MODALS AS A PROBLEM FOR MT

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Summary
The paper demonstrates the problem of translating modal verbs and phrases and shows how some of these problems can be overcome by choosing semantic representations which look like representations of passive verbs. These semantic representations suit alternative ways of expressing modality by e.g. passive constructions, adverbs and impersonal constructions in the target language. Various restructuring rules for English, Swedish and Russian are presented.

Introduction
Modal verbs belong to the most frequent English words. Clauses with modal expressions make up a considerable part of the clauses of any text, why any MT-system which is claimed to cover empirical texts with reasonable quality must include solutions to the problems discussed in this paper (cf. An et al, 1993 for a corpus based approach). One of the problems connected with the analysis of such clauses is the fact that the distinction between auxiliaries and modals is not clear. Verbs like *ought to* and *dare (to)* are often labelled semi-auxiliaries, *begin* and *continue* are called aspectual verbs etc. A common denominator of auxiliaries, semi-auxiliaries, modals and several perception verbs is their "auxiliary meaning" including tense, modality and aspectual perspective (cf. Gawrónska, 1993). In the following, the term "auxiliary "will be used even when referring to verbs traditionally called modals and perception verbs.

The typical "auxiliary" meanings, e.g. modality, aspectual perspective and tense show great encoding variation between languages. And even within one language one may often choose between several different lexical-grammatical modes. In English one may choose between *X may come, It is possible that X comes,* and *X possibly comes* with only minor stylistic differences.

Swedish *kan* has both a root meaning (equivalent to *is able to*) and an epistemic meaning (equivalent to *may*), while English *can* only has the first meaning. The mode of encoding auxiliary meanings may be even more differentiated in other languages. Thus, *He must come*, has to be rendered by the passive construction *Il est obligé de venir* or the impersonal construction *Il faut qu'il vienne* in French. In Russian one would have had to render this sentence using an an adjective *(dolžen)* or an adverb *(nado, neobxodimo).* Japanese would have to use *konakereba narimasen* (literally: "It won't do if X does not come"). MT-systems dealing with a certain pair of languages may tailor the meaning representations of auxiliaries ad hoc, but multi-language systems such as Swetra, the Swedish Computer Translation Project (Sigurd & Gawrónska, 1990), must choose more universal representations and suitable restructuring transfer rules as will be demonstrated. The problem of modality is also of general interest for linguistic, semantic and cognitive theory (Sweetser, 1990).

English Verb Phrases
There are two basic types of verb phrases in English (cf Sigurd, 1992), one (1) consisting only of a finite main verb (with possible complements), e.g. *Bill jumps,* the other (2) consisting of a finite auxiliary verb followed by a non-finite main verb (with possible complements), e.g. *Bill must jump.* The non-finite main verb in the second type may be in the infinitive without *to* as illustrated, or in an infinitive with *to* as in *Bill began to jump.* The non-finite verb may also be a past participle as in *Bill has jumped* or a present participle as in *Bill began jumping.* The choice between non-finite forms is an automatic consequence of the preceding verb. We note that the *have* meaning perfect tense takes the perfect participle as in *Bill has jumped,* while the *have* which is an equivalent of *must* takes the infinitive with *to* as in *Bill has to jump.* The verb *begin* may take an infinitive with *to (Bill began to jump)* or alternatively a present participle *(Bill began jumping).* The auxiliaries in other languages, e.g. German and Swedish display similar combinatorial properties.

The second type of verb phrase mentioned may be expanded to include further non-finite auxiliaries, as illustrated in: *Bill must begin to jump, Bill must dare to begin to jump* and *Bill must dare to begin to be able to jump.*

Occasionally there may be a short adverb between the non-finite forms as in *Bill must*

dare not to jump and even after a _to_ as in _Bill must dare to not jump_, although the so called split infinitive construction is condemned by prescriptive grammarians.

