In: Matthias Weisgerber (ed.) 2003: *Proceedings of the Conference "sub7 – Sinn und Bedeutung". Arbeitspapier Nr. 114, FB Sprachwissenschaft, Universität Konstanz, Germany.* `http://ling.uni-konstanz.de/pages/conferences/sub7/`

FREE CHOICE IN MODAL CONTEXTS*

Maria Aloni,
University of Amsterdam

aloni@hum.uva.nl

Abstract

This article proposes a new analysis of modal expressions which (i) explains the difference between necessity and possibility modals with respect to the licensing of Free Choice *any* and (ii) accounts for the related phenomena of Free Choice *disjunction* in permissions and other possibility statements. *Any* and *or* are analyzed as operators introducing sets of alternative propositions. Modals are treated as quantifiers over these sets of alternatives. In this way they can be sensitive to the alternatives *any* and *or* introduce in their scope.

1 Introduction

This article discusses the distribution and interpretation of Free Choice (henceforth FC) *any* and *or* in modal statements (cf. Horn 1972, Kamp 1973). Consider the following examples.

(1) a. Anyone may come.

b. *Anyone must come.

(2) a. John or Mary may come. $\Rightarrow$ b. John may come and Mary may come.

c John or Mary must come. $\not\Rightarrow$ d. John must come and Mary must come.

In (1a) we have an example of FC *any*. In this context, *any* yields a universal-like interpretation. The sentence can be paraphrased as 'whoever you choose, (s)he may come'.

In (2a), we can interpret *or* as FC disjunction, that is disjunction with a conjunction meaning. The sentence has a reading where it entails (2b). On this reading the sentence has the same free choice flavor ('whichever you choose') that we find in example (1a).

Possibility and necessity statements differ, however, with respect to licensing FC constructions. Example (1b) is out, and sentence (2c) never entails (2d).

The phenomena in (1) and (2) constitute a problem for prominent theories of free choice items and modals. Kadmon and Landman's (1993) elegant analysis of *any* as an indefinite, if combined with the standard account of *may* and *must*, fails to predict the felicity of (1a). Furthermore, the standard analysis of modals and *or* leaves the facts in (2) unaccounted for. Recent approaches have attempted to solve these problems by analyzing *any* and *or* as inherently modal operators, while maintaining a standard account of *may* and *must*. In this article I will follow a different strategy. I propose to maintain K&L's simple analysis of *any* as an existential quantifier ($\exists$), and the standard treatment of *or* as logical disjunction ($\vee$). However, I will

*I would like to thank Alastair Butler and Paul Dekker for insightful comments.

assume an independently motivated 'Hamblin analysis' for $\exists$ and $\vee$ as introducing sets of alternative propositions. Modals are then taken to be operators over these sets of alternatives. The resulting analysis will give us a unified account of the phenomena in (1) and (2).

The article is structured as follows. The next section discusses existing theories of FC items and modal expressions and their problems. Section 3 presents a semantics, inspired by the analysis of questions, which accounts for the alternative propositions introduced by $\exists$ and $\vee$. Section 4 proposes an analysis of modals as quantifiers over these alternative propositions. Section 5 discusses a number of applications, and section 6 concludes the article mentioning a number of further lines of research.

2 Some background

2.1 *Any* as indefinite: Kadmon and Landman (1993)

English employs *any* in two different ways. *Any* can function as a negative polarity item and it can obtain a free choice interpretation. In a convincing article, Nirit Kadmon and Fred Landman have proposed a unified analysis of Polarity Sensitive (henceforth PS) and FC *any*, where a phrase *any* CN is uniformly treated as an indefinite expression with two additional semantic/pragmatic characteristics.

The first characteristic of *any* is that it contributes to the indefinite a reduced tolerance of exceptions as illustrated in (3).

(3) A: Do you have dry socks?

B: I don't have ANY socks.

As Kadmon and Landman observe, what B is saying in this dialogue is that she doesn't have socks and that wet socks are no exception to this claim. This reduced tolerance is expressed by the widening condition.

Widening *Any* widens the interpretation of the common noun along a contextual parameter.

On this account, *any* is an existential quantifier which widens the domain which otherwise would be associated with it by the context of utterance. This widening must come for a reason though and this explains why *any* is so picky in its distribution. The reason that K&L propose for the domain widening of *any* is strengthening of the statement made. In conversation, if given a choice, we normally go for the most informative candidates. It is only in structures in which domain widening leads to a stronger statement that *any* is allowed. This leads us to the second characteristic of *any*.

Strengthening *Any* is licensed only if the widening that it induces creates a stronger statement.

