? In fact, I don't think it should be terribly hard to devise such a definition.[12] If it weren't for this excruciating headache of mine I bet it would take me less than ten minutes.

DIDO:

Well, yes ... I mean, no, it *must* have something to do with compositionality. Everybody says it has. I'm afraid I don't have a sufficiently firm grasp of the dynamic concept of compositionality to be able to answer your question right now. I will look it up for you.[13] But compositionality isn't the only thing. A

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[11]   This is Krahmer and Muskens' (1995: 367-368) 'merging lemma'.

[12]   It isn't. See Zeevat (1989), for example.

[13]   It is doubtful that Dido will find enlightenment in the palace library. Dido's principal source in this as in other matters is Groenendijk and Stokhof's 1991 paper, but even after having spelled out that paper three or four times, she is still confused about what dynamic semanticists mean when they appeal to compositionality, as they so often do (and she is not alone in her bewilderment: Kamp (1990: 13), for example, confesses that he experiences the same difficulty). On the one hand, it is fairly obvious from the way they wield the notion that, when they demand that a semantic

further argument in favour of dynamic ';' is that it accounts for the contrast between (1a) and (1b). For in the KM_1 translation of the latter, i.e.,

(8)   [: whistle x] ; [x: man x, walk in the garden x]

the first occurrence of x is free, and therefore (1b) does not receive a proper interpretation,[14] which is as it should be. Whereas if we construe *and* as ' ' we predict that (1a) and (1b) are equally intelligible, and even have the same meaning.

Aeneas enters with his train.

BELINDA:
   See, your Royal Guest appears;
   How godlike is the form he bears!
AENEAS:
   When, Royal Fair, shall I be bless'd
   With cares of love and state distress'd?
DIDO [*ignoring the question*]:
   Hullo Aeneas dear. We were just chatting about dynamic semantics. I understand that you and I don't see eye to eye on this?
AENEAS:
   Well, let me think. Yes. The main problem, as I see it, is that dynamic *semantics* is an admittedly elegant but nonetheless misguided implementation of an essentially *pragmatic* principle. I concede that it is an obvious and even important truth that utterances are processed incrementally: word by word, phrase by phrase, clause by clause, sentence by sentence. Presumably, this

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theory be 'compositional', Groenendijk and Stokhof have a specific model in mind, viz. Montague's. On the other hand, Groenendijk and Stokhof maintain that compositionality is a 'methodological principle' (1991: 93) that can be called upon to arbitrate between theories that are otherwise equivalent in all relevant respects (empirical coverage, ontological parsimony, and so on). Putting these two strands together, one would appear to arrive at the uncomfortable position that there is a methodological principle urging semanticists to adhere as much as possible to Montague grammar — which makes about as much sense as the claim that, as a matter of methodological principle, psychological theories should deviate as little as possible from the hard-nosed canons of behaviourism. This is unlikely to be Groenendijk and Stokhof's view, but then it is difficult to tell what exactly their position amounts to. Anyway, apart from these exegetical quandaries it is clear that even on the strictest construal of the compositionality principle, DRT need not be any less compositional than dynamic semantics.

[14]   Not uncharacteristically, Dido appears to be somewhat confused here. In this particular version of dynamic semantics (eg20b) does get an interpretation on which the pronoun in the first conjunct is bound by the indefinite in the second. However, Dido's claim holds true of certain other dynamic systems.

processing strategy is forced upon us by our psycho-biological constitution. More likely than not, it is only thus that we could ever cope with the inexorable stream of verbal input that comes our way. The central tenet of dynamic semantics is that, to some extent at least, this processing strategy is encoded in the lexical entries of certain words, and especially in the lexical meaning of *and*. Thus formulated, it will be plain that the very notion of a dynamic semantics is wildly implausible. For what could ever be the rationale for such an encoding? One might just as well hold that there is an English word which, as part of its lexical meaning, represents the principle that one should not interrupt a speaker who is telling a good joke, or that the use of a hearing aid may improve the quality of speech perception.

Consider poor Entellus, who, due to an unfortunate accident at the beginning of his boxing career, processes utterances from right to left. Must we conclude from this that it is impossible for him to understand the meaning of *and*, or that, if he does understand it, what he does is inconsistent with his semantic knowledge? I fail to see that we are forced to conclude anything of the sort. But then the meaning of *and* cannot be dynamic in the way dynamic semantics makes it out to be.

