How do Negation and Modality Impact on Opinions?

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Abstract

In this paper, we propose to study the effects of negation and modality on opinion expressions. Based on linguistic experiments informed by native speakers, we distill these effects according to the type of modality and negation. We show that each type has a specific effect on the opinion expression in its scope: both on the polarity and the strength for negation, and on the strength and/or the degree of certainty for modality. The empirical results reported in this paper provide a basis for future opinion analysis systems that have to compute the sentiment orientation at the sentence or at the clause level. The methodology we used for deriving this basis was applied for French but it can be easily instantiated for other languages like English.

1 Introduction

Negation and modality are complex linguistic phenomena widely studied in philosophy, logic and linguistics. From an NLP perspective, their analysis has recently become a new research area. In fact, they can be beneficial to several NLP applications needing deep language understanding, such as sentiment analysis, textual entailment, dialogue systems and question answering. Handling negation and modality in NLP applications roughly involves two sub-tasks: (i) identifying these expressions and their scope and (ii) analyzing their effect on meaning and how this effect can help to improve text understanding. In this paper, we deal with the second task focusing on fine-grained sentiment analysis of French opinion texts.

Negation and modality function as operators modifying the meaning of the phrases in their scope. Negation can be used to deny or reject statements. It is grammatically expressed via a variety of forms: using *prefixes* ("un-", "il-"), *suffixes* ("-less"), *negator words*, such as "not" and *negative polarity items* (NPIs), which are words or idioms that appear in negative sentences, but not in their affirmative counterparts, or in questions, but not in assertions, for example "any", "anything", "ever". Negation can also be expressed using some nouns or verbs where negation is part of their lexical semantics (as "abate" and "eliminate"), or expressed implicitly without using any negative words, as in "this restaurant was below my expectations". Modality can be used to express possibility, necessity, permission, obligation or desire. It is grammatically expressed via adverbial phrases ("maybe", "certainly"), conditional verbal moods and some verbs ("must", "can", "may"). Adjectives and nouns can also express modality (e.g. "a probable cause").

Negation and modality can aggregate in a variety of ways: (1) multiple negatives, e.g, "This restaurant never fails to disappoint on flavor". In some languages, double negatives cancel the effect of negation, while in negative-concord languages like French, double negations usually intensify the effect of negation. (2) cumulative modalities, as in "You definitely must see this movie" and (3) both negation and modality, as in "you should not go see this movie".

Several reports have shown that negations and modalities are sentiment-relevant (Wiegand et al., 2010). Kennedy and Inkpen (2006) point out that

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negations are more sentiment-relevant than diminishers. Wilson et al. (2009) show that modalities as well as negations are good cues for opinion identification. Given that the sentiment-relevance of negations and modalities is an established fact, this paper aims to go further by exploring how this relevance is distilled according to the semantics of each operator.

To this end, we first study several taxonomies along with their associated categories of both modality and negation given by the linguistic literature. Among these categories, we decide to choose the categories of (Godard, to appear) for negations. For modalities, we rely on the categories of (Larreya, 2004) and (Portner, 2009). We thus distinguish three types of negation: *negative operators*, *negative quantifiers* and *lexical negations* and three types of modality: *buletic*, *epistemic* and *deontic*. We show that each type has a specific effect on the opinion expression in its scope: both on the polarity and the strength for negation, and on the strength and/or the degree of certainty for modality. These effects are structured as a set of hypotheses that we empirically validated via several linguistic experiments informed by native speakers. This evaluation methodology has already been used in sentiment analysis. Greene and Resnik (2009) chose psycholinguistic methods for assessing the connection between sentence structure and implicit sentiment. Taboada et al. (2011) used Mechanical Turk to check subjective dictionaries for consistency.

The empirical results reported in this paper provide a basis for future opinion analysis systems that have to compute the sentiment orientation at the sentence or at the clause level. The methodology we used for deriving this basis was applied for French but it can be easily instantiated for other languages like English. In this paper, all examples are in French along with their direct translation in English. Note however that there are substantial semantic differences between the two languages.

2 Related Work

2.1 Negation in Sentiment Analysis

Research efforts using negation in sentiment analysis can be grouped according to three main criteria: the effect of negation on opinion expressions, the types of negation used and the method employed to update the prior polarity of opinion expressions.