Semantic Representations of Verb Phrases

The meaning complexes corresponding to the verb phrases described may simply be rendered as lists of the constituent verb meanings, where the tense of the finite verb is shown, but the particular form of non-finite verbs and the occurrence or non-occurrence of infinitive markers are not shown. This is the approach taken by Swetra. The lexical meaning representations or semantic markers in Swetra are of the form _m(S, G)_, where _m_ denotes meaning, _S_ is the main meaning of the word denoted by a kind of Machinese English and _G_ the grammatical meaning. The verb form _jumps_ has the representation _m(jump, pres)_. The meanings of the infinitive form _(to) jump_, the past participle _jumped_ and the present participle _jumping_ are all rendered as _m(jump, nonf)_. The following table shows some preliminary meaning representations of verb phrases under the phrases.

jumps
[m(jump, pres)]
began to jump
[m(jump, nonf), m(begin, past)]
began jumping
[m(jump, nonf], m(begin, past)]
dare begin to jump
[m(jump, nonf), m(begin, nonf),
        m(dare, pres)]
may be able to jump
[m(jump, nonf), m(able, nonf), m(may, pres)]
was painted
[m(paint, nonf), m(passive, past)]

The semantic representations illustrated have the main verb first and the order of the verbs is thus reversed if compared to English. The order chosen is arbitrary. We have illustrated the representation of a passive phrase _was painted_ as well. This representation is also used for the Swedish morphological passive which is _målades_ (there is also a syntactic passive in Swedish: _blev målad_).

Passive Meaning Representations for some Auxiliaries

Linguists have often talked about the meanings of auxiliaries using words and concepts such as: compulsion, obligation, permission, ability, necessity, probability and possibility. Words which can be associated with

compulsion and obligation, e.g. _must, shall, ought to_ have been called deontic. A distinction between a root meaning and an epistemic meaning has been observed for a number of auxiliaries, e.g. _must_, where the two meanings are illustrated by the following two examples (from Sweetser, 1990, p, 49).

Bill must be home by ten; Mother won't let him stay out any longer

Bill must be home already; I see his coat

The epistemic meaning may also be rendered by sentence adverbials as illustrated by: _Bill is evidently/seemingly home_ or an impersonal expression with an adjective as in _It is clear/ obvious that Bill is home_. It would be an advantage if the semantic representations of auxiliaries could be related in a simple way to the meaning representations of such equivalent adverbs and adjectives.

The simplest way to represent the meanings of auxiliaries is illustrated by _m(can, pres)_. It is then logical to choose _m(can, nonf)_ for the assumed infinitive _be able to_. Similarly, one may represent the meaning of present _must_ by _m(must, pres)_ and and the meaning of the corresponding infinitive _be obliged to_ by _m(must, nonf)_. The phrase _be obliged to_ can, however, also be regarded as a passive in which case it would be represented as: _[m(oblige, nonf), m(passive, nonf)]_. With this representation in mind one may represent present _must_ as _[m(oblige, nonf), m(passive, pres)]_ instead and _can_ as _[m(able, nonf), m(passive, pres)]_ which directly gives us the synonym _is able to_.

There are further semantic arguments in favour of representing constructions with modal verbs in a way similar to passive clauses. The referent of the subject in a sentence with a modal verb is not as "agentive" as the referent of the subject of a typical active content verb. If the term agent is to be understood as the element of the event-situation that is actively involved in and responsible for the triggering of the event-situation in question (Gawrońska 1993), it becomes clear that the subject of a modal construction is not a typical agent. Its responsibility for triggering the event-situation is reduced by the obligation, allowance or compulsion component. In Russian and Polish, this property of the subject referent is overtly expressed by the dative case in several modal construction. The equivalent of the English or Swedish subject in Russian sentences with _nado_ ('it is obligatory'),

neobxodimo ('it is necessary'), *nel'zja* ('it is not allowed') or Polish *wolno* ('it is allowed') occurs in the dative, a case normally associated with the semantic roles 'beneficiary' or 'experiencer'.

