Modality and Modal Sense Representation in E-HowNet[*]

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Abstract. This paper explains how we define and represent modality in E-HowNet. Following Lyons (1977, reviewed in Hsieh 2003, among others), we hold that modals express a speaker's opinion or attitude toward a proposition and hence have a pragmatic dimension and recognize five kinds of modal categories, i.e. epistemic, deontic, ability, volition and expectation modality. We then present a representational formalism that contains the three most basic components of modal meaning: modal category, positive or negative and strength. Such a formula can define not only modal words but also words that contain modal meanings and cope with co-compositions of modals and the negation construction.

Keywords: modals, E-HowNet, negation

1. Introduction

E-HowNet, which evolved from HowNet (Dong & Dong 2006), represents an effort to define our knowledge of concepts in the world. Unlike synonym-based frameworks (e.g. WordNet), E-HowNet defines a word by specifying the relationship, as indicated by a set of features, between a core concept to other concepts. Each concept can be further analyzed into atomic meaning units called sememes named after HowNet. Therefore, a word in E-HowNet can be defined with simple concepts, sememes, or a mixture of simple concepts and sememes interacting with features.

E-HowNet has been proved to be capable of dealing with various kinds of concepts, even some very abstract ones, some of which being function words (Chen 2005 et al.) and the comparison construction (Huang et al. 2006), both describing the relationship between concepts. The representation of modality through E-HowNet is informative about the representational capacity of the framework for three reasons. First, modality is a meaning domain suggesting the attitude of the speaker and has a pragmatic dimension. Second, modality is considered a

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subcategory of function words that also has properties of content words (Chen 2005 et al.). The definition of modality thus provides insights into how words that fall somewhere in the middle on the content-function word continuum are defined. Third, modals' co-occurrences with negation markers show discrepancies between surface structure and meaning, and serve as a on the content-function word continuum are defined. Third, modals' co-occurrences with negation markers show discrepancies between surface structure and meaning, and serve as a testing ground for the defining capability of the framework.

In E-HowNet, the word to be defined is assigned a head, which is semantically and syntactically similar to it. Then, words that describe the head are linked to the head through features. For example, the word 小子 *xiaozi* 'lad' refers to someone who is young. Therefore, we represent the word with the head 人 *ren* 'person' and the modifying word 年幼 *nianyou* 'young'. Since 年幼 *nianyou* refers to the age of the person, the two concepts are linked by the semantic role 'age.' Its representations are as the following, with the first defined by simple concepts and the second by sememes:

(1) 小子 *xiaozi* 'lad'

<div align="center">
def: {人:age={年幼}}

def:{human|人:age={child|少兒}}
</div>

Eventually, the meaning of words and phrases in E-HowNet will be integrated for the semantic representation of sentences.

The organization of the paper is as follows: In Section 2, we state the definition of modality in E-HowNet. In Section 3, we explain how modals are represented as single words and as components of larger linguistic constituents. In Section 4, we deal with the co-occurrence of negation markers and modals. We show with that E-HowNet is able to cope with meanings that are determined by its relative position with other elements in a sentence. Following that, in Section 5, we conclude that E-HowNet can represent a semantic category like modality that (a) involves pragmatics and (b) belongs to function words but is like content words in some aspects.

2. The scope of modality

Following Hsieh (2005), we do not assume that modals have to be auxiliaries but identify them on semantic grounds. They all refer to speakers' judgment. There are two meanings unanimously recognized as central to modality: epistemic and deontic. The former refers to a speaker's judgment of whether a situation will happen and the latter to a speaker's attitude toward whether something is required to be done. Another two categories admitted by many researchers are words that denote abilities and volition (Hwang 1999, Li 2003, Hsieh 2003, Hsieh 2005). Another modal category that we recognize is expectation, which includes words

that describe whether a situation's taking place is expected or not. Below we summarize the five kinds of modal categories adopted by the current study, each followed by some examples:

Epistemic: judgment that something will (not) happen:

e.g. 絕對 '*juedui* 'absolutely,' 會 *hui* 'will,' 也許 *yiexu* 'maybe,' 不一定 *buyiding* 'not necessarily,' 不可能 *bukeneng* 'impossible,' 未必 *weibi* 'not necessarily'