According to the first criterion, most approaches treat negation as polarity reversal (Polanyi and Zaenen, 2006; Wilson et al., 2005; Moilanen and Pulman, 2007; Choi and Cardie, 2008). However, negation cannot be reduced to reversing polarity. For example, if we assume that the score of the adjective "excellent" is +3, then the opinion score in "this student is not excellent" cannot be -3. It rather means that the student is not good enough. Hence, dealing with negation requires to go beyond polarity reversal. Liu and Seneff (2009) propose a linear additive model that treats negations as modifying adverbs. In the same way, in (Taboada et al., 2011), the negation of an opinion expression shifts the value of its score to the opposite polarity by a fixed amount. Thus a +2 adjective is negated to a -2, but the negation of a very negative adjective is only slightly positive. Based on (Taboada et al., 2011)'s shift model, Yessenalina and Cardie (2011) propose to represent each word as a matrix and combine words using iterated matrix multiplication, which allows for modeling both additive (for negations) and multiplicative (for intensifiers) semantic effects. In our framework, we assume, as in (Liu and Seneff, 2009) and (Taboada et al., 2011), that negation affects both the polarity and the strength of an opinion expression. However, unlike other studies, we distill that effect depending on the type of the negation.

Two main types of negation were studied in the literature: negators such as "not" and content word negators such as "eliminate" (Choi and Cardie, 2008). Wilson et al. (2009) also consider negators and in addition distinguish between positive polarity shifters and negative polarity shifters since they only reverse a particular polarity type. Few studies take into account other types of negation. Among them, Taboada et al. (2011) treat NPIs (as well as modalities) as "irrealis blockers" by ignoring the semantic orientation of the word in their scope. For example, the opinion word "good" will just be ignored in "any good movie in this theater". We think that ignoring NPIs is not suitable and a more accurate analysis is needed. In addition, to our knowledge, no studies have investigated the effect of multiple negatives on opinions.

Finally, methods dealing with negation can be classified into three categories (Wiegand et al.,

2010). In *the shallow approach,* negation is embedded into a bag-of-words model which is then used by supervised machine-learning algorithms for polarity classification (Pang et al.2002; Ng et al. 2006). This method, rather simple, seems linguistically inaccurate and increases the feature space with more sparse features. The second approach concerns a *local contextual analysis of valence shifter terms* where negation modifies the prior scores of those terms (Taboada et al., 2011; Wilson et al., 2009). The last approach uses *semantic composition* where the polarities of words within the sentence are aggregated (Moilanen and Pulman, 2007). In this paper, we provide a way of treating negation and modality in a semantic composition framework.

2.2 Modality in Sentiment Analysis

In sentiment analysis, the presence of modalities can be used as a feature in a machine learning setting for sentence-level opinion classification. Among the few research efforts in this direction, Wilson et al. (2009) use a list of modal words. In (Kobayakawa et al., 2009), modalities are defined in a flat taxonomy: request, recommendation, desire, will, judgment, etc. According to the reported results, the gain brought by the modalities seems difficult to assess. However, to our knowledge, no work has investigated how modality impacts on opinions.

In NLP, modality is less addressed than other linguistic operators, such as negations. Most of the computational studies involving modality are focused on: (i) building annotated resources in terms of factuality information and (ii) uncertainty modeling and hedge detection in texts. Among annotated resources, we cite the FactBank corpus (Saurí and Pustejovsky, 2009) and the BioScope corpus (Vincze et al., 2008). In the second research strand, the efforts go from detecting uncertainty in texts (Rubin, 2010), to finding hedges and their scopes in specialized corpora (Vincze et al., 2008; Ganter and Strube, 2009; Zhao et al., 2010). However, there is only partial overlapping between hedges and modal constructions. Hedges are linguistic means whereby the authors show that they cannot back their opinions with facts. Thus, hedges include certain modal constructions (especially epistemic), along with other markers such as indirect speech, e.g., "According to certain researchers,...". On the other hand, there are modal constructions which are not hedges, e.g. when expressing a factual possibility, without uncertainty on behalf of the speaker, e.g. *may* in "These insects may play a part in the reproduction of plants as well".

