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Sense Representations for Extended Modalities in E-HowNet

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Sense Representations for Extended Modalities in E-HowNet

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1 Introduction

In E-HowNet, evaluative adverbs that express speaker's viewpoint are represented by relation roles of *attitude* and *modality*, for example, we define 著實 *indeed* as `def:attitude({speaker|說話者})={emphasize|著重}` and 必然 *certainly* as `def:possibility={extreme|極}`. Extended from conventional epistemic and deontic modalities, there are five modal categories, i.e. epistemic, deontic, capability, volition and expectation (Chung 2007). Since modal senses express speaker's evaluation for possible world events, they can be represented by the expression of the form `modal({event|事件})={DegreeValue|程度值}`, such as `possibility({leave|離開})={extreme|極}`. Most modal meanings are lexicalized by adverbs in Chinese, such as 可能 *possible*, 必須 *necessary* etc. However some modal meaning words may be head verbs of sentences which may or may not express the speaker's evaluations or attitudes, for instance 他願意來 *he is willing to come*. We consider the representational problems of adverbial and verbal expressions with modal senses. For instance, the modal adverb 不許 *must not* and the verb 礙難照准 *cannot approve something* are represented as `def:necessity={least|無}` and `def:not({permit|允許})` respectively, we need to explain what is the relation between the specific act of `{permit|允許}` and its relevant modal relation *necessity*. Do they have entailment relation? On the other hand, 能 *be able to* and 擅長 *be good at* are represented as `def:ability={very|很}` and `def: {able|能:degree={very|很}}` respectively, what are sense similarity and difference between *ability* and *able*? These are many questions need to be further explored. Our objective is not only to clarify the modal categories and distinguish the fine-grained senses for modalities, but also to illustrate the similarities and differences of adverbial modalities and other relevant verbs so that to achieve better sense representations for them.

In what follows, we state the re-adjusted modal scope in Section 2.1. In Section 2.2, we address the degree of modal sense and how we adopt degree values to represent senses of modal adverbs. The coarse-grained and fine-grained modal senses which determined by degree and the cause of evaluation are described respectively in Section 2.3 and 2.4. Following that, in Section 2.5 we raise the issue of contextual effects on meaning shifting between modal and general evaluative adverbs. In Section 2.6, we address the representation formulation of entailment relation between modal adverbs and verbs. Finally, we conclude our theory in Section 3.

2 The Representation of Modality in E-HowNet

2.1 The Scope of Modality

Lyons (1977) distinguished the notion of “linguistic meaning” into three components: descriptive meaning, social meaning and affective meaning. Affective meaning represents the speaker's or writer's feelings, moods, dispositions, and attitudes toward the propositional content of the message and the communicative context. Modal categories belong to affective meaning and are used to evaluate some piece of knowledge in a possible world; most of researchers reckon modalities only express epistemic and deontic senses and they can actually affect the true false values of a sentence. Previously, we adopted a more open perspective (Hwang 1999, Li 2003, Hsieh 2003, Hsieh 2005) which admits capability, volition and expectation are also within modal categories because in a certain extent they are in line with the feature of “evaluating some piece of knowledge in a possible world” on semantic grounds, but not necessary auxiliaries. For example, the modal senses in 足可 *be enough to*, 願聞其詳 *would like to know the detail* and 可望 *has been expected* are all point to assess knowledge in a possible world. However, we find these categories are closely related with specific events like {able|能}, {willing|願意} and {expect|期望} which in general, may not denote the sense of “evaluating some piece of knowledge in a possible world”. That is, included capability, volition and expectation senses into modal categories may cause confusion on semantic expressions of verbs like 能 *be able to* def: ability={very|很} and 擅 *be good at* def: {able|能:degree={very|很}}; 以期 *hope for* def: {expect|期望} and 不期 *unexpectedly* def: AsExpected={ish|稍}.¹ Furthermore both pairs of concepts, {ability|能力} and

¹ The senses of function words and content words are represented differently in E-HowNet. The

{able|能}, {AsExpected|意料中} and {expect|期望}, have shared core sense of {able|能} and {expect|期望} respectively, but have seemingly unrelated conceptual representations. Therefore we re-adjust our classification that only epistemic and deontic senses are regarded as pure modality since lexemes with these two senses are mostly adverbs. The other three modal senses of ability, willingness and expectedness and their verbal counter meanings will be represented by a better way. The modal categories in E-HowNet sense representation system thus can be illustrated as Figure 1.



