Towards An Interlingual Treatment of Modality

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Abstract

Modality is an important, but complex linguistic phenomenon that concerns all levels of language production. NLP research has rather refrained from this subject, but we show that many errors in machine translation systems are directly related to the absence of a proper interlingual treatment of modality. We outline the traces of such a modal interlingua by presenting the "Module of Modality", parts of which are currently being implemented in a Japanese-English system.

1 Introduction

The main goal of this paper is not the description of an implementation of a well-defined research subject. It is rather the attempt to show why a rather vague linguistic concept like modality should be attributed major attention within machine translation (MT) research and how it could be formalised to meet the needs of MT.

Modality is almost a virgin subject in natural language processing (NLP) research, contrary to the attention modality is paid in linguistic research. However, the lack of an appropriate treatment modality is a cause for major errors in the output of MT systems. MT systems need an interlingua] module of modality; but linguistic theory fails to provide a universal approach to modality.

We identify the essential points that would constitute a universal model. From empirical observation of Japanese and three European languages, we extract the Module of Modality (MoM), a formal and abstract representation of that linguistic phenomenon, as a blueprint for such an interlingual treatment.

Finally, parts of MoM are being implemented within a large-scale Japanese-English MT system.

2 Frequency of modal expressions

Modality is a semanto-pragmatic category that is well-examined in linguistics. It designates "the way in which the speaker comments the validity of the state of affairs that is denoted by an utterance"[1] (Metzler 1993: 395). Usually, linguists distinguish up to four types of modality: epistemic (judgement), deontic (obligation), dynamic (ability) and conditional (hypothesis).

Modality is intrinsic to language production. A survey of the occurrence of 13 candidates for modal elements in the EDR-corpus of Japanese (EDR 1995) shows that modal elements are not marginal, despite first appearance (cf. table 1). The element *ta* alone occurs in 31 % of the corpus sentences. That *ta* may mark (non-modal) past tense or (modal) hypothesis, doesn't undermine the importance of modality, but underlines the need to distinguish it clearly from other linguistic phenomena.

Modality type	Modalising element	Occurrence
Epistemic	*yo.*	437
	darou	3010
	souda	1317
	kitto	50
	osoraku	112
	youda	1148
Deontic	*tai*	2777
	noda, nodesu	3119
	kudasai	245
Dynamic	*dekiru*	909
Hypothesis	*ta.*	59729
	naraba	130
	toshitara	78

Table 1: Frequency of modal elements in the EDR-corpus (195,000 sentences)

[1] "[Modalität ist eine] Semant.-pragmatische Kategorie, welche sich auf die Art und Weise der Stellungnahme des Sprechers zur Geltung des in einer Äußerung denotierten Sachverhaltes bezieht."

3 Status quo of modality research

3.1 Modality research in linguistics

While modality has been a major research subject in linguistics, most work focuses on the theoretical explanation of phenomena in a single language (cf. Calbert 1975, Masuoka 1991) or the relation to modal logic (cf. Lyons 1977). Contrastive studies of modal structures across languages are rather rare, that are also useful for automated translation (cf. Aijmer [to appear], Palmer 1986). And surprising as it may be, as far as we know, there is no coherent, universal theory of modality (cf. also chapter 0).

Modality in MT systems

Nirenburg et al. (1992: 28) list modality as one of several "nonpropositional meanings" that would require an interlingual representation in MT. Despite this admonition, modality has been almost completely ignored in NLP[2], partly probably of the lack of a coherent, universal theory to implement[3]. Additional reasons may have been the frequent characterisation of modality as representing the "subjective" part of an utterance, scaring off researchers equating "subjective" with "not exact/ arbitrary", or the "speaker" involvement falsely suggesting that modal phenomena are limited to spoken language.

We distinguish MT systems that have an autonomous module of processing modality and those that don't.

Treatment within the verbal phrase

In MT systems with a modal module, modality is an abstract representation of the modal features within the verbal phrase (e.g. "ALT-J/E"[4], "Hon'yaku-no oosama"[5]). In both source and target language, the representation corresponds to surface elements like mode or modal auxiliaries. This treatment is parallel to the treatment of tense/aspect in the way that the propositional information of the verb is separated from the "circumstantial" information. Ikehara et al. (1991) show that this "interlingual" step has to be done even in transfer-based systems.