The strength of a sentence is defined in terms of entailment. Strengthening means that *any* is licensed only if the statement on the wide interpretation entails the statement on the narrow interpretation.

Let us see now how K&L's analysis successfully captures the basic generalizations about *any*.

The first example concerns an episodic sentence. Let A and B be contextually selected quantificational domains such that $A \supseteq B$.

(4) a. *John talked to any student.

b. *wide*: $\exists_A x(S(x) \wedge T(x,j)) \quad \not\Rightarrow \quad$ *narrow*: $\exists_B x(S(x) \wedge T(x,j))$

K&L correctly predict that *any* is not licensed in example (4), because enlarging the domain of the existential in this construction leads to a loss of information.

In negative contexts, we get the opposite. Since negation reverses entailment, domain widening leads to stronger negative sentences and, therefore, we correctly predict that (5) is grammatical.

(5) a. John did not talk to any student.

b. *wide*: $\neg\exists_A x(S(x) \wedge T(x,j)) \quad \Rightarrow \quad$ *narrow*: $\neg\exists_B x(S(x) \wedge T(x,j))$

Under negation, *any* is licensed and we talk in these contexts of a 'negative' polarity interpretation.

The last example concerns FC *any* in a generic sentence. Let GEN_x stand for a generic operator, the interpretation of which is assumed to change the quantificational force of $\exists x$ in its scope from existential to universal in much the same way as in standard dynamic analyses of (un)selective binding (e.g. Dekker's (1993) analysis of adverbial quantification).

(6) a. Any dog hunts cats.

b. *wide*: $\mathrm{GEN}_x(\exists_A x D(x); HC(x)) \quad \Rightarrow \quad$ *narrow*: $\mathrm{GEN}_x(\exists_B x D(x); HC(x))$

In this example domain widening leads to a stronger statement because of the effect of the generic operator which gives *any* universal force. Therefore K&L correctly predict the felicity of (6).

To conclude, in the K&L analysis, PS and FC *any* are uniformly treated as existential quantifiers. The universal effect of FC *any* is the result of binding by an operator with universal force, for example a generic operator. On this analysis, FC *any* is basically an indefinite interpreted generically.

Let us see now what are the predictions of this theory for *any* in modal contexts. Before doing this let us review what *may* and *must* are normally taken to mean.

2.2 *May* and *must*: the standard account

On a standard account of modal expressions, *may* (or *can*) ($\Diamond$) and *must* ($\Box$) are analyzed in terms of compatibility and entailment with respect to a set of possible worlds which varies relative to the sort of modality under discussion (epistemic, deontic, ...) and other pragmatic factors (see Kratzer 1977).

(i) $\Diamond\phi$ is true in w iff ϕ is *compatible* with the relevant set of worlds A_w;

(ii) $\Box\phi$ is true in w iff ϕ is *entailed* by A_w.

Two problems arise if we assume this analysis. First of all, in combination with the K&L theory of *any*, it fails to predict the felicity of example (7a). Domain widening never strengthens an existential possibility statement disregarding whether $\exists$ takes narrow or wide scope over $\Box$.

(7) a. Anyone may come.

b. $\Diamond\exists x C(x)$ widening $\not\Rightarrow$ strengthening

c. $\exists x \Diamond C(x)$ widening $\not\Rightarrow$ strengthening

Furthermore, this analysis of modals leaves FC disjunction in possibility statements unaccounted for. Sentence (8c) which analyzes (8a) does not entail (8d) which analyzes (8b).

(8) a. John or Mary may come. $\Rightarrow$ b. John may come and Mary may come.

c. $\Diamond(C(j) \vee C(m))$ $\not\Rightarrow$ d. $\Diamond C(j) \wedge \Diamond C(m)$

A number of authors have tried to account for these data by proposing original analyses for *any* and *or* as inherently modal operators, while maintaining the standard account of *may* and *must*. For example, Dayal (1998) and Giannakidou (2001) propose to analyze FC *any* as an intensional quantifier, that is, a quantifier ranging over intensional objects rather than individuals, which, therefore, requires an intensional context in order to be felicitous (the quantifier requires a modal operator which binds its world variable). In an inspiring article, Zimmermann (2000) proposes to analyze disjunctions, *A or B*, as conjunctions of epistemic possibilities, $\Diamond A \wedge \Diamond B$. If *may* is interpreted epistemically, the equivalence between (8a) and (8c) follows then by general laws of epistemic logic.