Passive representations of some English auxiliaries

One may hesitate when choosing terms in the meaning representations as is obvious from works on modals. The following are used by Swetra.

/* allowance */
elex([m(allow, nonf), m(passive, pres)], v,
    aux, fin, _, 1, inf, i, []) --> [may].

The semantic representation *[m(allow, nonf), m(passive, pres)]* of the finite form *may* makes it comparable to the meaning representations of *is/was allowed/permitted to* and the infinitive *be allowed/permitted to*. This meaning may be illustrated by *Bill may come (as he asked)*. The form *may* may have another (epistemic) meaning as well (below).

/* obligation */
elex([m(oblige, nonf), m(passive, pres)], v,
    aux, fin, _, 1, inf, i, []) --> [must].

The representation [m(oblige, nonf), m(passive, pres)] gives *is obliged to* as a synonym as is generally suggested in grammars.

/* capability */
elex([m(able, nonf), m(passive, pres)], v,
    aux, fin, _, 1, inf, i, []) --> [can].

This representation makes it possible to get *is able to* as a direct synonym and the infinitive *be able to* which is desirable.

/* epistemic appearance */
elex([m(perceive, nonf), m(passive, pres)], v,
    aux, fin, _agr(pl, _, _), 1, toinf, i, [])
    --> [seem].

This analysis makes the phrase *Bill is perceived to come* parallel to *Bill seems to come*, which is reasonable, although the first phrase seems to be too specific and implies a latent agent. This epistemic meaning is also expressed by grammarians by such words as: inference, conclusion.

There is a number of epistemic expressions which indicate the sense modality of the perception more or less clearly as illustrated by: *Bill is said/heard/felt to come*.

/* epistemic possibility, probability, certainty */

elex([m(possible, nonf), m(passive, pres)], v,
    aux, fin, _, 1, inf, i, []) --> [may].
elex([m(probable, nonf), m(passive, pres)], v,
    aux, fin, _, 1, toinf, i, []) --> [ought].
elex([m(certain, nonf), m(passive, pres)], v,
    aux, fin, _, 1, inf, i, []) --> [shall].

The semantic representations of auxiliaries must be sensitive to the presence/absence of negation. The equivalent of English *must*, when not negated, is the etymologically related Swedish verb *måste*, whereas *must not* is not to be rendered by *måste inte* ('must' not), but by *får inte* ('is not allowed to'). The need for attention to negation becomes even more conspicuous when considering the effects of the interplay between negation and aspect in translation between Russian and English (cf. Isačenko 1962:198):

a. nado vernut' knigu
  'must' return-perf book-acc
  'one has to return the book/the book must be
    returned'
b. nado vozvraščat' knigi
  'must' return-imp books-nom/acc
  'one ought to return books'
c. ne nado vozvraščat' étu knigu
  neg 'must' return-imp this book-acc
  'one does not need/have to return this book'

The problem of translation between English and Russian can be solved by lexically encoded negation and aspect control, according to patterns like the following:

elex([m(oblige, nonf), m(passive, pres)], v,
    aux, fin, _, 1, inf, i, []) --> [must].
rlex([m(oblige, nonf).m(passive, pres)], adv,
    mod, inf, [perf], 1, _, _, [])
    --> [nado].

The Russian lexical entry (rlex) contains the information that an English modal verb with the meaning code *m(oblige, nonf), m(passive, pres)* is to be rendered by the Russian modal adverb *nado*, provided that *nado* is not negated and that it is combined with a perfective infinitive clause [perf]. Negation would have shown in the slot now marked [perf].This pattern covers cases exemplified by a. The other patterns are handled in an analogous way.

English and Swedish equivalents
It is evident from the analysis above that there is a number of auxiliaries which can be translated directly as a consequence of the semantic representations suggested. Table 1 shows corresponding English and Swedish

auxiliaries, adverbs and adjectives which one would also like to be able to translate between.

