

Sentiment Analysis Utilizing Modal Expressions^{*}

Jang Ji-won · Kim Jee-Eun

[Abstract]

This research presents a classification of English modal expressions which affect polarity values in sentiment analysis. Modality, commonly encountered in sentences, conveys various semantic attitudes of a speaker. Because of its special characteristics, the meaning of a modalized sentence is challenging to be correctly interpreted. The sentiment expressed with modal expressions is also difficult to evaluate. In order to increase the accuracy in evaluating sentiment values, modal expressions are collected from movie reviews and analyzed with selected linguistic cues to classify. The classification includes the expressions, its contextual components to co-occur, and the resulting sentiment value. Since it also lists up the classes which have not been dealt with in previous studies, it is expected to contribute performance improvement of a sentiment analysis system.

Key Words: sentiment analysis, subjectivity, modality, modal verb, polarity value

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I. Introduction

Fast growth in internet access has resulted in mass production of users' opinions on various subjects such as products, services, politics, entertainments and so on. Such user-generated contents are considered valuable for understanding and monitoring public opinions since they convey people's sentiments. Sentiment analysis categorizes text with positive, negative or neutral values. In order to interpret and evaluate sentiments, subjectivity identification has to be preceded; opinionated sentences need to be distinguished from factual ones in documents. Both subjectivity and sentiment can be identified by utilizing various linguistics cues with which many researches have been done. Despite a large volume of literature on the subject, very few studies have been performed using modality which not only affects the interpretation of sentiments, but also triggers to identify opinions.

Modality is a category of linguistic meaning which commonly encountered in English sentences utilizing modal verbs and also presents people's attitudes towards what they are saying. Since people express various semantic attitude utilizing modality, such as possibility, certainty, necessity, desire, and so on, the sentences including those meanings become the candidates for opinions. Accordingly, modality affects the evaluation of sentiments; eliminating sentiment information and intensifying or diminishing the degree of the sentiments.

The modality in linguistics is classified into several categories such as deontic, epistemic, etc. and the number of categories varies depending on the researchers. Even though such classification is crucial for figuring out modal meanings included in sentences, it has to be revised for sentiment analysis because linguistic cues are not explicitly represented to identify a modal class. In order to produce higher accuracy than the ones suggested by previous studies, this paper proposes a linguistic

approach for identifying the value of sentiment expressed in English sentences with modality. The focus of the approach is a classification of modal verbs which affects the evaluation of sentiments.

In the following section, previous studies on sentiment analysis are introduced and briefly reviewed. Section 3 describes linguistic modality and section 4 discusses a classification of English modal expressions which influence sentiment values. Finally, section 5 concludes the paper, summarizing the research and suggesting future research works.

II. Related Studies

Deciding subjectivity is a prerequisite to evaluate the polarity of sentiments. Wilson et al. (2005) introduces *OpinionFinder*, a system to identify and extract subjective information in documents. *OpinionFinder* recognizes subjective sentences in documents by marking the source of the subjectivity and using sentiment words as clues. This system decides the subjectivity of the sentences in documents by marking either subjective or objective.

Table 1. A brief summary of subjectivity marking in *OpinionFinder*

Input	Subjectivity
Cigarettes are bad for you	Objective
Cigarettes must be bad for you	Subjective
Cigarettes might be bad for you	subjective

As illustrated in Table 1, modality is used as a feature to identify subjectivity. The

system identifies the sentences with a modal auxiliary verb as subjective while the sentences without a modal verb as objective.

Table 2. A brief summary of polarity marking in OpinionFinder

Input	Polarity
... Cigarettes are not <u>bad</u> for you ...	409_412 negative

It does not evaluate the sentiment value of the sentence, but just locates a sentiment word with its polarity value as illustrated in Table 2. It just provides the location of the sentiment word, *bad*, marking its polarity value as negative. It seems it has to be modified to function as a full-fledged system.