Deontic: judgment that something is (not) allowed to happen due to the speaker's will or social or ethical reasons:

e.g. 可以 *keyi* 'may,' 應該 *yinggai* 'be supposed to,' 理當 *lidang* 'be supposed to,' 不該 *bugai* 'be not supposed to,' 不應 *buying* 'be not supposed to,' 不可 *buke* 'may not'

Ability: judgment that someone/something is (in)capable of something:

e.g. 能 *neng* 'be able to,' 會 *hui* 'can,' 不能 *buneng* 'cannot,' 不會 *buhui* 'cannot'

Volition: judgment that someone is (un)willing to do something:

e.g. 想 *xiang* 'hope to,' 不想 *buxiang* 'does not want to'

Expectation: judgment that something was (not) expected to happen or someone was (not) expected to do something:

e.g. 果然 *guoran* 'as expected,' 果真 *guozhen* 'as expected,' 不出所料 *buchusuoliao* 'as expected,' 竟然 *jingran* 'unexpectedly,' 不料 *buliao* 'unexpectedly,' 沒想到 *meixiangdao* 'unexpectedly'

The above examples tell three things about our identification of modals. First, besides auxiliaries, some adverbs are also considered modals, e.g. 果然 *guoran* and 沒想到 *meixiangdao*. Second, like Hsieh (2003), we think that some modals express a positive meaning whereas the others express a negative meaning. The former half of the examples of each modal category is on the positive side whereas the latter is on the negative side. Third, like most researchers, we believe that modals within the same category differ in modal strength (Hwang 1999, Li 2003, Hsieh 2003, Hsieh 2005). Lyons (1977, reviewed in Hsieh 1999) thinks the basic definition of modality is a semantic scope that refers to possibility and necessity, two meanings that differ in strength of assertion. Such a definition suggests that, within the same modal category, modals that express that a judgment is possible is weaker in modal strength than those that express that a situation is necessary. For example, in epistemic modality, the modal 也許 *yiexu* 'maybe' indicates the speaker's speculation that something might happen, whereas the modal 一定 *yiding* 'certainly' conveys the speaker's certainty for something to take place. 一定 *yiding* thus has stronger modal strength than 也許 *yiexu*. Therefore, for each modal category, we adopt two sememes to scale modal strengths:

ish|稍: sememe signaling weak to moderate modal strength.

extreme|極: sememe signaling strong modal strength

3. The representation of modals and words/sentences that contain modal meanings

In Section 2 we have described in brief the representation of meaning in E-HowNet.

We have proposed five modal categories. Besides, we believe that each category consists of modals that express positive and negative meanings. Finally, we give grades for modal strengths. The complete inventory of modal meaning representations is as follows:

Epistemic: possibility={extreme|極}; possibility={ish|稍};
impossibility={extreme|極}; impossibility={ish|稍};
Deontic: allowance ={extreme|極}; allowance ={ish|稍};
disallowance ={extreme|極}; disallowance ={ish|稍};
Ability: capacity={extreme|極}; capacity={ish|稍};
incapacity={extreme|極}; incapacity ={ish|稍};
Volition: willingness ={extreme|極}; willingness ={ish|稍};
unwillingness={extreme|極}; unwillingness={ish|稍};
Expectation: expectedness={extreme|極}; expectedness ={ish|稍};
unexpectedness ={extreme|極}; unexpectedness ={ish|稍};

In the following table we give an example for each modal meaning:

Table 1: Examples of each modal meaning

	strength	negative/positive	example
epistemic	ish|稍	possibility	也許 'maybe'
		impossibility	未必 'maybe not'
	extreme|極	possibility	絕對 'absolutely'
		impossibility	不可能 'impossible'
deontic	ish|稍	allowance	可以 'may'
		disallowance	不用 'do not have to'
	extreme|極	allowance	必須 'must'
		disallowance	不應該 'be not supposed to'
ability	ish|稍	capacity	會 'can'
		incapacity	不克 'not really can'
	extreme|極	capacity	能 'be able to'
		incapacity	不會 'cannot'
volition	ish|稍	willingness	想 'hope to'
		unwillingness	不想 'do not hope to'
	extreme|極	willingness	要 'want to'
		unwillingness	不要 'do not want to'
expectation	ish|稍	expectedness	果真 'really'
		unexpectedness	不料 'unexpectedly'
	extreme|極	expectedness	果然 'as expected'
		unexpectedness	竟 "very unexpectedly"