Although these theories are interesting and might be on the right track, the analysis I would like to defend here follows a different strategy. I propose to maintain K&L's uniform analysis of *any* as an existential quantifier ($\exists$) and a standard analysis of *or* as logical disjunction ($\vee$). I will however assume an independently motivated analysis of $\exists$ and $\vee$ as operators possibly introducing sets of propositional alternatives, and a new analysis of modals as quantifiers over these sets of propositions. In this way a unified solution for the problems in (7) and (8) is obtained.

There are a number of methodological advantages to my strategy that are easy to see and I would like to list them here.[1] On my account,

(i) We have a uniform treatment for FC *any* and *or* in modal contexts.

(ii) We maintain K&L's unified analysis of PS and FC *any*, while Dayal and Giannakidou have to postulate the existence of two different *any*s. In modal contexts, our *any* will automatically behave as a modal quantifier, without the need of a postulate.

(iii) We have a uniform account of FC disjunction in possibility statements. Zimmermann's analysis instead, which brilliantly explains the epistemic case, extends to permissions only at the cost of a number of extra assumptions.

We can now have a closer look at my proposal.

3 Alternatives

The starting point of the present analysis is the observation of a common character of *any* and *or* reflected by their formal counterparts $\exists$ and $\vee$. As it is clear from the following specification of the truth conditions of these constructions, existentially quantified sentences and disjunctions tell you that at least one element of a larger set of propositions is true, but do not tell you which. (By $[\![\phi]\!]_{M,w,g}$ and $[\![\phi]\!]_{M,g}$ I denote the extension (truth value) and intension (proposition, i.e. set of possible worlds) of ϕ in model M with respect to (world w and) assignment g respectively.)

[1] A proper comparison of the predictions of my analysis and those of Dayal, Giannakidou and Zimmermann is needed, but must be left to another occasion.

$$[\![\exists x A]\!]_{M,w,g} = 1 \quad \Leftrightarrow \quad \exists p \in \{[\![A]\!]_{M,g[x/d]} \mid d \in D\} : w \in p;$$

$$[\![A \vee B]\!]_{M,w,g} = 1 \quad \Leftrightarrow \quad \exists p \in \{[\![A]\!]_{M,g}, [\![B]\!]_{M,g}\} : w \in p.$$

Both $\exists xA$ and $A \vee B$ can be thought of as introducing a set of alternative propositions and, indirectly, raising the question about which of these alternatives is true. In this section, I give a formal account of the sets of propositional alternatives introduced by these constructions. I will then show how this logic of alternatives is needed for a proper analysis of interrogative sentences.

I recursively define a function $[\bullet]_{M,g}$ which maps formulae ϕ to sets of pairs $\langle w, s\rangle$ consisting of a possible world w and a sequence of values s, where the length of s is equivalent to the number $n(\phi)$ of surface existential quantifiers in ϕ, – for atoms and negations, $n(\phi) = 0$; for $\phi = \exists x\psi$, $n(\phi) = 1 + n(\psi)$, and for $\phi = \psi_1 \wedge \psi_2$, $n(\phi) = n(\psi_1) + n(\psi_2)$ (see Dekker 2002).

Definition 1

1. $[P(t_1, \ldots, t_n)]_{M,g} = \{\langle\langle\rangle, w\rangle \mid \langle[\![t_1]\!]_{M,w,g}, \ldots, [\![t_n]\!]_{M,w,g}\rangle \in [\![P]\!]_{M,w,g}\}$;
2. $[t_1 = t_2]_{M,g} = \{\langle\langle\rangle, w\rangle \mid [\![t_1]\!]_{M,w,g} = [\![t_2]\!]_{M,w,g}\}$;
3. $[\neg\phi]_{M,g} = \{\langle\langle\rangle, w\rangle \mid \neg\exists s : \langle s, w\rangle \in [\phi]_{M,g}\}$;
4. $[\exists x\phi]_{M,g} = \{\langle ds, w\rangle \mid \langle s, w\rangle \in [\phi]_{M,g[x/d]}\}$;[2]
5. $[\phi \wedge \psi]_{M,g} = \{\langle s_1 s_2, w\rangle \mid \langle s_2, w\rangle \in [\phi]_{M,g} \ \& \ \langle s_1, w\rangle \in [\psi]_{M,g}\}$.

Disjunction $\vee$, implication $\rightarrow$ and universal quantification $\forall$ are defined as standard in terms of $\neg$, $\wedge$ and $\exists$.

In this semantics, a formula is associated with a set of world-sequence pairs, rather than, as usual, with a set of worlds. This addition is essential to derive the proper set $\mathrm{ALT}(\phi)_{M,g}$ of alternative propositions induced by formula ϕ, which is defined as follows.