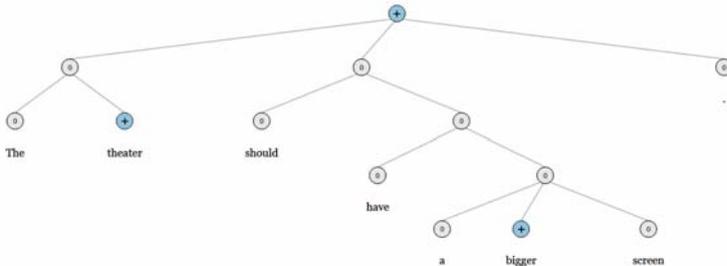
Some researches introduce more advanced sentiment analysis systems by providing a wider range of scales of polarity values. Wiebe et al. (2004) creates a sentiment lexicon with five scales; strong positive, weak positive, neutral, weak negative, and strong negative. Similarly, Stanford University also provides five sentiment classes (Socher et al., 2013). Other researches have implemented a finer-grained scale of polarity values. Taboada et al. (2011) builds a sentiment lexicon with a ten-point scale, from -5 to +5. A sentiment analysis system provided by Natural Language Toolkit (NLTK) also provides more detailed sentiment scales; it is ranged from 0.1 to 1.0 for both positive and negative values respectively. However, complex-scaled polarity values are hard to determine since the degree of intensity is not absolute but relative.

Some sentiment analysis studies make use of particular syntactic patterns as a linguistic cue to evaluate sentiment. Jindal and Liu (2006) and Ganapathibhotla and Liu (2008) analyze sentences with comparatives. They identify comparative expressions to determine the sentiment. Narayanan et al. (2009) conduct sentiment

analysis with conditional sentences. Only few researches have performed on modality in the field of sentiment analysis. Liu et al. (2014) and Liu (2015) provide a classification of modal verbs according to their polarity value. For example, they interpret a sentence including a dynamic modal verb *can* as positive without considering the context. However, *can* is ambiguous in that it also functions as deontic and there is no linguistic clue to distinguish dynamic from deontic. This type of blind-folded generalization cannot be applied to the evaluation of sentiment.

A sentiment analysis system provided by Stanford University (Socher et al., 2013) calculates sentiment by summing up polarity values of a phrase level in comparison to the other systems which utilizes words. However, it seems that this system does not take into account modality as illustrated in Figure 1.

Figure 1. An example of sentiment analysis using the model of Stanford University



The sentiment of the sentence should not be positive. However, it is incorrectly evaluated as positive since it seems to focus on the sentiment words while ignoring the modal auxiliary verb, *should*.

Another sentiment analysis system provided by NLTK determines polarity values in documents. This model also does not consider a modal verb when evaluating

sentiment as illustrated in Figure 2 and 3.

Figure 2. Sentiment analysis of a sentence without a modal verb by NLTK

The screenshot shows the NLTK sentiment analysis interface. On the left, under "Analyze Sentiment", the language is set to "english". The "Enter text" field contains the sentence "He ripped the screenplay to shreds." Below the text field is a yellow box with the text "Enter up to 50000 characters" and an "Analyze" button. On the right, under "Sentiment Analysis Results", a green box displays "The text is **neg**." Below this, a note states "The final sentiment is determined by looking at the classification probabilities below." The "Subjectivity" section shows "neutral: 0.5" and "polar: 0.5". The "Polarity" section shows "pos: 0.3" and "neg: 0.7".

Figure 3. Sentiment analysis of a sentence with a modal verb by NLTK

The screenshot shows the NLTK sentiment analysis interface. On the left, under "Analyze Sentiment", the language is set to "english". The "Enter text" field contains the sentence "He would rip the screenplay to shreds." Below the text field is a yellow box with the text "Enter up to 50000 characters" and an "Analyze" button. On the right, under "Sentiment Analysis Results", a green box displays "The text is **neg**." Below this, a note states "The final sentiment is determined by looking at the classification probabilities below." The "Subjectivity" section shows "neutral: 0.5" and "polar: 0.5". The "Polarity" section shows "pos: 0.3" and "neg: 0.7".

The sentences in Figure 2 and 3 have the identical structure except the modal verb, *would*, which should result in different interpretation. However, the results of the evaluation are the same; positive 0.3 and negative 0.7. This confirms that modality has not been interpreted properly.