3.1 The representation for modal words

Some words have modal representation in E-HowNet simply because they are modals. Take 也許 *yiexu* 'maybe,' a word that belongs to epistemic modality, for example. It is an epistemic modal and hence has the meaning of possibility, has a low modal strength and hence is indicated by {ish|稍}, and expresses a positive meaning:

(2) 也許 *yiexu* 'maybe'

$$\text{def: possibility}=\{\text{ish}|稍\}$$

3.2 The representation for compound words that have inherent modal meanings

Modal representations also appear in words that are not modals themselves but have modal implications. For example, in expressing potential forms, we use a modal representation to modify the head, which is a verb:

(3) 信得過 *xindeguo* 'can trust'

$$\text{def:\{believe|相信:capacity=\{ish|稍\}\}}$$

3.3 The representation for linguistic constituents that are not modals but have modal meaning

So far, we have talked about the modal representation of either modals or particular forms. In fact, the representation may also appear in any linguistic constituent that contains modal meaning. For example:

(4) 毋遺後患 *wuyihouhuan* 'Get rid of potential threats'

def: {PassOn|留給:possession={mishap|劫難},disallowance={extreme|極}}

4. The interaction between modals and negation markers

The meaning of a modal differs when occurring in different relative positions with the negation marker. Therefore, to show that E-HowNet can capture such meaning shifts is to show that the framework is able to cope with contextual variance and achieves near canonical meaning representation.

The meaning as a result of the interaction between words that mean negation and modals can have two modal strengths: lower and higher on both the positive side and negative side of modal meanings, as shown in the following diagram:
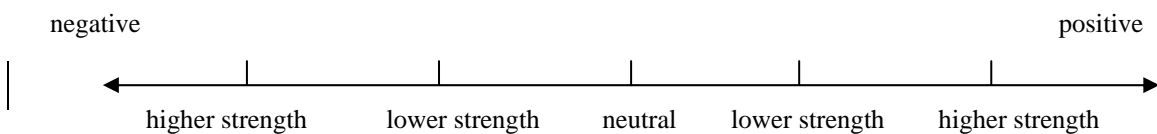

Figure 1: Scale of modal strength

We call modals with weak modal strength (i.e. represented by ish|稍) "ish modals" and modals with strong modal strength (i.e. represented by extreme|極) "extreme modals". According to Li (2003), the combinations (a)*Neg+Mod+V*, (b) *Mod+Neg+V*, and (c) negation forms+V show different behaviors.

Some modals and negation markers can co-occur in the constructions *Neg+Mod+V* and *Mod+Neg+V*: some modals have more than one sense and can occur in a negation construction only under one reading. We will discuss the behaviors of ish modals and extreme modals separately. As will be seen, the two kinds of modals usually experience a shift in modal strength when occurring in the Neg+Mod+V construction but not in the Mod+Neg+V construction.

4.1 The *Neg+Mod+V* construction

4.1.1 Ish modals

If a {ish|稍} type modal co-occurs with a negation marker in the construction *Neg+Mod+V*, the scope of negation is almost always over the modal strength, with the modal meaning negated and turned to carry a {extreme|極} meaning. We call such phenomena a 'scale shift.'

For example, the representation for a sentence like 他不可能來 *Ta bu keneng lai* 'It is impossible for him to come,' which contains the construction *Neg+Mod+V,* would be as below:

(5) 他不可能來

   Ta bu keneng lai

   he Neg possible come

  'It is impossible for him to come.'

    def:{come|來:agent= {3rdPerson|他人:gender={male|男}}, impossibility=_{extreme|極}}

While 可能 *keneng* is a ish modal, in 不可能 *bu keneng* the value of modal strength becomes {extreme|極}, showing a scale shift.