3 Dealing with Negation

Negation has been well studied in linguistics (Horn, 1989; Swart, 2010; Giannakidou, 2011). For French, we cite (Muller, 1991; Moeschler, 1992; Corblin and Tovena, 2003) and (Godard, to appear)'s work as part of the "Grande Grammaire du français" project (Abeillé and Godard, 2010). Our treatment of negation is based on the lexical-syntactic classification of (Godard, to appear) that distinguishes three types of negation in French:

- *Negative operators*, denoted by NEG: they are the adverbs "pas" ("not"), "plus" ("no more"), "non" ("no one"), the preposition "sans" ("without") and the conjunction "ni" ("neither"). These operators always appear alone in the sentence and they cannot be combined with each other.

- *Negative quantifiers*, denoted by NEG_quant, express both a negation and a quantification. They are, for example, the nouns and pronouns "aucun" ("none"), "nul" ("no"), "personne" ("nobody"), "rien" ("nothing") and the adverbs "jamais" ("never") and "aucunement"/"nullement" ("in no way"). Neg_quant have three main properties: (i) they can occur in positive sentences (that is not negated), particularly in interrogatives, when they are employed as indefinite or when they appear after the relative pronoun "que" ("that") (ii) in negative contexts, they are always associated to the adverb "ne" ("not") and (iii) they can be combined with each other as well as with negative operators. Here are some examples of this type of negation extracted form our corpus: "on ne s'ennuie jamais" ("you will never be bored"), "je ne recommande cette série à personne" ("I do not recommend this movie to anyone").

- *Lexical negations* denoted by NEG_lex which are implicit negative words, such as "manque

de" ("lack of"), "absence de"("absence of"), "carence" ("deficiency"), "manquer de" ("to lack"), " dénué de" ("deprived of"). `NEG_lex` can be combined with each other as well as with the two previous types of negation.

This classification does not cover words such as *few* or *only*, since we consider them as weak intensifiers (strength diminishers) rather than negations.

For each opinion expression `exp`, `OP(exp)` indicates that the expression `exp` is in the scope of the negation `OP ∈ NEG, NEG_quant, NEG_lex`. Multiple negations are denoted by `OP_i(OP_j((exp)))`. In French, there are at most three negative words in a multiple negative. However, this case is relatively rare in opinion texts; this is why, we only deal with two negatives. Usually, multiple negatives preserve polarity, except for those composed of `NEG_lex` and `NEG_quant` or `NEG` which cancel the effect of `NEG_lex`. For example, in "manque de goût" ("lack of taste"), i.e `NEG_lex(taste)`, the polarity is negative, while in "il ne manque pas de goût" (roughly, "no lack of taste"), i.e. `NEG(NEG_lex(taste))`, the opinion is positive. This property was also observed in (Rowan et al., 2006). Thus, multiple negatives preserving negation concern the following combinations:

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NEG_quant(NEG_quant(exp)),
NEG_quant(NEG(exp)),
NEG(NEG_quant(exp)).
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We analyse the frequency of our negation categories in a corpus of French opinion texts. We use a manually built subjective lexicon (Benamara et al., 2011) that contains 95 modalities and 21 negations. An analysis of a corpus of 26132 French movie reviews (about 863 TV series) extracted from the allociné web site[1] shows that around 26 % of reviews contain NPIs and/or multiple negations.

3.1 Hypotheses

The effects of each negation type are based on the following hypotheses:

N1.a The negation always reverses the polarity of an opinion expression, that is a positive opinion expression becomes negative when in the scope of

a negation. For example, "exceptionnel" ("exceptional") and "pas exceptionnel" ("not exceptional").

N1.b The strength of an opinion expression in the scope of a negation, is not greater than of the opinion expression alone. For example, for the adjective "exceptionnel" ("exceptional"), the strength of its negation, that is "pas exceptionnel" ("not exceptional"), is lower.

N2. The strength of an expression when in the scope of a `NEG_quant` is greater than when in the scope of a `NEG`. For instance: "jamais exceptionnel" ("never exceptional") is stronger than "pas exceptionnel" ("not exceptional").

N3. `NEG_lex` has the same effect as `NEG`, as for *lack of taste* and *no taste*.

N4. The strength of an expression when in the scope of multiple negatives is greater than when in the scope of each negation alone. For example, "plus jamais bon" ("no longer ever good") is stronger than "plus bon" ("no longer good").

3.2 The experimental setup

The previous hypotheses have been empirically validated by volunteer subjects through two protocols: Protocol 1 for N1.a and N1.b, and Protocol 2 for N2 to N4 [2].