You claim that the lexical meaning of *and* is dynamic. What about German *und*, French *et*, or Finnish *ulkomaalainen*? Are they dynamic, too?

DIDO:

Of course they are.

AENEAS:

So you're claiming that in all languages of the world the lexical meaning of conjunction consists of a truth-conditional and a dynamic part.[15] Is that a coincidence, or what? Could there have been a language whose conjunction has the same truth table as *and* but without being dynamic, or whose dynamics is different from that of *and* — right-to-left instead of left-to-right, perhaps? It seems to me that such questions hardly make any sense at all. But then, again, the lexical meaning of *and* cannot be dynamic.

Or consider a young child learning the meaning of *and*. Are we to suppose that he learns the meaning of *and* in two steps? The truth-conditional part first, perhaps, and the dynamic part afterwards — or would it be the other way round? Would it be possible for a child to get the truth-conditional import of *and* right but founder on its dynamic aspects? Clearly, such considerations are absurd: the lexical meaning of *and* isn't dynamic.

BELINDA:

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15   It is not crucial to the following argument that the meaning of dynamic conjunction is factorized along these lines. The only thing that matters is that   ;   and   ;   are so close together in logical space that whenever one is considered as a candidate for the interpretation of *and*, the other must count as a rival hypothesis.

I believe I see your point. But isn't this yet another skirmish over where the boundary between semantics and pragmatics must be drawn?

DIDO:

That is exactly what I keep telling him, but he just won't listen. True, it is an essential part of my position that a certain amount of pragmatics is encoded in the lexicon. But there is nothing wrong with that. For after all, it can hardly be denied that there are all sorts of pragmatic information that must be lexically encoded. I am perfectly willing, though, to relabel my position, and refrain from calling mine a 'semantic' analysis. As far as I can see, that will settle the issue.

AENEAS:

It will not, because my concern is not, or not only, with the semantics/pragmatics distinction. Rather, I am concerned with what is in the lexicon and what is not. It is not just that if Dido has her way, the lexical meaning of *and* is more complicated than one would have expected, but that the lexical entry of *and* is involved in the implementation of a processing principle which evidently has no business in the lexicon *at all*.

Frankly, I confess that I'm at a loss to see what kind of theory of meaning dynamic semantics can reasonably be taken to be. For, as I have just argued, it is blatantly evident that the received view among its practitioners of what dynamic semantics *is* is just wrong. But having dispensed with that view, what remains is a family of logics seeking to justify their existence — and it is completely unclear to me how one might help them to attain that goal.

Act II

Scene 2: The grove. Enter Aeneas, Dido, Belinda, and train.

BELINDA:

Part of Aeneas' objection against dynamic semantics seems to be that it deals with certain pragmatic phenomena by fiddling with the semantics of the connectives, in particular that of *and*.

DIDO:

Well, in a way that is true. But I don't really see what is wrong with this research strategy. In fact, I only see advantages. Let me give another example.[16] As in all varieties of dynamic semantics, certain laws of classical logic do not hold in KM_1. In particular, the law of double negation breaks down in KM_1: prefixing a DRS

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[16]   In the following, Dido borrows rather freely from Krahmer and Muskens' (1995) discussion of dynamic negation and disjunction. See Groenendijk and Stokhof (1990) and Dekker (1993) for analyses that are very much akin in spirit.

with a negation sign doesn't even result in a new DRS, but yields a DRS-condition instead; and while in classical logic (9) is valid,

(9)   ¬

an analogous equivalence does not obtain in KM_1. This would be just as well if it weren't for the fact that there are certain anaphoric phenomena that require these equivalences to hold. The following are cases in point:

(10) It's not true that this palace doesn't have a bathroom. It's on the second floor.

(11) Either there is no bathroom in this palace or it is in a funny place.

BELINDA:

Funny examples, too.