Definition 2 $\mathrm{ALT}(\phi)_{M,g} = \{\{w \mid \langle s, w\rangle \in [\phi]_{M,g}\} \mid s \in D^{n(\phi)}\}$.

As an illustration consider the two cases of an atom Px and of an existential sentence $\exists xPx$.

Formula	*Content*	*Alternatives*
$P(x)$	$\{\langle\langle\rangle, w\rangle \mid [\![P(x)]\!]_{M,w,g} = 1\}$	$\{[\![P(x)]\!]_{M,g}\}$
$\exists xP(x)$	$\{\langle\langle d\rangle, w\rangle \mid [\![P(x)]\!]_{M,w,g[x/d]} = 1\}$	$\{[\![P(x)]\!]_{M,g[x/d]} \mid d \in D\}$

The informational content of the two formulae in the first column, expressed by means of sets of world-sequence pairs, is displayed on the second column. Note that the length of the sequence is equivalent to the number of surface existential quantifiers of the sentence, 0 and 1 respectively.

These contents uniquely determine the sets of propositions displayed on the third column. Atom Px induces a singleton set, containing the proposition 'that the individual that g assigns to x is such that P'. The existential sentence $\exists xPx$ induces a set of genuine propositional alternatives,

[2]Eventually, in order to express domain widening, we will have to assume that quantifiers are indexed to a contextually selected domain (see Westerståhl 1984).

$\{$that d_1 is P, that d_2 is P, $\ldots\}$, containing as many elements as there are possible values for the quantified variable x (see Hamblin 1973).

In this semantics, the propositional alternatives introduced by a sentence are defined in terms of the set of possible values for an existentially quantified variable. To properly account also for the alternatives introduced by disjunctions, I propose to add to our language, variables p, q ranging over propositions, so that, for example, we can write $\exists p({}^{\vee}p \wedge {}^{\vee}p = A)$ for A, where the operator ${}^{\vee}$ receives the standard interpretation so that $[\![{}^{\vee}p]\!]_{M,g,w} = 1$ iff $w \in g(p)$. In interaction with $\exists$ or $\vee$, this addition, otherwise harmless, extends the expressive power of our language in a non-trivial way. Although the (a) and (b) sentences below are truth conditionally equivalent, the sets of alternatives they bring about, depicted on the right column, are not the same. While the (a) representations introduce singleton sets, the (b) representations induce genuine sets of alternatives.

(9) a. $\exists p({}^{\vee}p \wedge {}^{\vee}p = \exists x A(x)) \quad \mapsto \quad \boxed{\exists x A(x)}$

b. $\exists p({}^{\vee}p \wedge \exists x({}^{\vee}p = A(x))) \quad \mapsto \quad \begin{array}{|c|}\hline A(d_1)\\\hline A(d_2)\\\hline \ldots\\\hline\end{array}$

(10) a. $\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B) \quad \mapsto \quad \boxed{A \vee B}$

b. $\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B)) \quad \mapsto \quad \begin{array}{|c|}\hline A\\\hline B\\\hline\end{array}$

On this account, a sentence, beyond having truth conditions, also introduces a set of propositional alternatives. This extra structure seems to be needed for a proper account of interrogative sentences. If we take interrogatives $?\phi$ to denote the sets of alternatives induced by ϕ, the sets induced by (9a) and (9b) above can serve as denotations for polar existential questions (example (11)) and constituent questions (example (12)) respectively.

(11) a. Does anybody smoke?

b. $?\exists p({}^{\vee}p \wedge {}^{\vee}p = \exists x A(x))$ b'. $\boxed{\exists x A(x)}$

(12) a. Who smokes?

b. $?\exists p({}^{\vee}p \wedge \exists x({}^{\vee}p = A(x)))$ b'. $\begin{array}{|c|}\hline A(d_1)\\\hline A(d_2)\\\hline \ldots\\\hline\end{array}$

In order for this account to make sense, a question meaning (e.g. the sets of propositions depicted in (11b') or (12b')) should not be taken to represent the set of possible answers to the question, as for example in Hamblin, but rather as the set of propositions for which the truth value is under discussion. Otherwise, for example, we would predict that question (11a) does not have a negative answer.

Interestingly, this analysis of questions allows for a perspicuous representation of the ambiguity of 'disjunctive' questions like (13a), between a polar reading (expected answers: *yes*/*no*) and an alternative reading (expected answers: *coffee*/*tea*) (see von Stechow 1990).