4.1.2 Extreme modals

Likewise, most of the extreme modals that can occur in the construction have the modal strength negated. For example:

(6) 你不必來

   Ni bu bi lai

   you Neg must come

   'You do not have to come.'

         def: {come|來:agent={listener|聽者},disallowance={ish|稍}}

While 必 *bi* 'must' is an extreme modal, 不必 *bu bi* 'does not have to' is represented with {ish|稍}, indicating a scale shift caused by the negation marker *bu* before the modal.

   However, that *bu* before a modal induces a scale shift is not without exceptions. For example, as seen in Table1, the volition modals 要 *yao* 'want to,' which is an extreme modal, and 想, *xiang* 'hope to, which is an ish modal, retain their scale in 不要 *bu yiao* 'do not want to' and 不想 *bu xiang*, 'do not hope to.' We have not come to an explanation of this.

4.2 The *Mod+Neg+V* construction

4.2.1 Ish modals

All ish modals can occur in the construction, which entails the negation of the proposition

following the negation marker. For example, 他可能不來 *Ta keneng bu lai* 'He will probably not come' is represented as below:

(7) 他可能不來

    Ta keneng bu lai

    he maybe Neg come

    'He will probably not come.'

    def:{.not.come|來:agent={3rdPerson|他人:gender={male|男}},possibility={ish|稍}}

4.2.2 Extreme modals

All of the extreme modals convey the negation of the proposition after the negation marker. So, 不帶雨傘想必不要緊 (as in 看這大太陽，不帶雨傘想必不要緊 'It should be safe not to bring an umbrella--Look at the shinning sun!') *Bu dai yusan xiangbi bu yaojin* 'It should be safe not to bring an umbrella' is represented as follows:

(8) 不帶雨傘想必不要緊

    Bu dai yusan xiangbi bu yaojin

    Neg bring umbrella must Neg-matter

    'It should be safe not to bring an umbrella.'

    .def: {.not.important|重要:theme={.not.bring|攜帶:patient={tool|用具:telic={obstruct|阻
        止:instrument={~},patient={RainSnow|雨雪}}}},possibility={extreme||極}}

Again, 想必 remains an extreme modal in the Mod+Neg+V construction 想必不要緊 *xiangbi bu yiaojin*.

4.4 Sense ambiguity

We mentioned in the beginning of this section that some modals belong to more than one category but can only occur with the negation marker under one reading. The following is an example:

(9) 他可以開車

    Ta keyi kaiche

    he may/can drive

    'He is allowed/knows how to drive.'

def:{drive|駕馭:patient={LandVehicle|車},agent={3rdPerson|他人:gender={male|男}},allowance={ish|稍}}

and

def:{drive|駕馭:patient={LandVehicle|車},agent={3rdPerson|他人:gender={male|男}},capacity={ish|稍}}

(10) 他不可以開車

    Ta bu keyi kaiche

    he Neg may drive

    'He is not allowed to drive.'

def:{ drive|駕馭:patient={LandVehicle|車},agent={ 3rdPerson|他人:gender={male|男},disallowance={extreme|極}}

The 可以 *keyi* 'may/can' in the first sentence can have either a deontic meaning or refers to the ability of the subject. However, the second sentence has to denote a deontic meaning. Some of the modals that show similar behaviors include:

要 *yao* 'will/want to': which belongs to the epistemic, deontic, and volition modality but has to denote an epistemic or deontic meaning in *Mod+Neg+V*.

會: which belongs to either the epistemic or the ability modality but has to denote an epistemic meaning in Mod+Neg+V. For example, 他會不來嗎? *Ta hui bu lai ma* 'Is it possible that he won't come?' can only have an epistemic reading.

5. Conclusion

Our representation of modals shows that E-HowNet is able to cover a meaning domain like modality that has qualities of content and function words and is also linked to pragmatics. It is also shown that the interaction between modals and negation markers and modals can be represented in a coherent way using a few features. This indicates that the framework is also able to represent words that have the same components but which are ordered differently, e.g. words that appear in the *Neg+V+Mod* and the *Mod+Neg+V* construction.

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