DIDO:

In KM_1, the pronoun *it* in the second sentence of (10) cannot have *a bathroom* as its antecedent, because negated sentences are tests: an antecedent introduced within the scope of a negation cannot be picked up from outside. This prediction surely holds for simple cases, but data like (10) suggest that double negation should make a DRS accessible again, to speak in DRT terms. If the law of double negation were to hold in a dynamic system like KM_1, we would have an immediate explanation for the well-formedness of (10). Similar considerations apply to (11). In KM_1, a pronoun on one side of *or* cannot have its antecedent on the other side, because disjunctions are internally static. Again, in general this is correct, but (11) would appear to be an exception to the rule. However, if the law of double negation and the analogue of (9) were to hold in a KM_1-type system, we would have an explanation for cases like (11), too. Krahmer and Muskens' KM_2 is designed to meet these two requirements.[17]

The language of KM_2 differs from that of KM_1 only in that (2c) is replaced with:

(12) If   is a DRS, then ¬ is a DRS.

In KM_1, the negation sign combines with a DRS to form a DRS-condition; in KM_2, a negated DRS is a DRS. In all other respects, the syntax of KM_2 is the same as that of KM_1. In KM_2, (10) and (11) can be represented as (13) and (14), respectively:

(13) ¬¬[x: bathroom x, x is in this palace] ; [: x is on the second floor]

(14) ¬¬[x: bathroom x, x is in this palace]   [: x is in a funny place]

(Note however that (13) is a DRS and (14) a DRS-condition.) It still remains to be seen how the occurrences of x on the right-hand sides of (13) and (14) can be

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bound on the left. We can solve this problem by adopting a technique from partial logic, and associating with each DRS a positive as well as a negative extension. DRS-conditions only have a single extension, as before, but the definition of ' ' is modified so that, roughly speaking, the negation of the first disjunct becomes 'part of' the meaning of the second:

(15) *Semantics of* $\mathbf{KM_2}$

    a. $\|\mathbf{R}\,x_1, ..., x_n\| = \{f : f(x_1), ..., f(x_n) \text{ are defined } \& \ \langle f(x_1), ..., f(x_1)\rangle \in I(\mathbf{R})\}$

    b. $\|x = y\| = \{f : f(x) \text{ and } f(y) \text{ are defined } \& \ f(x) = f(y)\}$

    c. $\|\ \Rightarrow\ \| = \{f : \ g, \text{ if } \langle f, g\rangle \in \|\ \|\ulcorner, \ h \text{ such that } \langle g, h\rangle \in \|\ \|^+\}$

    d. $\|\ \Rightarrow\ \| = \{f : \ g, \text{ if } \langle f, g\rangle \in \|\ \|^+, \ h \text{ such that } \langle g, h\rangle \in \|\ \|^+\}$

    e. $\|\ ;\ \|^+ = \{\langle f, g\rangle : \ h \text{ such that } \langle f, h\rangle \in \|\ \|^+ \ \& \ \langle h, g\rangle \in \|\ \|^+\}$
        $\|\ ;\ \|\ulcorner = \{\langle f, f\rangle : \neg\ g, h \text{ that } \langle f, h\rangle \in \|\ \|^+ \ \& \ \langle h, g\rangle \in \|\ \|^+\}$

    f. $\|\neg\ \|^+ = \|\ \|\ulcorner$
       $\|\neg\ \|\ulcorner = \|\ \|^+$

    g. $\|[x_1, ..., x_n : \ _1, ..., \ _m]\|^+ = \{\langle f, g\rangle : f \subseteq g \ \& \ \text{dom}(g) = \text{dom}(f) \cup \{x_1, ..., x_n\} \ \& \ g$
       $\in \|\ _1\| \cap ... \cap \|\ _m\|\}$
       $\|[x_1, ..., x_n : \ _1, ..., \ _m]\|\ulcorner = \{\langle f, f\rangle : \neg\ g \text{ such that } f \subseteq g \ \& \ \text{dom}(g) = \text{dom}(f)$
       $\cup \{x_1, ..., x_n\} \ \& \ g \in \|\ _1\| \cap ... \cap \|\ _m\|\}$

It is easily seen that in this system, $\neg\neg$ is equivalent with , and $\neg$ and are now equivalent, too,[18] and so $\mathbf{KM_2}$ explains the data in (10)-(11) in a very neat way.

AENEAS [*impatiently*]:

It is neat, but it doesn't explain anything.

DIDO:

I beg your pardon?

AENEAS [*anxious to change the subject because he wants to show off with his hunting trophy*]:

Behold upon my bending spear
A monster's head stands bleeding,
With tushes far exceeding
Those did Venus' huntsman tear.