(13) a. Do you want coffee or tea?

b. $?\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B)$ b'. $\boxed{A \vee B}$ (polar reading)

c. $?\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B))$ c'. $\begin{array}{|c|}\hline A \\ \hline B \\ \hline\end{array}$ (alternative reading)

In example (13a), intonation seems to play a disambiguating role. In alternative questions, the alternatives are normally stressed. This suggests an interesting parallelism, which deserves further investigation, between the representations in (13b) and (13c), and the possible focal structures of sentence (13a) (see Aloni and van Rooy 2002).

To summarize, in this section we have presented a logic of the propositional alternatives introduced by a sentence that is inspired and motivated by the analysis of interrogative sentences. Of all the constructions, only a relatively small number introduce sets of genuine alternatives, namely constructions like (9b) and (10b) which crucially contain occurrences of $\exists$ or $\vee$, which are precisely the formal representations of our FC items *any* and *or*.

4 Modals as operators over alternatives

I propose to treat modal expressions as operators over sets of propositional alternatives. In this way they will be sensitive to the alternatives introduced by *any* ($\exists$) and *or* ($\vee$) in their scope. I propose the following analysis of *may* (or *can*) ($\Diamond$) and *must* ($\Box$).

Definition 3 [Modals]

$$[\Diamond\phi]_{M,g} = \{\langle\langle\rangle, w\rangle \mid \forall\alpha \in ALT(\phi)_{M,g} : \ \exists w' \in A_w : w' \in \alpha\};$$

$$[\Box\phi]_{M,g} = \{\langle\langle\rangle, w\rangle \mid \exists\alpha \in ALT(\phi)_{M,g} : \ \forall w' \in A_w : w' \in \alpha\}.$$

Intuitively, $n(\Diamond\phi) = n(\Box\phi) = 0$ and

(i) $\Diamond\phi$ is true in w iff *every* alternative induced by ϕ is *compatible* with the relevant sets of worlds A_w;

(ii) $\Box\phi$ is true in w iff *at least one* alternative induced by ϕ is *entailed* by A_w.

With this account, *may* and *must* are still analyzed in terms of compatibility and entailment with respect to a relevant set of worlds, but the former involve *universal* quantification over a set of alternatives, whereas the latter an *existential* one. This is in accordance with the intuition that possibility statements are generic statements, whereas necessity statements are individual ones. As an illustration consider permissions versus obligations. According to Kamp (1973), the function of a permission statement is to lift a prohibition, that is, to render permissible a class of possible actions. Obligations instead can only concern individual actions. My proposal can be seen as a formalization of Kamp's insights about permissions and obligations and its generalization to other sorts of modals, in particular, epistemic ones. It has often been observed that there is a parallelism between epistemic possibility statements and questions. For example, one of the effects of uttering a sentence like 'It may be raining' is the introduction of the question 'whether it is raining'. Our analysis of modals as operators over sets of alternatives, standing for propositions for which the truth value is under discussion, captures this parallelism in a perspicuous way.

On this account of modal expressions, $\Diamond$ and $\Box$ cease to be one the dual of the other. Counterexamples to dualism are given by cases in which the embedded sentence introduces genuine sets of alternatives. As we will see in the following section this failure is supported by our intuitions.

5 Applications

In this section we show how the analysis presented in the previous pages gives us a perspicuous explanation of the examples we discussed in the introductory part of the article.

Let us start with an example of interaction between *or* and *may*.

(14) a. John or Mary may come.

b. $\Diamond\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B))$ b'. $\begin{array}{|c|}\hline A \\ \hline B \\ \hline\end{array}$

c. $\Diamond\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B)$ c'. $\boxed{A \vee B}$

Example (14a) is ambiguous between the two analyses in (14b) and (14c). These two sentences express universal quantifications over the two sets of alternatives represented in (14b') and (14c'). Sentence (14b) is true iff each proposition in set (14b') is compatible with the relevant modal base. On this reading, the sentence then entails that 'John may come and Mary may come'.

(15) $\Diamond\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B)) \;\Rightarrow\; \Diamond A \wedge \Diamond B$

The second reading of the sentence lacks this entailment because the relevant set of alternative is now the singleton set in (14c'). Sentence (14c) still entails 'John may come or Mary may come', as is expected.

(16) a. $\Diamond\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B) \;\not\Rightarrow\; \Diamond A \wedge \Diamond B$

b. $\Diamond\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B) \;\Rightarrow\; \Diamond A \vee \Diamond B$

This second reading can be paraphrased as 'John or Mary may come, but I don't know which'.

In the following example, *or* interacts with *must*.

(17) a. John or Mary must come.

b. $\Box\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B))$ b'. $\begin{array}{|c|}\hline A \\ \hline B \\ \hline\end{array}$

c. $\Box\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B)$ c'. $\boxed{A \vee B}$

Also this example is ambiguous between two readings. On the first reading, represented in (17b), the sentence is true iff at least one of the two propositions in the set displayed in (17b') is entailed by the relevant modal base. Note that on this reading, the sentence does not entail the conjunction 'John must come and Mary must come', but it has the weaker entailment that 'John must come or Mary must come'.