Figure 1: Modal Categories in E-HowNet Sense Representation System

2.2 Senses and Arguments of Modalities

All modalities have a common ground sense of “speaker’s evaluation for some pieces of knowledge in a possible world” and express different relational senses. For instance, “possibility” evaluates the probability of an event becoming true. Modal sense could be realized by different syntactic constructions, such as modal auxiliaries, modal verbs, adverbs, nouns etc. Followings are examples in Chinese.

(1) Modal adverb

張三很可能在家 Zhang San is likely at home.

former is expressed simply by relation roles while the latter is represented by specific entities. The following examples show their representational differences.

Modal adverb 能 *be able to* is defined as def:ability={very|很} while 能吃 *be able to eat* is expressed as def:{eat|吃:ability={very|很}}

Content word 擅長 *be good at* is defined as def: {able|能:degree={very|很}} while 擅長電腦 is expressed as def: {able|能:content={電腦|computer},degree={very|很}}.

(2) Noun + Adjective (Stative verb)

張三在家的可能性很高 *It is highly possible that Zhang San is home.*

(3) Stative Verb

張三在家這件事很可能 *It is likely that Zhang San is at home.*

The above three sentences have the same meaning. In this paper, we do not concern the problem of how to discriminate modal senses and non-modal senses. Our major concern is how to represent the modal senses and verbal senses such that under the framework of the E-HowNet sense representation, the semantic composition process may produce same or very similar expressions for the above three sentences. The semantic expression for them could be `def:possibility({張三在家 | Zhang San at home })={很可能 | is likely}`.

2.2.1 Possibility

The modality of *possibility* denotes epistemic guessing towards a possible event. It is a binary relation to express the probability of the host event to be true. The general semantic expression for possibility is `def:possibility({event | 事件})={DegreeValue | 程度值}`. For example, the sense of modal adverb 必定 *definitely* is represented as `def:possibility={extreme | 極}` and the sentence of 他必定來 *he will come definitely* is expressed as `def:{come | 來 : agent={3rd person | 他 }, possibility={extreme | 極}}`.

2.2.2 Necessity

The modality of *necessity* denotes deontic demand towards a future event. Similarly, *necessity* is also a binary relation which is used to express necessity of an action. For example, the sense of modal adverb 必須 *must* is represented as `def:necessity={extreme | 極}` and the sentence of 他必須來 *he must come* is expressed as `def:{come | 來 : agent={3rd person | 他 }, necessity={extreme | 極}}`. Epistemic and deontic are recognized as two major modalities. However, addressing semantic overlapping, *necessity* is not as simple as *possibility*, there are several specific events like {permit | 允許} and {agree | 同意} related with *necessity* which need to be discriminated and we will discuss the issue at the Section 2.6.

2.2.3 The Other Extended Modalities

As for the sense representation for the other modal-like adverbs, such as the words contain the sense of capability and volition, instead of creating new modal relations to describe them, we composite existing primitive concepts of {degree|程度}, {able|能} and {willing|願意} to create the expressions of degree({able|能}) and degree({willing|願意}) to denote the senses of capability and volition. The primitive concepts {able|能} and {willing|願意} are physical state and mental state to express verbal senses of *be good at* and *willing* respectively. Thus *ability*=def degree({able|能}) and *willingness* =def degree({willing|願意}). Both modal relations accept degree values as their values, such as 不孕 *barren* is defined as def: {pregnant|懷孕:ability={least|無}}, and more examples are shown in (6). We also found there are many non-adverbial usages for words of the sense of *ability* and *willingness* in Mandarin Chinese which express *able* and *volition*, such as the state verb 在行 *be expert at* and the mental act 願意 *willing*. Thus the representative expressions for 在行 *be expert at* is def:{able|能} and 願意 *willing* is def:{willing|願意}. For more examples, 力不從心 *unable to do as much as one wants to* is defined as def: {able|能:degree={least|無}}, 依依不捨 *can't bear to part* is defined as def: {willing|願意:content={leave|離開},degree={ish|稍}} and 誓不甘休 *do not let it go at that* is defined as def:{willing|願意:content={cease|停做},degree={least|無}}. In contrast, 能睡 *be able to sleep* and 願離開 *willing to leave* can be expressed as def:{sleep|睡:ability={very|很}} and def:{leave|離開:willingness={very|很}} in which both *able* and *willing* became adverbial modifiers, if they have modal senses. Nevertheless representational formats for adverb or head verb are convertible each other.