Even such systems, though, still account only for a small part of modal phenomena. E.g., they are not capable of gathering several elements in the source sentence that constitute modality as a whole (we will call them "trigger combinations" below). In the following example of J→E[6]. the particle *te* + and the past tense of the adjective *yoi* ("good") express the speaker's judgement that an action in the past was satisfying.

1 J: *Yame-te-yokat-ta.* (stop-PARTICLE-good-PAST_TENSE)
E (correct): *I did well stopping it.*
E (system [ALT-J/E]): *I might stop.*[7]

Relegation to the lexical level

In most MT systems, modality is not translated autonomously and there is no distinct module of modality at any translation stage. Modality treatment is just – presumably unconsciously – relegated to the dictionary. This "method" may work in numerous cases between European languages, where modal auxiliaries play a crucial role and often have equivalents in the other language, like *pouvoir* (F) – *können* (D) – *can* (E).

Transfer-based systems like "T1"[8] or "Atlas"[9] recur to the dictionary; but even for close languages, this method doesn't work. E.g., T1 translates the conditional auxiliary *würde(n)* (D) always by *would* (E), while the subordinate clause in English would ask for the past tense, cf..

2 D: *Ich würde dir helfen, wenn ich nicht arbeiten würde.*
E (correct): *I would help you if I wasn't working.*
E (system [Tl]): * *I would help you if I would not work.*

Importance of interlingual module

Out of 100 English sentences which were wrong translations of Japanese sentences containing a conditional clause (indicated by *naraba* ["if"]), the main cause of the failure of the translation could be attributed to the inadequate treatment of the conditional modality in 57 cases.

[2] "The Computation and Language E-Print Archive" (http://xxx.lanl.gov/cmp-lg/) lists only one single paper treating modality for the last five years (apart from six papers on modal logic) [searchwords: "modal", "modality"].

[3] One should not confound the linguistic notion of modality as treated in this article and the notion of "modal logic", the latter one indeed being a central research subject in artificial intelligence.

[4] ALT-J/E, non-commercial system by NTT CS laboratories, Kyoto, Japan (J → E)

[5] "Hon'yaku-no oosama" (Version 2.0) by IBM (E → J)

[6] The following abbreviations are used for languages in this article:
D=German, E=English, F=French, J=Japanese

[7] The same combination (particle "te" + adjective "yoi"), only with the adjective in present tense, is the dictionary equivalent for *may* (permission). This interpretation led to the system's wrong construction of *might* as the hybrid past tense of *may.*

[8] "T1 Professional 3.0" (D O E) by Langenscheidt, commercial version derived of "Metal" of Siemens.

[9] "Atlas V 5" (J ↔ E) by Fujitsu

Verb level	Other parts-of-speech	Sentence level	Text level	Others
Tense	Adjectives	Nominalisation/ Formal Nouns	Context	Intonation
Aktionsart	Verbs	Person (Subject)		Complex constructions
Mode	Particles/Clitics	Word order		Cotext
Inflection	Conjunction	Parenthetical adjective clause		(Not realised)
Modal auxiliaries	Adverbs	Punctuation		
(Non-)Finiteness		Clause Type		
		Parenthetical verb clause		

Table 2: Linguistic Categories Involved In Modalisation

We can resume that modality is a major cause of errors in MT, and that the major reason for this is the absence of a modal module in the system, being independent of lexical or syntactical (VP) constraints in the source language, in other words, the absence of an abstract, interlingual module.

4 Traces of an interlingua for modality

The failure of current MT systems when translating modal expressions is an inevitable result of the absence of an interlingual module of modality within the system. This interlingual module of modality would be the formalisation of a universal theory.

Six points can be identified that separate current conceptions of modality from serving as an abstract, language-independent formal representation.

4.1 Definition range of the research subject

Although or perhaps because modality is a frequent research subject, many authors refrain from giving an explicit definition of "modality" [10].

Modality research in NLP often follows this bad example of the linguists and assumes that the definition range is clearly delimited in linguistics, while it is not at all. It is thus no wonder that modality often seems to serve as a "litter" category for any secondary verbal information. Murata's modality approach through example-based MT (1999) consciously focuses on tense, aspect and voice. The modality module of ALT-J/E includes mainly complex verb structures like voice or causative. Only 22 out of the 99 "modal" categories in this system are truly modal in the conventional definition of modality.