III. Linguistic Analysis of English Modality

Modality is a semantic grammatical category expressing semantic notions such as possibility, probability, necessity, obligation, permission, ability, or intention, which represent a speaker's attitudes and semantic orientations toward an entity. Since it adds a broad range of semantic nuances to an utterance, it is crucial to identify its appropriate meaning within the context. This results in various researches on modality in linguistics. Among the researches, this study has adopted a linguistic model introduced by Palmer (2001). Modality in English is realized through mood and a modal system.

3.1. English Mood

Mood is a grammatical category for signaling modality. Mood is categorized into indicative, imperative, and subjunctive. Indicative mood is used to indicate and state a fact. It is encoded by declarative and interrogative sentences. Imperative mood expresses command, request, exhortation, or advice representing desirable states which have not happened yet.

- (1) Movie making usually takes a few months.
- (2) I hate the movie released last week.
- (3) Did you like the movie?
- (4) Stop watching the movie!

Some declarative sentences do not carry any sentiment as in sentence (1) while other sentences such as sentence (2) express a speaker's opinion. Interrogative

sentences hardly express a speaker's opinion since it is a process of seeking information rather than stating a fact as shown in sentence (3). Similar to interrogative mood, imperative mood does not deliver a speaker's sentiment as in (4).

Subjunctive mood expresses irrealis such as wish, possibility, judgment, obligation or necessity, which has not yet been realized. Subjunctive mood expresses a speaker's sentiment although it represents counterfactuality. English subjunctive is realized utilizing *if* clause with *were*, *should/would/could* + *have* + *past participle (pp)*, and so on.

(5) It would be nice if the screen were a little bigger.

(6) The director should have studied American culture a little closer.

Sentence (5) expresses the speaker's negative sentiment towards the movie screen, utilizing subjunctive mood. The movie screen is not big enough to satisfy the speaker at the time of uttering the sentence which conveys a desire for the screen to be bigger. Similarly, sentence (6) expresses the speaker's negative sentiment on the director while using *should* + *have* + *pp*.

3.2 English Modal System

English modal system is constructed using modal auxiliary verbs. By employing different auxiliaries, three types of modal meanings are conveyed; epistemic, dynamic and deontic.

(7) John may/will/can be at the theater to watch The Dark Night.

(8) He must be a famous director.

Epistemic modality expresses a speaker's judgments on factual status as shown in sentences (7) and (8). Epistemic modality is encoded using modal auxiliary verbs including *may*, *might*, *must*, *can*, *could* and *will* to deliver various modal meanings such as assumptive, speculative, potential, subjunctive and so on.

(9) John *may/can* book a movie ticket.

(10) John *must/should* book a movie ticket.

Deontic modality indicates obligation or permission by an external force. A list of modal auxiliaries, *may*, *can*, *must* and *should*, expresses deontic modality as illustrated in sentences (9) and (10). *May/can* in (9) encodes permission and *must/should* in (10) expresses obligation.

(11) John *can* write a screenplay.

(12) John *will* finish editing the movie by tomorrow.

Dynamic modality expresses a speaker's ability or willingness to do something. *Can* is adopted to encode ability as in sentences (11) and *will* is used to mean willingness of the subject of the sentence as presented in (12).

As illustrated in the example sentences above, modality conveys a speaker's sentiment. Proper interpretation of modality is necessary to identify accurate sentiment values. It naturally has to be dealt with in sentiment analysis to produce better results. Few researches analyze sentiment utilizing modality because linguistic modality is categorized according to a meaning that each class expresses. Modal auxiliary verbs present an ambiguity when it is used in a sentence to convey a modal meaning. For example, *can* expresses multiple modal meanings including epistemic, deontic, and dynamic. The class of the modality can only be identified by

interpreting the meaning of the sentence. In sentiment analysis, however, disambiguation of modal meaning requires explicit linguistic patterns which only few researches have suggested.