DIDO:

Oh, come on, Aenie dear! Tell us what is wrong with my beautiful theory.

AENEAS:[19]

All right, all right. To start with, your treatment of double negation covers only a fraction of what is in fact a much more general phenomenon. To illustrate, consider:

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[18] That is to say, $\|\neg\neg\ \|^+ = \|\ \|^+$, $\|\neg\neg\ \|\ulcorner = \|\ \|\ulcorner$, and $\|\neg\ \ \| = \|\ \ \|$, in all models.

[19] Some of the critical points that Aeneas will muster in the following are duly registered, though not answered, in the footnotes to Krahmer and Muskens' paper.

(16) It's ludicrous to pretend that this palace doesn't have a bathroom. You
      showed it to me, remember?

Here anaphora is possible, and this example is obviously of the same making as
(10). However, since KM$_2$ is designed to account for the double-negation cases
only, you don't have an explanation for examples like (16).

   Intuitively speaking, it is clear at least in outline how such cases should be
analysed. If someone utters the first sentence of (16), then the hearer may *infer*
that according to the speaker the palace has a bathroom. So the anaphor in the
second sentence is accounted for on the assumption that, under certain
circumstances, such inferences may give rise to new reference markers that can
be picked up by subsequent anaphoric pronouns. Although I readily admit that it
is by no means clear what the details of such an analysis will look like, it is
obvious that an approach along these lines is called for. But if an inference-based
explanation must be adopted for cases like (16) anyway, then why should one
resort to a quite different line of attack in the double-negation cases? They are just
instances of inference-based anaphora, and so there is no need to deploy any
special-purpose machinery. On the contrary, any theory that does so immediately
disqualifies itself on methodological grounds.

BELINDA:
One cannot help feeling that his point is well taken.

AENEAS:
And it is not restricted to examples like (16). Here is another pair of problematic
cases:[20]

(17) a. Hector remembered to bring a cloak. He left it in the hallway.
      b. Hector didn't forget to bring a cloak. He left it in the hallway.

Your dynamic theory doesn't say anything about (17a): there is no connective in
sight that could be proclaimed 'dynamic', and so it fails to explain why anaphora
is possible in this case. (17b) makes things even worse. Even if you are prepared to
adopt a decompositional analysis on which 'forget' = 'not remember',[21] KM$_2$ just
predicts that (17b) is the same as (17a), but this doesn't solve the problem. So in
both cases the inference-based account must be resorted to.

   And this is not the end of it. Consider the following contrast:

(18) It is not true that there wasn't a single guest at Penelope's party.
      a. ?But he was out on the terrace.
      b. But they were all out on the terrace.

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[20]   Krahmer and Muskens cite a similar pair in a footnote (1995: 374-375, n. 21). They attribute the
crucial observation to an anonymous referee for the *Journal of Semantics*.

[21]   As Krahmer and Muskens (*ibid.*) suggest.

An inference-based theory can readily explain this difference: on the basis of world knowledge about parties it may be inferred from the first part of (18) that there was more than one guest at Penelope's party, and therefore a plural pronoun is called for. In KM$_2$, however, the logic eliminates the double negation, thus predicting that the first sentence of (18) is equivalent to — well, equivalent to what? To 'There was a single guest at Penelope's party,' perhaps? But then (18b) should be awkward, not (18a). At any rate, not only is it otiose to 'make negation dynamic'; it actually creates problems instead of solving them.[22]

It will be obvious that what I have said about double negation carries over to the bathroom disjunctions, but these cause additional problems, to boot. Consider the following contrast:

(19) a. Either there is no bathroom in this palace or it is in a funny place. (=(11))
    b. Either it is in a funny place or there is no bathroom in this palace.

(19a), in which the pronoun follows its antecedent, is a fairly normal sentence. By contrast, (19b), in which the order is reversed, is decidedly marked. Let us grant for argument's sake that the KM$_2$ account of negation is on the right track. Then an interpretation of ' ' along the lines of (15c) accounts for (19a). But it rules out (19b). This seems too drastic, however. Although (19b) is marked, it is perfectly intelligible, and just the kind of the thing that someone might say under certain circumstances.