[10] Even Palmer (1986) fails to give an explicit definition of modality.

An interlingua for modality should cover the formal and functional areas presented in the next two subchapters.

4.2 Forms: Which linguistic categories can trigger modality?

Most modality theories cover only a small number of linguistic categories involved in modalisation. Even recent works like Metzler (1993) define modality mainly through two verbal categories, modal auxiliary verbs and verbal mode. However, for instance, mode is a marked phenomena for instance of Indo-European languages, and is completely absent e.g. in Japanese, where modality is often established by means of discourse particles like *yo* or *ne* (cf. Masuoka 1991,Ueno 1989).

How can we identify the elements that add modality to a given sentence? All identifiable elements and categories in a modal sentence have to be left out one after another until it is clear without which one the sentence has only a plain propositional meaning. Focussing on examples in Japanese, English, German and French, with this method, we have identified so far 23 linguistic categories involved in modalisation (cf. table 2).

Seeing the wide range of categories involved in modalisation, one is tempted to ask rather what category cannot be modal than the opposite. It is important to notice that the usage of none of these categories is exclusively modal, not even the traditional modal auxiliaries or verb mode These categories are not the cause for modality (the cause will be treated in the next chapter); they are the linguistic forms in which modality can appear.

4.3 Modal "functions"

The linguistic search of modality emerged from the notion of modality in logic; initially, linguists classified

modal expressions along the logic notions of alethic[11], deontic and epistemic modality (cf. Lyons 1977).

If we want to try to formalise translation of modal expressions, we have to ignore the wish to recognise actual cognitive function classes behind modal expressions in order to get out of this vicious circle. Rather than functions, we need to define equivalency classes by listing all overt elements that can be interchangeably used to produce a certain effect of modality (=function). Overt elements belonging to such a class will be called trigger elements of this class.

When translating trigger elements, linguistic elements in the target language that represent the modality represented by the source language trigger elements, will enter the set of trigger elements in the target language.

Such monolingual equivalency classes must be intersected with equivalency classes in other languages, resulting in (a probably increased number of) interlingual equivalency classes. For instance, while English surprisingly seems to have one single class for both "normative" obligation[12] and objective assumptions (both expressed by *must),* forms in Japanese (e.g. *no-da* vs. *hazu-da)* or German *(müssen* vs. *einfach müssen)* are not interchangeable, thus establish two separate monolingual classes, so that there will be also two separate interlingual equivalency classes.

This way of defining equivalency classes can be automated; manually, we have identified so far 17 different classes for the four languages in focus. These classes constitute the heart of the "Module of Modality" that is presented in the next chapter.

4.4 Mono-functional approach

Even if we can identify new form-based functions, many forms may trigger two or more functions, while only few forms unequivocally identify a single function. However, it is in fact the most frequent elements like the "classical" modal auxiliaries like *must, may* or *müssen, sollen* (D) that seem to cover a whole range of modal functions (obligation, permission, strong probability). On the other hand, functionally clearly assignable forms seem to occur much less often than the ambiguous ones. This is shown in Table 1 by the frequent occurrence of the ambiguous forms *ta, deshou* or *no-da* compared to the rarity of *kino* or *kudasai* in Japanese.

In many cases, functions can be clearly identified (=forms can be disambiguated) only because of characteristic combinations of trigger elements, called trigger combinations. Thus, in Japanese, *ta* is identified as introducing a hypothesis, if the same sentence contains, for instance, *naraba* or *toshitara.*

In fact, the above stated tendency of languages to use ambiguous modal forms rather than clearly identifiable ones leaves no choice but to look for second elements that help identify the whole modal class. Thus, the assignment of trigger combinations is a central part of formalising the translation of modal expressions.

4.5 Syntactically divergent structures

The variety of categories presented in Table 2 makes clear that the assumption that modality is a property of the verb suggested by the dominance of mode and modal auxiliaries in some languages, is not true. Modality is a property of the sentence; it is a modification after the entire proposition has been established (that may sometimes be marked on the verb), and that can be done on different levels of the sentence construction.