Unlike the case of degree({able|能}) and degree({willing|願意}), the sense of {AsExpected|意料中} cannot be expressed as a simple compositional relation with the mental act {expect|期望} directly, their semantic connection can be exemplified by the sense definition of 果然 *as expected* in (4):

- (4) 果然 *as expected* def:AsExpected({event X})={extreme|極}, which equals to def:similarity({result({expect|期望})),{event X})={extreme|極}, where *event X* denotes the co-referenced event.

Therefore, we adopt the mental state {AsExpected|意料中} to indicate how a proposition meets expectations. Strictly speaking, {AsExpected|意料中} does not

have the sense of “evaluating some piece of knowledge in a possible world”, so should not be considered as a modal sense. However its adverbial usages are very common and the examples are shown in (7).

After restructuring, the new representational formalism can express modal senses and still maintain related event senses without overlapping and ambiguity. Each modal category includes plenty of adverbs whose coarse-grained sense can be distinguished by their strength, so we divide strength to four degrees to initially classify modal sense into four groups, as discussed in the following section.

2.3 The Coarse-Grained Modal Senses with Four Degree Levels

In E-HowNet sense representation system, modality is expressed as event roles which have specific values. We find *degree*, another event role in E-HowNet, whose values, i.e. {extreme|極}, {very|很}, {ish|稍} and {least|無}, can be adopted to express modal values, as shown in (5).

(5) Modal Values

- PossibilityValue

possibility= {extreme|極} e.g. 一定 *must*, 包準 *certainly*, 早晚 *sooner or later*, 自應 *should be*

possibility= {very|很} e.g. 八成 *most likely*, 看起來 *it looks as if*, 理應 *probably*

possibility= {ish|稍} e.g. 也許 *maybe*, 說不定 *perhaps*, 難保 *dare not guarantee*

possibility= {least|無} e.g. 不會 *won't*, 絕非 *definitely not*, 不可能 *impossibly*, 萬無 *certainly won't*

- NecessityValue

necessity= {extreme|極} e.g. 務必 *should*, 不能不 *have to*, 必須 *must*, 不得已 *have no alternative*

necessity= {very|很} e.g. 本該 *basically should*, 不妨 *might as well*, 最好 *had better*, 自當 *ought to*

necessity= {ish|稍} e.g. 不必 *not have to*, 毋須 *not have to*, 不需 *no need*

necessity= {least|無} e.g. 不行 *not be allowed*, 切莫 *must not*, 休想 *don't imagine that it's possible*

In addition to the typical modals, other modal-like adverbs can also be represented in the same way, for example, we define adverbs that express the senses of capability and expectation as following examples in (6) and (7).

(6) CapabilityValue

- ability={extreme|極} e.g. 必能 *be capable of*
ability={very|很} e.g. 足可 *be enough to*, 禪能 *can*, 得起 *afford*
ability={ish|稍} e.g. 無從 *have no way of doing something*, 不過 *fail to*, 不了 *incapable*
ability={least|無} e.g. 不克 *unable to*, 無法 *cannot*, 不能夠 *fail to do*

(7) AsExpectedValue

- AsExpected={extreme|極} e.g. 果真 *as expected*, 無怪 *no wonder*
AsExpected={very|很} e.g. 終究 *eventually*, 可想而知 *it can be seen that*, 畢竟 *after all*
AsExpected={ish|稍} e.g. 沒想到 *unexpectedly*, 說也奇怪 *strangely*, 豈料 *unexpectedly*
AsExpected={least|無} e.g. 居然 *to one's surprise*, 甚至於 *even (to the point of)*, 竟敢 *have the impertinence to*

There is no adverb to denote *willingness* in Mandarin Chinese and all words of the sense *willing* are considered as mental-act verbs, such as 願意 *willing*, 有意 *intend*, 甘願 *willing* etc. They are all expressed as def:{willing|願意} and have the part-of-speech V.