DIDO:

Oh, but that's no problem. Just replace (15c) with:[23]

(20) $\| \quad \| = \{f : (\quad g, \text{ if } f, g \quad \| \|^\Gamma, \quad h \text{ such that } g, h \quad \| \|^+) \& (\quad g, \text{ if } f, g \quad \| \|^\Gamma, h \text{ such that } g, h \quad \| \|^+)\}$

This makes disjunctions commutative again, so that now anaphoric links can run in both directions.

AENEAS:

Right, but how do you explain the fact that (19b) is marked and (19a) is not?

DIDO:

Well, that's a *pragmatic* fact, and therefore must be accounted for by a *pragmatic* theory!

AENEAS:

So you maintain that ordering effects in conjunctions are due to the semantic interpretation of *and*, while ordering effects in disjunctions are of a pragmatic nature. A curious position.

DIDO:

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[22] Krahmer and Muskens remark, apropos of an analogous example, that the difference is due to a 'uniqueness effect' (1995: 359). They don't bother to spell out what this means in their framework.

[23] Krahmer and Muskens (1995: 371) consider this possibility, but come down in favour of the non-commutative variant.

Okay, okay. I hereby withdraw (20), so now disjunction is non-commutative again, and the contrast between (19a) and (19b) is accounted for. And now you were going to ask why (19b) is possible, if only marginally?

AENEAS:

I was.

DIDO:

Well now, *that*'s a pragmatic fact, and therefore none of *my* business. But:
The skies are clouded, hark! how thunder
Rends the mountain oaks asunder.

BELINDA [*repeated by Chorus*]:

Haste, haste to town, this open field
No shelter from the storm can yield.
[*Exeunt Dido and Belinda and train.*]

Act III

Scene 2: The palace. Dido, Belinda, and train. Enter Aeneas.

BELINDA:

See Madam, see where the Prince appears;
Such sorrow in his look he bears,
As would convince you still he's true.

AENEAS:

What shall lost Aeneas do?
How, Royal Fair, shall I impart
The God's decree, and tell you we must part?

DIDO:

Thus on the fatal banks of the Nile,
Weeps the deceitful crocodile;
Thus hypocrites, that murder act,
Make Heav'n and Gods the authors of the fact.
    But before you bid me farewell, I should like to hear a bit more about that kataphora argument you referred to the other day.

AENEAS:

With pleasure. In general, anaphors are preceded by their antecedents (which is why anaphors and antecedents are so called). But occasionally an anaphor will precede its antecedent;[24] such cases are sometimes referred to as instances of

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[24]   Etymologically speaking, this is a contradiction in terms, but apparently Aeneas finds this terminological abuse too convenient to forgo. In the following Aeneas is indebted to van Deemter's (1990) discussion of kataphora.

'kataphora'. I find this usage convenient, but it may be misleading because it may be taken to imply that anaphora and kataphora are distinct phenomena, and that, therefore, a theory of anaphora need not be concerned with the problem of forward reference. Although I accept that there are differences between anaphora and kataphora, I reject such implications, and intend to use the term 'kataphora' in a purely descriptive way.

The following examples illustrate the phenomenon:[25]

(21) a. Yes, the doctor warned him, but Achilles kept on.
     b. He looks at me and Hector goes out of his mind.
     c. He lied to me, and Hector was my friend!
     d. I don't know what he has on him, but it seems that Ascanius is blackmailing the mathematics teacher.

In each of these examples one or two pronouns in the first conjunct refer forward to an antecedent in the second conjunct. Intuitively, such sentences are most likely to be uttered in a context in which the intended antecedents of these pronouns have already been introduced, but there are at least two ways of showing that such anaphors cannot always be construed as referring backward. First, consider the following discourse:[26]

(22) Antheus and Hector were arguing when I came in. Well, I am standing by the door and then *he* looks at me and {he/Hector} goes out of his mind.

Apparently, the italicized occurrence of *he* is at least dependent on the second occurrence of *Hector*, for if we replace the latter with a pronoun, it becomes unclear whom the first *he* is intended to refer to. This should suffice to discredit the simple-minded view that kataphora is just backward referring anaphora in disguise. The same point is brought home more forcefully by the observation that forward referring pronouns may have indefinite antecedents, as the following examples show:

(23) a. I don't know what he_i has on $them_j$, but it seems that [one of the pupils]$_i$ is blackmailing [some of the teachers]$_j$.
     b. I don't know what $they_i$ have on $them_j$, but it seems that [most of the pupils]$_i$ are blackmailing [at least one or two of the teachers]$_j$.