This implies that it is hardly more than (lucky) coincidence if one modal class has syntactically similar trigger elements on both sides of the translation. Equivalent modal forms are very often syntactically divergent. This is why modality cannot be dealt with on the lexical level, but why modal information has to be relayed to the target language separately, in an abstract, interlingual representation.

This divergence can only be dealt with, if the modal information of a sentence is completely separated from the syntactical analysis and generation, i.e. if it is transmitted to the target language in the abstract terms of an interlingua, even in mere two-language systems.[13]

If modal information was left to even very refined transfer mechanisms, we still would have to establish precise mapping rules for every single trigger into every single trigger in both languages. It is not feasible, though, to list all possible combinations.

4.6 Different degree of modalisation

The last difficulty in translating modal expressions lies in the phenomenon that different languages seem to require a different degree of modalisation. This means that a "weak" modal expression may be better not be translated at all in the target language, resulting in a "null" modal expression.

In this respect, Japanese seems to be higher modalised than European languages. E.g.

3a J: *Omoshiro*-so*!* ("It sounds interesting.")

[11] alethic modality = "the necessary or contingent truth of propositions" (Lyons 1977: 791)

[12] "Normative" duty means that the duty is only related, but not imposed by the speaker (e.g. by society, religion).

[13] Similarly, Bond et al. (1997) show that nominal and adverbial time expressions (in J→E translation) cannot be handled in direct (lexical) mapping, but require an abstract "intermediate" representation.

with *so* indicating that this is the speakers impression, not knowledge, may become a mere

3b D: *Interessant!*

in German without any modalisation.
Such qualitative differences can only be handled through a interlingual representation.

5 The "Module of Modality" – MoM

In the following, we propose a Module of Modality (MoM). MoM is a formal and abstract representation of modality. The traces of MoM are following the outline for a modal interlingua in the preceding chapter. It is designed to serve as a base and paradigm for modality research in NLP, and as a model for the interlingual representation of modality in MT.

5.1 Syntax

Every sentence containing modality is described in three dimensions

World	**Remoteness**[14]
	Proposition

Table 3: The three dimensions of the MoM

We call "world" a modal subtype, a refined function. In the appendix, all worlds are listed with examples in English and the equivalent in another language identifying the trigger elements.

Every overt modal trigger in a language can now be described as a feature combination in terms of the MoM.

5.2 Trigger elements and singularity of worlds

As outlined above, one single trigger element will often be assigned to more than one modal world. This is why we consider sets of two or more trigger elements for the same world as trigger combinations that can eventually clearly define a single world. In fact, the examples show that most modal worlds require this "redundancy" in the considered languages; they require more than one element to be materialised.

Elements can also serve as negative triggers to exclude certain worlds from being considered as candidates. E.g. in English, past tense excludes Directive_duty (*Go home yesterday!); 2nd or 3rd person (different from the speaker being the 1st person) excludes Plan (*I want to come.* vs. *I want him to come.* [Directive_duty])

Every world can occur maximally once per proposition (singularity). That means that if there is more than one element triggering that world, the additional elements don't constitute separate worlds, but all triggers related to that world must merge into a single trigger combination.

Different combinations of trigger features may however indicate different degrees within one world ("reinforcement") as in the example of the world of "Belief".

5.3 Further features

Some modal worlds may be divided into several subworlds to account for detailed meaning shifts. For instance, "Belief" is indexed by a number from 1 to *5* indicating the strength of conviction.

Modalisation is recursive, i.e. a modalised proposition can be modalised again, embedded in another modal world. This accounts mainly for the possibility to relate propositions "modalised" by other speaker's, e.g. *I think you must not swim here,* or *He seems to think that I will come to his party.*

6 Implementation

Instead of constructing an autonomous testing system exclusively for MoM, we were able to add MoM as a new module to the existing, large-scale ALT-J/E MT system (J→E), starting with the implementation of the world "Belief".

"Belief" in Japanese is a classical illustration of the importance of defining trigger combinations rather than single triggers because "opinion" elements at the beginning of a sentence are often echoed by second and third redundant elements at the end. Up to now, the system translated all these elements separately as normal adverbs, producing sentences starting with three adverbs *(Probably surely perhaps ...)* in the English output. According to the singularity postulate for modal worlds, such elements have to be considered as a trigger combination for "Belief".