(18) a. $\Box\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B)) \not\Rightarrow \;\Box A \wedge \Box B$

b. $\Box\exists p({}^{\vee}p \wedge ({}^{\vee}p = A \vee {}^{\vee}p = B)) \Rightarrow \;\Box A \vee \Box B$

The second reading of the sentence, represented in (17c), also lacks this weaker entailment. On this reading, the sentence remains unspecific as to the exact person who must come.[3]

[3] As recognized by Zimmermann himself, his modal analysis of disjunction fails to capture this second reading of sentence (17).

(19) $\Box\exists p({}^{\vee}p \wedge {}^{\vee}p = A \vee B) \quad \not\Rightarrow \quad \Box A \vee \Box B$

Let us now turn to our predictions concerning the interactions of modals and *any*. Let us start with *any* in a possibility statement.

(20) Anyone may come.

In (21) we have the three different ways in which an existential quantifier and a modal operator can interact (other possible combinations being logically equivalent).

(21) a. $\Diamond\exists p({}^{\vee}p \wedge \exists x({}^{\vee}p = A(x)))$ a'. $\begin{array}{|c|}\hline A(d_1) \\ \hline A(d_2) \\ \hline \ldots \\ \hline \end{array}$ widening $\Rightarrow$ strengthening

b. $\exists x\Diamond\exists p({}^{\vee}p \wedge {}^{\vee}p = A(x))$ b'. $\boxed{A(x)}$ widening $\not\Rightarrow$ strengthening

c. $\Diamond\exists p({}^{\vee}p \wedge {}^{\vee}p = \exists x A(x))$ c'. $\boxed{\exists x A(x)}$ widening $\not\Rightarrow$ strengthening

Only (21a) can serve as a representation for sentence (20), because it is only in this construction that domain widening does not lead to a loss of information. (21a) is true iff each of the propositions in (21a') (that d_1 comes, d_2 comes, etc) is compatible with the relevant modal base. Representation (21a), therefore, entails the universal sentence 'For each individual, (s)he may come'.

(22) $\Diamond\exists p({}^{\vee}p \wedge \exists x({}^{\vee}p = A(x))) \quad \Rightarrow \quad \forall x\Diamond A$

The other two possible representations (21b) and (21c), which involve quantification over singleton sets of propositions and cannot serve to represent (20) (strengthening is not satisfied), can be used to express the specific and non-specific reading for sentences like (23) or (24).

(23) A philosopher may come.

(24) Some philosopher may come.

Example (23) can receive all three logical analyses in (21), the universal-like interpretation (21a) expressing the generic reading of the sentence.

Representation (21a), however, should not be available for example (24) which never yields a universal-like interpretation. Note that *some* (like *any*, but unlike *a*) is picky in its distribution. For example, it cannot occur within the immediate scope of negation or as a generic. I expect that an explanation of why representation (21a) is ruled out for (24) should follow from a proper theory of the distribution of this marked indefinite expression (e.g. Farkas 2002, Szabolcsi 2002).

To conclude let us consider *any* in a necessity statement.

(25) *Anyone must come.

As it is easy to see, we correctly predict that example (25) is out because domain widening does not lead to a stronger statement on any of its possible readings in (26).

(26) a. $\Box\exists p({}^{\vee}p \wedge \exists x({}^{\vee}p = A(x)))$ a'. $\begin{array}{|c|}\hline A(d_1) \\ \hline A(d_2) \\ \hline \ldots \\ \hline \end{array}$ widening $\not\Rightarrow$ strengthening

b. $\exists x \Box \exists p(^{\vee}p \wedge {}^{\vee}p = A(x))$ b'. $\boxed{A(x)}$ widening $\not\Rightarrow$ strengthening

c. $\Box \exists p(^{\vee}p \wedge {}^{\vee}p = \exists x A(x))$ c'. $\boxed{\exists x A(x)}$ widening $\not\Rightarrow$ strengthening

In our analysis, *must*, in contrast with *may*, does not have the ability to change the quantificational force of an indefinite in its scope, therefore, we seem to predict that, in necessity statements, an indefinite with *a* cannot receive a generic interpretation and *any* is not allowed. There are however examples of necessity statements in which *a* can be interpreted generically and *any* is licensed. Consider the following sentences:

(27) a. A car must have security belts. (generic reading available)

b. Any car must have security belts.