Modal sense representation applies not only to adverbs but also to verbs that contain modal sense. For example, 可燃 *combustible* is defined as def:{burn|焚燒:ability={very|很}} and 首要條件 *the necessary condition* is defined as def:{condition|條件:necessity={extreme|極}}. Similarly, such an expression can also express modal meanings, take *necessity* as an example:

(8) The Sense Composition for Sentences with *necessity*

你務必前來 *you have to come.*

Def:{come|來:theme={你|you}, necessity={extreme|極}}

你不妨前來 *You might as well come.*

Def:{come|來:theme={你|you}, necessity={very|很}}

你不需前來 *You need not to come.*

Def:{come|來:theme={你|you}, necessity = {ish|稍}}

你切莫前來 *You should not come.*

Def:{come|來:theme={你|you}, necessity = {least|無}}

In general, a modal relation like general relations, such as color, name, weight etc., takes two arguments. One is the host event for evaluation and another is evaluation result of degree value. Its logical expression is $\text{def:modal}(\text{HostEvent|事件})=\{\text{DegreeValue|程度值}\}$. In the above sentences, the two arguments of *necessity* are *come* as host event and {extreme|極}, {very|很}, {ish|稍}, {least|無} are four different scales of degree values. The argument of host event is omitted in the expression of $\text{necessity}=\{\text{Value}\}$ since it happens to be the head of the sentential expression. Examples for the uses of other modality are shown in (9).

(9) 他沒法參加 *He is unable to come.*

Def:{參與|ParticipateIn:theme={他|he},ability={least|無}}

他竟然逃走 *He run away unexpectedly.*

Def:{flee|逃跑:agent={他|he},AsExpected={ish|稍}}

他寧可挨餓 *He would rather starve.*

Def:{HungryThirsty|飢渴:experiencer={他|he}, willingness={very|很}}

Adverbial usages of modalities are expressed as two argument relations. However, non-adverbial usages of modal verbs might occur for *able*, *willing* and *AsExpected* as mentioned before. Their event frames take three arguments, i.e. theme (or experiencer), content event, and degree value. The modal expressions for adverbial and verbal usages can be summarized in two formulations as given in (10a) and (10b) respectively.

(10) a. {content event: subject({content event})={}, modal={degreeValue}}

e.g. 我一步也走不動 *I cannot walk any more.*

def:{walk|走:theme={我|I},ability={least|無}}

e.g. 父親不願承擔責任 *Father is unwilling to take responsibility.*

def:{bear|承擔:experiencer={父親|father},willingness={least|無}}

e.g. 伊拉克居然攻打美國船 *Iraq attacked the United States ship surprisingly.*

def:{attack|攻打:agent={Iraq|伊拉克},patient={ship|船:possessor={US|美國}},AsExpected={least|無}}

b. {modal verb: Theme(modal verb)={}, content event={}, degree={degreeValue}}

e.g. 劉邦長於持久戰 *Liu Bang is good at protracted war.*

def:{able| 能 :theme={ 劉邦 | LiuBang },content={ 持久戰 | ProtractedWar},degree={very|很}}

e.g.我對爭冠志在必得 *I was determined to win the title race.*

def:{willing| 願意 :experiencer={ 我 |I},content={ 爭冠 | WinTheTitleRace },degree={extreme|極}}

e.g. 他這樣做是我始料不及的 *What he did was not my expected.*

def:{AsExpected|意料中: experiencer={我|I}, content={他這樣做| he did}, degree={least|無}}

2.4 Fine-Grained Differences of Modal Senses

The coarse-grained classification for modal adverbs is according to their modal senses and different degree values as shown in (5, 6, 7), we want to further breakdown modal sense into fine-grained classifications by adding further semantic features. The modal senses can be arranged in the following hierarchy with differentiation features in front and after each of classification we exhaustively list the epistemic and deontic modal adverbs in Mandarin Chinese.