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[25] (21a-c) are inspired by Bolinger's (1977) paper, which offers many more examples. Aeneas takes it for granted that the dynamic account of *and* also applies to certain other connectives that are traditionally viewed as 'implying' *and*, such as *but* and *because*. This assumption seems reasonable. True, it is not necessary to accept this, but since these connectives are so obviously similar to *and* in all relevant respects, the possibility that *but*, for example, diverges from *and* in this point can be safely ignored.

[26] Van Deemter (1990: 283) discusses a similar case.

In (23a), *he* and *them* **refer forward to** *one of the pupils* **and** *some of the teachers*, respectively. These indefinites are most likely to be construed specifically, but as (23b) demonstrates, this is not a prerequisite for kataphora: in this example it is hard if not impossible to give *at least one or two of the teachers* a specific construal, but nonetheless it is the intended antecedent of the preceding pronoun *them*.

The existence of kataphora is at odds with the dynamic semantics account of anaphoric reference in conjunctions, and in particular cases like (23a, b) are counterexamples against the dynamic standard theory, as exemplified by $KM_{1/2}$. The question therefore is if and how your dynamic theory can be amended so as to account for these data.

DIDO:

Oh, come off it. Kataphora is such a marginal phenomenon. I don't see why I should bother.

AENEAS:

Against this I maintain that more often than not it is marginal phenomena that prove to be crucial to scientific progress. For example, physicists set up elaborate machinery with the explicit purpose of provoking 'marginal' phenomena to occur, which would never happen under ordinary circumstances. Closer to home, donkey sentences are marginal facts if anything is, and yet it is indisputable that they have contributed a great deal to recent developments in pragmatics (or semantics, as you would say).

DIDO:

Kataphora isn't a semantic phenomenon as I understand it; it is a *pragmatic* phenomenon.

AENEAS:

But what *is* a semantic phenomenon on your understanding? If you take this line you must be able to specify in a non-circular way what is and what is not part of the semantic domain. Of course, I don't expect you to give me a formally explicit demarcation criterion. But it is not unreasonable to demand from any scientific theory that it be able to provide at least a rough and ready characterization of its empirical domain, without resorting to slogans to the effect that 'Semantics (or conchology or feminist theology or whatever) is what we do.' Although, as far as I know, it has never been put this way, dynamic semantics is based upon the premiss that *some* of the facts that used to be relegated to the pragmatics department are more properly viewed as being of a semantic nature. But to the best of my knowledge, nobody has ever bothered to explain what kind of erstwhile pragmatic facts are involved in this terminological reshuffle and what is left behind for a pragmatic theory to explain. I seem to recall that I made this point before, but just in case I haven't: dynamic semantics isn't a semantic *theory* — it's a bunch of logics whose link with the empirical is tenuous at best.

DIDO:

Oh, let's forget about that, shall we? Here's my theory of kataphora. In the examples you cited conjunction is interpreted from right to left, instead of left to right. In $KM_{1/2}$ terms, this is to say that conjunction is interpreted as follows:[27]

(24) $\| \phi ; \psi \| = \{ \langle f, g \rangle : \exists h \text{ such that } \langle f, h \rangle \in \| \psi \| \ \& \ \langle h, g \rangle \in \| \phi \| \}$

Truth-conditionally speaking this is equivalent to the standard definition, it is just that the processing order is reversed.

AENEAS:

I see at least two problems with this solution. First, having argued at some length that it is hard to accept that conjunction is dynamic, I don't see that this difficulty is alleviated by the further claim that it is dynamically ambiguous, so to speak. Furthermore, it will clearly not do to postulate that conjunction is ambiguous, because normally speaking forward reference across *and* is not possible, as we have seen with the following (=(1)):

(25)   a.   A man walks in the garden and he whistles.
       b.   He whistles and a man walks in the garden.