Both protocols are based on a set of questions that we built so that: (1) they reflect the most frequent linguistic structures found in our corpus, and (2) they do not contain words or expressions on which people have prior opinions for/against. In addition, the number of questions within each protocol was designed so that we ensure a trade-off between the amount of data needed for proving our hypotheses and the quality of the data, subjects have to remain focused in order to avoid errors due to tiredness.

Protocol 1. A set of six questions are shown to subjects. In each question, an opinionated sentence is presented, along with its negation using negative operators, as in "This student is brilliant" and "This student is *not* brilliant". The strengths of the opinions vary from one question to another on a discrete scale. Several types of scales have been used in sentiment analysis research, going from continuous scales (Benamara et al., 2007) to discrete ones
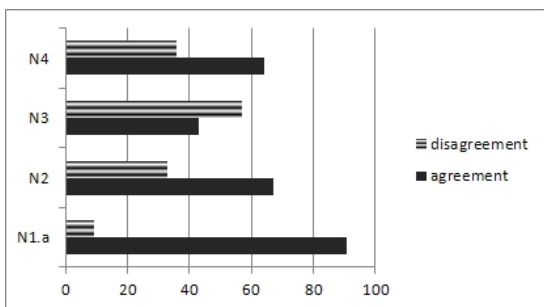
Figure 1: Empirical validation of N1 to N4.

(Taboada et al., 2011). Since our negation hypotheses have to be evaluated against human subjects, the chosen length of the scale has to ensure a trade-off between a fine-grained categorisation of subjective words and the reliability of this categorisation with respect to human judgments. We thus use in our framework a discrete 7-point scale, going from -3 (which corresponds to "extremely negative" opinions) to $+3$ (for "extremely positive" ones) to quantify the strength of an opinion expression. Note that 0 corresponds to cases where in the absence of any context, the opinion expression can be neither positive nor negative. A set of 81 native French speakers were asked to indicate the strength of each sentence in a question on the same 7-point scale.

Protocol 2. Eight questions are shown. Each question contains a pair of sentences: one containing a negative operator, the other having either a negative quantifier or a lexical negation, or multiple negatives, as in "This student is *not* brilliant" and "This student is *never* brilliant". Subjects are asked to compare the strengths of the sentences in each pair. A set of 96 native French speakers participated in this study.

3.3 Results

The results of these assessments are shown in Figure 1, as the average agreement and disagreement between the subjects' answers and our hypotheses. The results show that all four hypotheses are validated. For N1.a, we obtain an average agreement of 90.7 % when excluding the answers corresponding to the strength 0 (20.37 % of all answers). We note that for opinion strengths from -1 to $+2$ (that is, "mildly negative" to "very positive" opinions), N1.a is 100 % verified. The same trend is observed for -2

("very negative") and $+3$ opinion strengths (87.8 % and 93 % agreement, respectively). However, for "extremely negative" opinions, e.g., "l'acteur est nullisime" ("the actor is worthless"), we observe that only 48.8 % of subjects reverse its polarity. The results for N1.b are shown in Table 1. The rows correspond to opinion strenghts given by subjects for sentences without negation and the columns, and the subjects' answers to the same sentences, this time negated. In this table, we discarded the row for the subjects' answers to the 0-strength original sentences (without negation) because the number of instances was very low.

	+3	+2	+1	0	-1	-2	-3
+3	0	0	4.7	32.9	**58.9**	3.5	0
+2	0	0	0	4.9	**82.0**	13.1	0
+1	0	0	0	0	**84.3**	14.5	1.2
-1	0	0	**62.5**	37.5	0	0	0
-2	0	1.2	**51.9**	39.5	7.4	0	0
-3	0	1.4	26.4	**43.0**	23.6	5.6	0

Table 1: Results (in percents) for N1.b

We observe that the hypothesis N1.b is verified for all configurations of strengths. In addition, a non-negligible percentage of the subjects assign a 0 strength to the negation of all negative opinion expressions. This is particularly salient for extremely negative expressions. The same goes for extremely positive expressions.

N2 is verified at 67 %. This might me because the gap between the strength of `NEG_quant (exp)` and `NEG(exp)` is rather small.

N3 is verified at 43 %. This low result reflects the fact that, as expected, for "lack of" (i.e., "manque de", very frequent in French movie reviews) N3 is not validated: 81 % of the subjects consider the opinion in the scope of this lexical negation to be less negative than the opinion in the scope of the negative operator "not". This disparity in the results show that a thorougher study has to be undertaken in order to better distill the effect of lexical negations on opinion expressions.