Table 1: English and Swedish equivalents

	English	Swedish
/* allowance */ [m(allow, nonf), m(passive, pres)]	may is allowed to is permitted to	får, må är tillåten att är medgiven att tillåts att medges att
/* obligation */ [m(oblige, nonf), m(passive, pres)]	must is obliged to has to obligatorily compulsory	måste är tvungen att tvängsvis nödvändig
/* capability */ [m(able, nonf), m(passive, pres)]	can is capable of	kan är i ständ att
/* epistemic appearance */ [m(perceive, nonf), m(passive, pres)]	seem to appear to is said to may should seemingly apparently evidently obviously clearly apparent obvious	verkar att förefaller att synes, tycks ser ut att sägs, lär kan torde skall synbarligen till synes uppenbarligen tydligen klart uppenbart tydligt
/* epistemic possibility etc */ [m(possible, nonf), m(passive, pres)]	may possibly possible	kan möjligen möjligtvis möjlig
[m(probable, nonf), m(passive, pres)]	should probably probable	torde sannolikt sannolik
[m(certain, nonf), m(passive, past)]	must certainly	måste säkert säkerligen

Deriving Parallel Constructions

If there is no equivalent auxiliary in the target lexicon an advanced MT-system may try to find an equivalent by deriving parallel constructions e.g. with adverbials. It will then have to make changes in the functional representation and move parts of the meaning representations. The following is a general Prolog rule, which moves the epistemic meaning from the predicate to the adverb. The rule assumes the analysis of auxiliaries presented above and suitable lexical representations. The rule states that if there is a structure such as A, there is also B.

```
restruct(A, B) :-
A=[pred([m(X, nonf)], [m(Epist, _)],
      m(passive, T)]]),
      advl([])],        % N may come
B= [pred([m(X, T)]),
      advl(m(Epist, _))].% N comes possibly
```

Note how the tense morpheme (T) is also moved.

The following rule illustrated how *It is possible that Bill comes can be derived*. It presupposes a certain syntactic analysis where English *it* is represented as *impers*.

```
restruct(A, B) :-
A= [subj(N), pred([m(X, nonf), [m(Epist, _)],
      m(passive, T)]])], % N may come
B=[subj(impers), pred([m(Epist, _),
      m(passive, pres)]),
      obj([subj(N), pred(m(X, T))])].
      % It is possible that N comes
```

In translation from and into Russian, there is a need for rendering an impersonal construction, like *nado vernut' knigu*, into an English or Swedish construction with an overtly realized subject (E. *The book must be returned*, S. *Boken måste lämnas tillbaka*). In such cases, the 'restruct' rules move the representation of the Russian object into the subject slot of the target representation and instantiate the mode variable in the constant 'passive'. The definiteness value of the subject is assumed to be, by default, +definite, which generally holds for perfective constructions with singular objects and preverbal subjects.

```
restruct (A, B):-
A= [subj([]), pred([m(Verb, [nonf, perf]),
      Aux, Tense, Mode]), obj(m(Z, _))],
      % nado vernut' knigu
```

```
B= [subj(m(Z, def)), pred([m(Verb, nonf),
      Aux, m(passive, Tense)])].
      % the book must be returned
```

As an alternative, the empty subject slot is filled by a generic personal (genpers) pronoun (E. *one*, S. *man*):

```
restruct (A, B):-
A= [subj([]), pred([m(Verb, [nonf, perf]),
      Aux, Tense, Mode]), obj(m(Z, _))],
      % nado vernut' knigu
B= [subj(m(genpers, _), pred([m(Verb, nonf),
      Aux, m(passive, Tense)]), obj(m(Z,
      dem))].
      % one must return this book
```

Such rules may be used as transfer rules in MT systems. They may also be used in order to derive synonymous expressions in the same language. Some subtle semantic and stylistic differences between the target and the source sentences sometimes occur. However, the translations are generally comprehensible.

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