So apart from the fact that the lexical entry of *and* would have to explicitly allow for a conjunction to be processed either from left to right or from right to left, it would also have to specify that the former option is generally preferred to the latter. The same objection now applies with a vengeance: there is no reason whatsoever to suppose that this patently pragmatic information is lexically encoded. And not only is this supposition unfounded, it results in a clumsy and roundabout account of the facts. For it is much simpler, obviously, to state once and for all that utterances are processed from left to right than to encode such a principle into individual lexical entries.

A further problem with your proposed account of kataphora is that examples can be constructed in which anaphoric dependencies run in opposite directions. The following are cases in point:

(26)   a.   Achilles worked on it$_i$ [for over a year]$_j$, and then$_j$ he emerged from his workshop with [one of the most beautiful ukuleles the world has ever seen]$_i$.
       b.   It still is a mystery how she managed to smuggle them$_i$ into [her palace]$_j$ without being noticed, and yet it is now established beyond any reasonable doubt that Penelope has been keeping [two hundred Nubian slaves]$_i$ there$_j$ for more than a decade.

In (26a), the pronoun in the first conjunct refers forward to the indefinite NP in the second, while at the same time *then* in the second conjunct refers backward

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[27]   An analogous DPL definition of ';' is considered (and rejected) by van Deemter, too, and the same holds for the second alternative given in (27) below (van Deemter 1990:296-297).

to the temporal adverbial in the first; and the same holds, mutatis mutandis, for the pronouns *them* and *there* in (26b).

DIDO:

Oh, but the dynamic meaning of *and* may allow binding in both directions, if we define it as follows:

(27) $\| \; \| = \{ \langle f, g \rangle : \exists h$ such that either $\langle f, h \rangle \in \| \| \ \& \ \langle h, g \rangle \in \| \|$ or $\langle f, h \rangle \in \| \| \ \& \ \langle h, g \rangle \in \| \|\}$

AENEAS:

No, this will not do, because it still doesn't allow for bidirectional anaphora within one and the same conjunction; it only allows for anaphoric links to run in one direction *or* the other. Incidentally, (27) would make conjunction commutative again; but didn't you equate dynamic semantics with the position that conjunction is non-commutative?

DIDO [*impatiently*]:

It is all a matter of scope then: whenever a pronoun is used kataphorically, its antecedent is construed as taking scope over the clause in which the pronoun occurs.[28] Thus in (23b), for example, *most of the pupils* and *at least one or two of the teachers* are construed as having widest and second-widest scope, respectively.

AENEAS [*imperturbable*]:

Technically speaking, this is the least problematic of all the various treatments of kataphora we have considered so far. There are several methods for dealing with scope, and in principle any of these might be pressed into service to deal with kataphora. But apart from its technical feasibility this approach has little to recommend it.

First, it is at odds with the widely accepted notion that there are non-trivial restrictions on scope taking: if we accept that (23b), for example, must be analysed in terms of scope, then apparently we are forced to conclude that, with respect to scope taking, practically anything goes — which is just wrong.

Secondly, the scope analysis goes against the spirit of dynamic semantics. To say that natural language conjunction is dynamic is to say that it is processed from left to right, i.e., that the second conjunct is processed in the context of the first. But, evidently, if an NP in the second conjunct is allowed to outscope the first, then the first conjunct is interpreted in the context of (part of) the second.

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[28] Dekker (1993: 107-108) adopts this approach for examples like the following:

If he is in danger, every man prays to God.

If he isn't insane, no man beats a donkey.

Although he does not (and need not) argue the point here, Aeneas believes that an analysis in terms of scope is appropriate for cases like these, although, as he will try to show, it should not be extended to kataphora across *and*, *but*, or (other) sentence boundaries.

Even if this is unproblematic from a logical point of view, it is hard to fathom what the explanatory merit of such an account might be.

Thirdly, if you decide to advocate a scope analysis of kataphora, you will be pulling the rug from under your own theory. For if we can account for kataphora along these lines, then surely we can treat *all* sorts of anaphora in conjoined sentences in terms of scope, without having to assume that conjunction is dynamic. In fact, a static theory of scope can handle practically anything a dynamic semantics can account for.[29] But then there is no point in maintaining that the semantics of natural language is a dynamic one.

BELINDA [*haughtily*]:

What, then, is the right account of kataphora?