7 lexical elements are set as trigger words. Already in the lexical analysis phase (before the syntactical interpretation), the number of triggers in the source sentence is counted and, in case it exceeds one, all triggers are removed from the sentence and replaced by a single, unambiguous belief adverb *(kitto);* this structure is relayed to the next translation stage.

7 Perspectives

We hope that this paper shifts the focus in MT research towards the subject of modality and the importance of an interlingual representation for modality. In our own

[14] The remoteness feature has only two values: [+Remote] vs. [-Remote]. It indicates the proximity of the proposition to the modalising act and is necessary e.g. for distinguishing different types of the conditional world.

research, we will try to show the adequacy of MoM by implementing more parts of it into ALT-J/E.

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Appendix: The modal worlds

World	*Examples* (Trigger Elements)[15] Category of Trigger Elements
Knowledge	E: *I **know** that he came.* Parenthetical Verb J: *Kare-ga kita-yo,* Particle
Belief	E*: I **might** have forgotten about it.* Modal Auxiliary J: ***Tabun** wasureta-**kamoshirenai**.* Adverb + Auxiliary
Probability	E: *You **must have** done it.* Modal Auxiliary + Tense J: *Anata-ga yatta **hazu-da**.* Formal Noun + Copula D: *Du **mußt** es **einfach** getan **haben**.* Auxiliary + Adverb + Tense
Evidential	E: *He **seems** to be ill.* Auxiliary D: ***Es sieht so aus, als ob** er krank ist.* Parenthetical Construction
Quotative	E: ***They say** he is going to resign.* Parenthetical Verb J: *Kare-ga jinin-suru **souda**.* Inflection + Auxiliary D: *Er **habe** keine Lust.* Mood
Recommendation	E: *You **better** go and see a doctor.* Adverb E: ***Perhaps** you **should** go and see a doctor.* Adverb + Auxiliary
Desire	E: ***If only** he could come here!* Conjunction + Adverb + Modal Auxiliary + Punctuation J: *Kare-ga **kitara-ii-na**.* Auxiliary + Adjective + Particle F: ***J'espère qu'**il **ne viendra**.* Parenthetical Verb + Particle + Tense
Plan	E: *I **want to go**.* Auxiliary + Non-finite Form J: *Ikou-**to omou**.* Auxiliary + Parenthetical Verb
Directive_ duty	E*: **Go** home!* Mood (Imperative) + Exclamation Mark J: ***Omae**-ga kaeru-**no-da**.* Person (“you”) + Formal Noun + Copula
Directive_ permission	E: *You **may** go home now.* Modal Auxiliary D: ***Geh ruhig** heim!* Imperative + Adverb

[15] The examples in the other languages are translations of the English example.

Appendix: The modal worlds (continued)

World	*Examples* (Trigger Elements)[16] Category of Trigger Elements
Normative_duty	E: *You* ***mustn't*** *swim here.* Modal Auxiliary D: ***Man darf*** *hier nicht schwimmen.* Person (impersonal) + Modal Auxiliary
Normative_ permission	E: *You* ***can*** *swim here.* Person + Modal Auxiliary J: *Koko-wa oyoi****de-mo-ii****.* Auxiliary + Particle + Adjective
Dynamic	E*: He* ***can*** *play the piano.* Modal Auxiliary J: *Kare-wa piano-wo hiku-****koto-ga dekiru****.* Formal Noun + Particle + Verb
Condition	E: ***If I were you, I would*** *not go to the party.* Conjunction + Clause Type + Auxiliary F: *A ta place, je n'****irais*** *pas à la fête.* Verbal Inflection
Interrogative	E*:* ***Is*** *he rich?* Word Order (Verb) + Punctuation J: *Kare-ga kanemochi-desu-****ka****.* Particle
Commissive	E: ***I will*** *do it.* Person + Auxiliary D: **Ich** mache es **wirklich**. Person (speaker) + Adverb
Comparative	E: *This is* ***like waiting*** *for Godot.* Particle + Non-finite J: *Sore-wa* ***marude*** *Godot-wo matteru-****you-da****.* Adverb + Formal Noun + Copula

[16] The examples in the other languages are translations of the English example.