The (a) example can receive a generic interpretation and the (b) example is grammatical. Therefore, if their possible analyses are as in (26), they seem to constitute counterexamples to our theory. 'Having security belts' is an examples of a so-called 'individual-level' predicate. Individual-level predicates have been argued to be inherently generic, that is, they are required to occur in the scope of a generic operator in order to be felicitous (e.g. Chierchia 1995). A possible solution for (27) would then be that it is the generic operator, and not *must*, which allows a generic interpretation of *a* and licenses *any* in these examples. The sentences in (27) would then be analyzed as follows:

(28) $\Box \mathrm{GEN}_x(\exists x C(x); HSB(x))$

This analysis is confirmed by the fact that if we leave out *must* from the sentences in (27) nothing changes with respect to their licensing universal-like interpretations.

(29) a. A car has security belts. (generic reading available)

b. Any car has security belts.

Example (29a) can have a generic interpretation and (29b) is grammatical. Their analysis in (30) accounts for these facts:

(30) $\mathrm{GEN}_x(\exists x C(x); HSB(x))$

There is however a loose end that I should attend to before closing this section. Consider the following pair. Example (31a) is from (Heim 1982).

(31) a. A car must be parked in the garage. (generic reading available)

b. (?) Any car must be parked in the garage.

Example (31a) can be interpreted generically and (31b) is acceptable (at least to some speakers). Note that the solution described for (27) is not available here. If we assumed the analysis in (28) for the sentences in (31), then we would make the wrong predictions about the following facts:

(32) a. A car is parked in the garage. (*no* generic reading available)

b. *Any car is parked in the garage.

Interestingly, *must* in examples (31a) (on its generic reading) and (31b) can only be interpreted deontically, whereas (27a) (on its generic reading) and (27b) allowed also an epistemic interpretation. I am not sure how we should account for these facts. The universal effect of *a* and *any* in (31) is the result of binding by an operator with universal force. If we want to maintain my analysis of *must* as an existential quantifier, we will have to assume the presence of another operator here, e.g. a generic operator as above. We need however evidence for this. As we know, the predicate 'being parked in the garage' is stage-level and stage-level predicates do not require generic operators. We could maybe assume that deontic *must*, but crucially not epistemic *must*, has the ability, under specific circumstances, to transform a stage-level predicate into an individual-level predicate. The examples in (31) could then receive roughly the following analysis, which would account for their possible universal-like interpretations (and would not contrast with the facts in (32)):[4]

(33) $\mathrm{GEN}_x(\exists x C(x); \Box PG(x))$

A possible explanation for why this analysis does not support an epistemic interpretation could be that, as has been argued for example by von Fintel (2002), epistemic *must* cannot occur in such an embedded position (according to their Epistemic Containment Principle, a quantifier cannot have scope over an epistemic modal).

6 Conclusion and further research

I have proposed an analysis of *may* and *must* as operators over sets of propositional alternatives. This gave us an account of their sensitivity to the alternatives introduced by FC *any* and *or* in their scope. The interpretation of *may* involved universal quantification over alternatives α taking wide scope over existential quantification over possible worlds w ($\forall\alpha\exists w$). *Must* combined existential quantification over alternatives with universal quantification over worlds ($\exists\alpha\forall w$). It is tempting to extend this analysis to other (modal) operators. If we follow this line, all FC licensing operators could then be treated as universal quantifiers ranging over sets of propositional alternatives. For example, the generic operator, GEN, would involve *universal* quantification over both alternatives and worlds ($\forall\alpha\forall w$). Possibility adverbs like *maybe* or *perhaps* would instead be examples of expressions involving *existential* quantification over alternatives and worlds ($\exists\alpha\exists w$). This is supported by the fact that they do not license *any* in their scope.

(34) *Maybe/Perhaps anyone comes.

An interesting question is whether an analysis along these lines of embedding verbs like *want*, *believe* or *know*, beyond explaining their (in)ability of licensing FC items, could shed some light on others of their linguistic properties, e.g. locality effects (see Butler 2003).

Other phenomena that deserve further attention include modals in subjunctive mood, e.g. the contrast between possibility and necessity with respect to licensing FC items is less sharp in this case; and the variety of indefinite expressions in English and other languages, e.g. indeterminate pronouns in Japanese, or *irgendein* in German, which have also be argued by Kratzer and Shimoyama (2002) to require a Hamblin semantics.