AENEAS [*smiling serenely*]:

Naturally, it is a pragmatic account. To begin with, we must rid ourselves of the presumption that pronouns always require an antecedent.[30] As the following examples illustrate, there are occurrences of pronouns that lack an antecedent altogether:

(28) a. In Carthage, they work pretty hard.
    b. In Italy, they only perform Italian operas.
    c. They don't make them like that anymore.

In none of these examples does *they* have an explicit antecedent, and intuitively speaking it isn't bound at all. As a rule, pronouns prefer to be bound, but this is a preference only; it is not an absolute requirement. It may be the case that this preference is wired into the lexical entry of pronominals, but this is not necessary. For, given that pronouns are definite and that their descriptive content is poor, it is to be expected that they will generally require an antecedent in order to be interpretable. Be that as it may, the examples in (28) lend some plausibility to the idea that pronouns do not require an explicit antecedent under all circumstances.

Even if a pronoun 'expects' an antecedent with which to link up to, there is no reason to assume that the lexical entry of a pronoun specifies that an antecedent must be available at the moment the pronoun occurs, nor need there be a rule that requires that pronouns prefer to follow their antecedents. For, again, it may well be that such a preference derives from the fact that, on the one hand, pronouns are dependent upon the context for their interpretation, while, on the other hand, utterances are processed incrementally. The combination of these

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[29]   This is shown by Dekker (1991: Chapter 3). To remain on the safe side, Aeneas says 'practically anything' because Dekker maintains that there are certain phenomena that must be treated by construing negation as a dynamic operator, and such phenomena cannot always be accounted for in terms of scope. Since it is doubtful, however, that there is any need for a dynamic construal of negation in the first place, as we have seen, this subtlety can safely be ignored.

[30]   Apparently, Aeneas intends to leave out of consideration the possibility of interpreting pronouns deictically.

two factors implies that a pronoun is preferably employed to refer backward, but doesn't exclude forward reference. Thus the marginal status of kataphora is due to the descriptive poverty of pronominals, on the one hand, and a completely general processing principle, on the other. It has nothing to do with the meanings of such connectives as are involved, or with the scope of the antecedent expression. It will be obvious that this view of anaphora is most naturally implemented in DRT.

DIDO:

But I don't see that this is incompatible with my theory.

AENEAS:

Whether or not this view is compatible with dynamic semantics is another matter, I agree. Here we must distinguish between the engineer's and the theorist's point of view. (A considerable part of the work that has been done within the dynamic semantics framework has concentrated on engineering problems.) From an engineering point of view, there is no reason to doubt that the view of anaphora that I advocate can be implemented in, for example, dynamic Montague grammar[31] or in Muskens' version of dynamic semantics.[32] Being based on more (Muskens) or less (Groenendijk and Stokhof) standard type theories, these frameworks should be able to incorporate *any* view of anaphora that is sufficiently explicit. However, seen from the linguistic theorist's point of view, it is to be feared that little will be gained by such an undertaking other than an increase in complexity.

At any rate, my point is not that there is no way dynamic semantics could ever cope with kataphora, technically speaking. Rather, the point I want to make is that there is a severe tension (to put it mildly) at the conceptual level between the dynamic view of conjunction and the existence of kataphora. If I am right, kataphora contravenes a processing strategy that hearers adopt most of the time. That's the way it is, for processing strategies are just that: strategies. They cannot be expected to be fail-safe. If you were right, however, kataphora would be at odds with the lexical meaning of *and* — which is a different thing altogether. This brings us back to what I said already in Act I: dynamic semantics is an elegant but misguided implementation of a principle that is unquestionably of a pragmatic nature.

At first, dynamic semantics seems to offer a neat explanation of certain linguistic facts by way of relatively minor extensions of the lexical entries of connectives and quantifiers. Then you realize that these little bits of extra information do not belong in the lexicon. Furthermore, apart from the fact that there is no place for them, there is no need for them either. Dynamic semantics is not just wrong: it is a nonstarter.

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[31]   Groenendijk and Stokhof (1990), Dekker (1993).

[32]   Muskens (1990, 1996).

DIDO [*resigning*]:
   To Death I'll fly
   If longer you delay;
   Away, away! ...
AENEAS [*retreating*]:
   For your sensual charms I may yearn,
   But not for your mind's dynamic turn.
   [*Exit Aeneas.*]
CHORUS:
   Great minds against themselves conspire,
   And shun the cure they most desire.
   [*Etcetera.*]

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