IV. Classification of Modal Expressions in Sentiment Analysis

To provide a classification of modal expressions for sentiment analysis, eight English modal verbs are selected for this research; *can*, *could*, *will*, *would*, *might*, *may*, *should*, and *must*. The total number of 13,378 sentences with those verbs are collected from two different sources; 12,863 from the movie review data by Pang and Lee (2004) and 515 New York Times movie reviews by Kim (2013). The sentences are analyzed using the sentiment lexicon of Hu and Liu (2004) in order to determine the polarity values of words. The sentences are examined to check how modal verbs affect sentiment and how differently each modal verb behaves from one another. As a result, modal verbs are found out to assign, shift or remove a polarity value according to a particular pattern occurring in a sentence. The result are described in comparison to the classification suggested by Liu et al. (2014) and Liu (2015).

4.1. Modal Verbs with a Positive/Negative Word

A modal verb changes the polarity value when it occurs with a sentiment word, either positive or negative. Liu (2015) claims that *can* or *could* assigns a positive value when it is used to express ability as shown in sentences (13a) ~ (15a).

- (13a) I can count on Apple.¹⁾ (+)²⁾
(14a) This device can deal with the connection problem. (+)
(15a) This phone can do speed dialing but my previous phone cannot. (+)
- (13b) I count on Apple. (+)
(14b) This device deals with the connection problem. (+)
(15b) This phone does speed dialing but my previous phone does not. (+)
- (16) A movie trailer can/could spoil the entire movie. (-)

Sentences (13a) ~ (15a) are, however, still positive without the modal verb. They are interpreted as positive because of the underlined sentiment words as confirmed in (13b) ~ (15b). Sentence (16) includes *can/could* and a negative sentiment word *spoil*, which is interpreted as negative. This example contradicts what Liu (2015) claims; a sentence with *can* is interpreted as positive. From the list of examples presented above, the polarity value of a sentence with *can/could* is determined by a sentiment word, not the modal verb itself.

Another set of modal verbs *will/would* affect the evaluation of sentiment in the same way to *can/could*. Liu (2015), however, fails to provide a clear explanation how *will* influences sentiment while he suggests that *would* occurring with a positive sentiment word assigns negative sentiment as listed in sentences (17) and (18).

- (17) I would have loved this product. (-)
(18) It would have been a good car. (-)

The sentiment value of (17) and (18) is evaluated as negative because of *would* followed by *have + pp*. This pattern should be treated separately from *would* alone since they assign different polarity values respectively.

May and *might* have not been dealt with from previous studies. They behave in the same way to *can* and *could* in assigning a polarity value. Sentence (19) including a positive word *recommend* is interpreted towards positive, and sentence (20) with a negative word *rip to shreds* towards negative.

(19) I may/might recommend everyone to watch this movie. (+)

(20) He may/might rip the screenplay to shreds. (-)

Modal verbs, *should* and *must*, are complicated to generalize their patterns. When they occur with a positive sentiment word, the polarity value of the sentence varies as listed in sentences (21) ~ (23).

(21) He should/must recommend everyone to watch this movie. (+)

(22) The actor should/must impress the audience. (0)

(23) The movie theater should/must be clean. (0/-)

Sentence (21) expresses positive sentiment when it contains a positive sentiment word *recommend* while sentence (22) is evaluated as neutral even though its components are identical as (21). The difference between the two sentences is the type of a verb, whether to be a psych verb. Sentence (23) is ambiguous in that it can be interpreted as either neutral or negative depending on the current state of the subject.

A sentence with a negative sentiment word is not discussed with the reasons. It does not appear in the data and the resulted meaning seems awkward because the modal verbs express the expectation of the speaker. Since generalization of the patterns for *should* and *must* is hard to draw with the current research, it has to be examined further with more data.

4.2. Modal Verbs with a Negation Word *NOT*

The modal verbs changes polarity values when they occur with a negation word such as *not*. *Can* and *could* present interesting behaviors with a negation word in a sentence as shown in sentences (24) and (25).

(24) I can/could not count on Apple. (-)

(25) The movie trailer can/could not spoil the entire movie. (0/diminished -)

They reverse the polarity when it is followed by a positive sentiment word as displayed in sentence (24). They, however, neutralize the polarity value when a negation word and a negative sentiment word occur in the sentence as shown in (25). The negation word occurring with a negative sentiment word does not reverse the sentiment, rather it cancels out the negative sentiment in a system with the polarity range of -1 to 1. It may diminish the sentiment with a finer-grained scale.