At last I would like to mention one observation which originally motivated my interest in free choice phenomena. The observation concerns the relation between an apparent breakdown of

[4]'The sentences in (31) seem to quantify over cars which must be parked rather than over all cars. These 'topical' domain restrictions are disregarded in representation (33).

exhaustivity as we have in so called *mention-some* interpretations of questions and free choice readings of *any* and *or*. Questions normally obtain exhaustive interpretations. Question (35a) can only be completely answered by giving an exhaustive list of the invited persons.

(35) a. Who did John invite?

b. Bill. ($\Leftrightarrow$ Bill and nobody else)

Sometimes, however, a wh-question can be completely answered by mentioning just one of the positive cases. A famous example, due to Groenendijk and Stokhof, is the following, where (36b) seems to completely resolve question (36a), but still does not imply the exhaustive answer.

(36) a. Where can I buy an Italian newspaper?

b. At the station. ($\not\Leftrightarrow$ At the station and nowhere else)

The hypothesis I propose, supported by the following facts, is that an interrogative ϕ? can have a mention-some reading only if ϕ is a FC licensing context.

(37) a. Where can I buy an Italian newspaper?

b. You can buy an Italian newspaper at the station or at the market. $\Leftrightarrow$

You can buy an Italian newspaper at the station and you can buy an Italian newspaper at the market.

c. You can buy an Italian newspaper anywhere.

In contrast with:

(38) a. Who did John invite?

b. John invited Bill or Mary. $\not\Leftrightarrow$

John invited Bill and John invited Mary.

c. *John invited anybody.

If this hypothesis is confirmed, I expect my analysis of free choice to be able to shed some new light on the *mention-some*/*mention-all* contrast and, eventually, contribute to an account of the phenomena discussed in this final paragraph.

References

Aloni, M. and van Rooy, R.: 2002, The dynamics of questions and focus, *in* B. Jackson (ed.), *Proceedings of SALT 12,* Cornell University, Ithaca, NY.

Butler, A.: 2003, Predicate logic with barriers and its locality effects. This volume.

Chierchia, G.: 1995, Individual–level predicates as inherent generics, *in* G. N. Carlson and F. J. Pelletier (eds), *The generic book*, The University of Chicago Press, Chicago and London, pp. 176–223.

Dayal, V.: 1998, *Any* as inherently modal, *Linguistics and Philosophy* **21**, 433–476.

Dekker, P.: 1993, *Transsentential Meditations. Ups and Downs in Dynamic Semantics*, PhD thesis, University of Amsterdam.

Dekker, P.: 2002, Meaning and use of indefinite expressions, *Journal of Logic, Language and Information* **11**, 141–194.

Farkas, D.: 2002, Varieties of indefinites, *in* B. Jackson (ed.), *Proceedings of SALT 12*, Cornell University, Ithaca, NY.

Giannakidou, A.: 2001, The meaning of free choice, *Linguistics and Philosophy* **24**, 659–735.

Hamblin, C. L.: 1973, Questions in Montague English, *Foundation of Language* **10**, 41–53.

Heim, I.: 1982, *The Semantics of Definite and Indefinite Noun Phrases*, PhD thesis, University of Massachusetts at Amherst. Published in 1989 by Garland, New York.

Horn, L.: 1972, *On the semantic properties of logical operators in English*, PhD thesis, UCLA.

Kadmon, N. and Landman, F.: 1993, Any, *Linguistics and Philosophy* **16**, 353–422.

Kamp, H.: 1973, Free choice permission, *Proceedings of the Aristotelian Society* **74**, 57–74.

Kratzer, A.: 1977, What 'must' and 'can' must and can mean, *Linguistics and Philosophy* **1**, 337–355.

Kratzer, A. and Shimoyama, J.: 2002, Indeterminate pronouns: The view from Japanese, *in* Y. Otsu (ed.), *The Proceedings of the Third Tokyo Conference on Psycholinguistics*, Tokyo (Hituzi Syobo), pp. 1–25.

Szabolcsi, A.: 2002, Captain nonnemo travels to the positive pole, the negative pole. and negative concordia. Invited talk at Sinn und Bedeutung 7, University of Konstanz.

von Fintel, K.: 2002, The meanings of epistemic modality (with Sabine Iatridou). Invited talk at Sinn und Bedeutung 7, University of Konstanz.

von Stechow, A.: 1990, Focusing and backgrounding operators, *in* W. Abraham (ed.), *Discourse Particles*, number 6, John Benjamins, Amsterdam, pp. 37–84.

Westerståhl, D.: 1984, Determiners and context sets, *in* J. van Benthem and A. ter Meulen (eds), *Generalized Quantifiers in Natural Language*, Foris, Dordrecht, pp. 45–71.

Zimmermann, E.: 2000, Free choice disjunction and epistemic possibility, *Natural Language Semantics* **8**, 255–290.