+epistemic

+extremely possible 無疑, 諒必, 十拿九穩, 十之八九, 八成, 穩, 鐵定, 不用說, 包準, 准, 準, 準定, 必, 必定, 必然, 絕, 絕對, 必不可免

+naturally 勢必, 勢所必然, 勢將

+by fate 命中注定, 注定

+very possible 理當, 理該, 理應, 該, 應, 應當, 應該, 自當, 自應, 大半, 多半, 大抵, 大致上, 想來, 想必, 想當然, 不消說, 無非, 定, 一定, 會, 總會, 當然, 無可避免, 不免, 難免, 免不了, 免不得

+naturally 自, 自然, 自是

+time-bound 早晚, 遲早, 或早或晚

+observation 看情形, 看樣子, 看上去, 看上來, 看來, 看起來, 聽來, 聽起來, 由此看來, 由此觀之

+low possible 好像, 彷彿, 彷彿, 似乎, 似, 似是, 敢情, 說不定, 搞不好, 容或, 恐怕, 大概, 也許, 或, 或者, 或許, 可能, 不至於, 不致, 不

致於, 不一定, 不見得, 未必, 未見得, 不盡然, 難保
+least possible 不可能, 不會, 絕不, 萬無, 決不, 絕非

+deontic

+extremely necessary 必須, 必需, 要, 得, 務, 須, 需, 給, 須要, 必, 必要, 必得, 須得, 務必, 務期, 務須, 務求, 自必, 直須, 尤須, 但須, 只得, 總得, 不能不, 不得不, 非, 非得, 不得已, 逼不得已, 情非得已, 迫不得已, 萬不得已, 逼不得已, 只好, 只有, 祇好, 祇有

+naturally 勢必, 勢須, 勢所必然

+time-bound 終須

+question 何須, 何必

+very necessary 理該, 當, 該, 該當, 應, 應當, 應該, 亟應, 正該, 自當, 自應, 本當, 本該, 自應, 理當, 理應, 宜, 宜於, 最好

+question 應否

+low necessary 能, 能夠, 可, 可以, 不為過, 未嘗不可, 尚無不可, 倒不如, 何妨, 何傷, 不妨, 無妨, 可要, 即可, 不必, 不須, 用不著, 大可不必, 不用, 不需, 毋庸, 毋須, 弗, 免, 甬, 無庸, 無須, 無需

+question 可否, 能否, 豈能, 怎能, 焉能, 豈可, 有何不可

+least necessary 不可, 不可以, 不行, 不准, 不容, 不得, 不許, 切勿, 切莫, 斷斷不可, 斷不能, 萬萬不可, 休想, 莫須, 不應該, 使不得, 不要, 不能, 勿, 毋, 別, 莫

2.5 The Similarities and Differences of Modal and Evaluative Adverbs

Modal categories, with the criterion of “evaluating some piece of knowledge in a possible world”, belong to affective meaning. That is, modalities entail the adverbial function of evaluation for an event. The modal verbs for *able*, *willing*, and *AsExpected* may or may not have the sense of “evaluating some piece of knowledge in a possible world”. However we do make the different representational expressions as shown in (10).

In E-HowNet, we use relation role of *attitude* and *modality* to describe affective meaning, several examples have been shown for modal representation in previous discussion, and examples that demonstrate the use of *attitude* are given in (11) before we further discuss the similarities and differences between *attitude* and *modality*.

- (11) 未免 *a bit too* Def:attitude({speaker|說話者})={not({agree|同意})}
 膽敢 *to have the audacity to* Def:attitude({speaker|說話者})= {angry|生氣}
 何必 *why on earth* Def:attitude({speaker|說話者})= {doubt|懷疑}
 絕對 *absolutely* Def:attitude({speaker|說話者})={emphasize|著重}

There is a question likely to be raised. Can we distinguish a modal adverb from general evaluative adverbs? For example, 絕對 *absolutely* is a general evaluative adverb that denotes emphatic mood towards a proposition as exemplified by the example 西藥絕對治不好精神病 *Western medicine absolutely cannot cure mental disease*. However, in the context of 明天絕對是晴天 *Tomorrow will be a sunny day absolutely*, it could be a modal word denotes the possibility of a proposition, is it an ambiguous case? Or simply the contexts transfer the semantic focus of 絕對 *absolutely*?

It is obvious that modal senses may not necessary derived from modal adverbs as illustrated by the examples in the Section 2.2. Similarly, with the different contextual words, the sense of 絕對 *absolutely* may shift from attitude({speaker|說話者})={emphasize|著重} to possibility={extreme|極}, it expresses a kind of speaker attitude, and the difference between the two representation is only the shift of semantic focus but not an ambiguous senses. In lexical level, a slight semantic difference can affect our representation, for instance, we defined the near-synonyms 竟敢 *have the impertinence to* as def:AsExpected={least|無} in (7) and 膽敢 *have the audacity to* as def:attitude({speaker|說話者})= {angry|生氣} in (11). Apparently, 竟敢 *have the impertinence to* is more modal-like, which expresses an unbelievable mood towards a just occurred event, than 膽敢 *have the audacity to*, which expresses the anger of the speaker. However both words also entail the sense of attitude({speaker|說話者})={not({agree|同意})}.