A list of modal verbs including *will*, *would*, *may* and *might*, behave in the same way to *can* and *could* when they occur with a negation word as shown in sentences (26) and (27).

(26) I will/would/may/might not recommend everyone to watch this movie. (-)

(27) He will/would/may/might not rip the screenplay to shreds.
(0/diminished -)

The negation word reverses the polarity value when used with a positive word and neutralizes or diminishes the degree of sentiment when occurred with a negative sentiment word. However, there are subtle differences in the degree of the resulted sentiment depending on each modal verb.

Liu (2015) generalizes that the sentences with *should* express negative sentiment with a negation word by presenting sentences (28) and (29). However, the usage of *should* is not so simple to be generalized as Liu (2015) argues. No clear patterns for *should* determine the sentiment value to be positive or negative as shown in sentences (30) and (31).

- (28) They should not make the screen so big. (-)
- (29) Kids should not act foolish. (-)
- (30) Jumping into a pond should/must not be dangerous. (0)
- (31) I should/must not recommend everyone to watch this movie. (-)

Another modal verb *must* has not been considered in the study by Liu (2015). It influences the sentiment value in the same way as *should* works as shown in (30) and (31).

4.3 Modal Verbs with *Have + Past Participle*

Modal verbs affect the polarity value of a sentence when they occur with a syntactic pattern, *have + pp*. The research by Liu et al. (2014) and Liu (2015) have not hardly discussed the sentiment shift caused by the modal verbs used with this particular pattern. A list of *can/may/might/must* diminishes or neutralizes the degree of sentiment when used with *have + pp* as in sentence (32).

- (32) The psychological elements can/may/might/must have made this film interesting. (0/diminished +)
- (33) The psychological elements can/may/might/must have made this film disgusting. (0/diminished -)

Since the modal verbs with *have + pp* encode speculative/assumptive/deductive meaning, they naturally diminish or neutralize the sentiment as in (32) and (33). Because of its nature, each modal verb creates subtle differences in the degree of the resulted sentiment.

Another list of *should/would/could + have + pp* expresses hypothetical or subjunctive meaning. When they occur with a sentiment word, they behave differently from the rest of the modal verbs. The polarity value becomes negative although the sentiment word is positive. Since the pattern, *should/would/could + have + pp*, is known to represent desire or regretful emotion, the sentences including this pattern express negative sentiment, as in sentences (34) and (35).

(34) The theater should/would/could have bought a big screen. (-)

(35) ?The theater should/would/could have made a screen so small. (-)

Sentence (35) sounds awkward when it is identical to (34) except the sentiment word being negative. Its sentiment remains negative but it is semantically anomalous considering the domain of the data, namely movie reviews.³⁾

In comparison to the rest of the modal verbs, a sentence with this pattern does not change its sentiment value even when it is negated. Its sentiment value remains the same, being negative as shown in sentences (36) and (37).

(36) The entrapment scene should/would/could not have been boring. (-)

(37) ?The entrapment scene should/would/could not have been exciting. (-)

Similar to sentence (35) whose resulted meaning is awkward when the pattern is used with a negative sentiment word, sentence (37) also sounds semantically odd when occurred with a negation word and a positive sentiment word. Nevertheless, its

polarity value stays negative. Again, the degree of the sentiment varies depending on each modal verb to be included in the sentence. When *would* or *could* is employed in a sentence, an assumptive or speculative meaning can be read from a sentence. Further researches on *would* and *could* with *have + pp* are required.

Table 3. A sentiment classification of modal expressions

Modal expressions	Evaluated Sentiment
Can/could/will/would/may/might + a positive sentiment word	Positive or diminished positive
Can/could/will/would/may/might + a negative sentiment word	Negative or diminished negative
Should/must + a positive/negative sentiment word	Positive, negative, or neutral
Can/could/will/would/may/might + NOT + a positive sentiment word	Negative
Can/could/will/would/may/might + NOT + a negative sentiment word	Neutral or diminished negative
Should/must + NOT + a positive/negative sentiment word	Positive, negative, or neutral
Will (NOT) + have p.p + a positive/negative sentiment word	Neutral
Can/may/might/must (NOT) + have p.p + a positive sentiment word	Diminished positive
Can/may/might/must (NOT) + have p.p + a negative sentiment word	Diminished negative
Should/could/would (NOT) + have p.p + a positive/negative sentiment word	Negative

Table 3 summarizes what is discussed in section 4. It presents the analysis result of modal expressions by which sentiment values are expected to be correctly assigned.