Even though the semantic expressions can differentiate the modal sense and verbal sense representations, it is hard to make distinction, since the true modal sense must depend on the context provided by the utterances. In fact there is actually no strict difference between modal words and general evaluative adverbs. For example, one may argue that although the words like 果真 *as expected* and 居然 *to one's surprise* are normally used to evaluate the events have already happened, but in interrogative sentences like 關鍵果真在人? *Is the key point really on the people?* Or 他居然沒死? *Didn't he actually die?* The speaker has not known the

answer yet, that is, they do not violate the criterion of evaluating the proposition in a possible world. It seems the same case with 絕對 *absolutely* we just mentioned above, i.e. the lexical classification cannot fully distinguish the modality expression, and it is why the definition and classification for modal words raise so much discussion.

2.6 Representation of Entailment between Modal adverbs and Verbs

Finally, we want to further address how we represent the relation between modalities and mental acts when the former entails the latter, as we have revealed in (4) for *AsExpected* taking {expect|期望} as precondition. Similarly the semantic relations between *able* and *ability*, *willing* and *willingness* are expressing same event but different focuses as shown in (12 a, b).

(12) a. 能睡 *be able to sleep*

def:{able|能: content={sleep|睡}, degree={very|很}} vs.
def:{sleep|睡: ability={very|很}}

b. 依依不捨 *can't bear to part*

def: {willing|願意: content={leave|離開}, degree={ish|稍}} vs.
def: {leave|離開: willingness={ish|稍}}

Regarding *necessity*, we can logically infer that $necessity(\{event X\})=\{DegreeValue Y\}$ implies $possibility(\{event X\})=\{DegreeValue Y\}$. Also it is logically plausible that $necessity(\{event X\})=\{DegreeValue Y\}$ implies that speaker {permit|允許} the event X with degree value Y.

As a consequence, we can represent the entailment relation between *necessity* and its relevant verbs as the formulas in (13).

(13) 理應 *should* def:necessity({event X})={very|很}, which entails

def:{agree|同意: degree={very|很}, experiencer={speaker|說話者}, content={event X}} where *event X* denotes the co-referenced event. Or

務必 *must* def:necessity({event X})={extreme|極}, which entails

def:{permit|允許: degree={extreme|極}, agent={speaker|說話者}, content={event X}} where *event X* denotes the co-referenced event.

3 Conclusion

In this paper, we re-adjust the modal scopes of E-HowNet ontology to a unanimous classification with the criterion of “evaluating some piece of knowledge in a possible world”, that is, only adverbial usages of modal senses are regarded as modality and the other modal-like verbal usages for capability, volition and expectation, though have different representational formulation, do not necessary violate above criterion if they are contextual modalities in sentential level. We believe the true modal sense must depend on the context provided by the utterances, but should not be restricted to a given set of words. On the other hand, considering achieving a distinguishable sense representation system, i.e. avoiding sense overlapping and confusion, we have to take both modal expression and general verbal expression into account. In fact, it is the very reason we express capability, volition and expectation in terms of verbal senses of {able|能}, {willing|願意} and {expect|期望}.

Nevertheless, the representative formulation for modalities and modal-like adverbs are similar, we use a uniform value representational system for modals which is the same as the values for event role *degree*, i.e. {extreme|極}, {very|很}, {ish|稍} and {least|無}, which can appropriate express modal sense as examples listed below:

果真 <i>as expected</i>	def:AsExpected={extreme 極}
足可 <i>be enough to</i>	def:ability={very 很}
也許 <i>maybe</i>	def:possibility={ish 稍}
不容 <i>not tolerate</i>	def:necessity={least 無}

Since we believe the lexical classification cannot fully distinguish the modality expression, our major task is to propose a better sense representation that can properly describe modal senses and will not interfere with the sense representation of general specific events, but not try to strictly differentiate modals and evaluative adverbs.

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