V. Conclusion

This research has identified modal expressions which have a significant impact on the sentiment value of a sentence. The expressions are composed of a modal verb with/without a particular linguistic component and a sentiment word. Together with a sentiment word, the expressions assign, reverse, diminish or neutralize the sentiment value. They have hardly mentioned or discussed in previous works since modalized sentences conveys more complex meaning than the sentences without a modal. Nevertheless, modalized sentences implying sentiment have to be examined because of the influence of modality on evaluating sentence sentiment as this research suggested. Sentiment analysis considering modality should be performed in order to produce more accurate results.

Table 3 in section 4 summarizes the result of this research. It presents a sentiment classification which is expected to contribute to improve the performance of a sentiment analysis system. However, this classification has to be updated with further researches on identifying more patterns to influence sentiment values. For example, the sentiment of a modalized sentence can be either diminished or neutralized when the predicate of the sentence is composed of a psych verb. A comparative structure together with a modal verb can also be used as a significant linguistic cue to shift the sentiment. Since issues with those patterns related to sentiment analysis are big enough to become a separate research topic, they are reserved for future works.

Notes

- 1) The underlined word refers to a sentiment word.
- 2) As for evaluating the sentiment in sentences, we consulted with a native English speaker who studies Linguistics. The symbols, (+), (-) and (0) represent positive, negative and neutral sentiment respectively.
- 3) Polarity values of a sentiment word differ depending on a domain. In the domain of small appliances or portable machines, for example, 'big' would be interpreted as negative while 'small' would be positive.

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국문초록

양태 표현을 활용한 감성분석

장 지 원 (한국외국어대학교)

김 지 은 (한국외국어대학교)

본 연구는 감성어를 포함하고 있는 영어 문장의 극성값에 영향을 미치는 양태 표현들을 감성분석에서 활용할 수 있도록 분석하고 분류한다. 양태 표현은 화자가 취하는 다양한 의미론적 태도를 드러내는 문법적 요소이다. 양태 특유의 속성상 양태화된 문장의 의미는 정확히 해석하기가 쉽지 않고 양태 표현을 통해 나타나는 감정가치 또한 정확히 분석하는 데 어려움이 있는 것이 사실이다. 그러나 양태 표현이 문장에서 화자의 감성을 표현·해석하는 데 핵심적 방법이자 단서가 되므로 감정가치에 영향을 미치는 양태 표현을 분류하고 분석하는 작업은 감성분석의 중요한 연구과제일 수밖에 없다. 본 연구에서는 감성분석의 정확도를 향상시키기 위해 영화 리뷰 데이터에서 양태 표현을 포함하고 있는 문장을 수집하여 분석하고 분류하였다. 데이터 분석을 통해 양태동사를 포함하고 있는 표현의 유형, 문장 내의 문맥 구성요소, 계산된 극성값 등을 기준으로 양태 표현을 분류했다. 본 연구는 선행연구에서 다루지 않았던 양태 표현들을 분석했을 뿐 아니라 이를 포함하고 있는 문장의 극성값을 판단하여 감성분석에 적용할 수 있는 토대를 마련했다는 점에서 감성분석 시스템의 질적 향상에 기여할 것이다.

주제어: 감성분석, 주관성, 양태, 양태동사, 극성값

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이름: 장지원 (제 1저자)

소속: 한국외국어대학교

주소: 서울특별시 동대문구 이문로 107 한국외국어대학교 영어대학 영어학과

이메일: liwhiw@nate.com

이름: 김지은 (교신저자)

소속: 한국외국어대학교

주소: 서울특별시 동대문구 이문로 107 한국외국어대학교 영어대학 영어학과

이메일: jeeunk@hufs.ac.k