Finally, N4 is verified at almost 64 %. The disagreement comes from the question testing the effect of the `NEG_quant (NEG_quant)` combination. We think this might come from the

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fact that `NEG_quant` already boosts the strength of an opinion expression, hence adding more `NEG_quant` does not necessarily yield an even stronger opinion expression.

4 Dealing with Modality

Drawing partly on (Portner, 2009) and on (Larreya, 2004) for French, we have chosen to split modality in three categories:

- *buletic*, denoted by `Mod_B` – it indicates the speaker's desires/wishes. This type of modality is expressed via a closed set of verbs denoting hope e.g. "I *wish* he were kind".

- *epistemic*, denoted by `Mod_E` – it indicates the speaker's belief in the propositional content he asserts. It is expressed via doubt, possibility or necessity adverbs, such as "peut-être" ("perhaps"), "décidément" ("definitely"), "certainement" ("certainly"), etc., and via the verbs "devoir" ("have to"), "falloir" ("need to/must") and "pouvoir" ("may/can"), e.g. "The movie *might* be good",

- *deontic*, denoted by `Mod_D` – it indicates a possibility or an obligation (with their contrapositives, impossibility and permission, respectively). It is only expressed via the same modal verbs as for epistemic modality, but with a deontic reading, e.g., "You *must* go see the movie".

Note that this classification takes into account neither evidential usage of modality nor epistemic modalities expressed in conditional verb moods since these usages are less frequent in our corpus.

Just like for negations, we project these categories on our corpus of French movie reviews and we observe that 53 % of the reviews contain at least one modal construction. In addition, the most frequent modals in those reviews are in decreasing order of occurrence: the epistemic and deontic verbs "devoir" and "pouvoir", buletic modal verbs and epistemic adverbs.

Unlike for negations, for the moment we do not take into account cumulative effects of modalities on an opinion expression, like in: "You *definitely must* see the movie!" as well as combination of negations and modalities.

We consider that each modal expression has a semantic effect on opinions. Unlike negation, this effect is not on both the polarity and the strength of opinions, but only on their *strength* – for instance, the strength of the recommendation "You must go see the movie, it's a blast" is greater than for "Go see the movie, it's a blast", and *certainty degree* – for instance, "This movie is *definitely* good" has a greater certainty than "This movie is good". In our framework, the strength is discretized on a three-level scale, going from 1 (minimal strength) to 3 (maximal strength). The certainty degree also has three possible values, in line with standard literature (Lyons, 1977; Saurí and Pustejovsky, 2009): *possible*, *probable* and *certain*. However, we consider that, in an opinion analysis context, the frontier between the first two values is rather vague, hence we conflate them into a value that we denote by *uncertain*. We thus obtain two certainty degrees, from which we built a three-level scale, by inserting between these values a "default" certainty degree for all expressions which are neither a modal nor in the scope of a modal.

4.1 Hypotheses

We will now specify the semantic effect of each modality type, on the strength and/or certainty degree of the opinion expressions. These effects are structured as a set of six hypotheses:

M1. `Mod_B` alters the certainty degree of opinion expressions in its scope. Thus, the certainty degree of an opinion expression in the scope of a `Mod_B` is weaker than the certainty degree of the opinion expression itself. e.g. in "I *hope* this movie is funny" there is less certainty than in "This movie is funny".

M2.1 `Mod_E` alters the certainty degree of opinion expressions in its scope. For adverbial `Mod_E`, this degree is altered according to the certainty of the respective adverb: if the latter is uncertain, then the certainty of the opinion in the scope of the adverb is reduced; otherwise, the certainty is augmented. For instance, "Le film est *probablement* bon" ("*Probably* the film is good") is less certain than "Le film est bon" ("The film is good"), which is, in turn, less certain than "Le film est *décidément* bon" ("The film is *definitely* good").

M2.2 The certainty of opinion expressions when in the scope of a verbal `Mod_E` is always lower than when alone. It varies according to the certainty of the respective verb, from *pouvoir* – lowest certainty, to *devoir* and *falloir* – greater certainty. For instance, the certainty of "Le film *peut* être bon" ("the film *might* be good") is lower than of "Le film *doit* être bon" ("the film *must* be good"), which, in turn, is lower than of "Le film est bon" ("the film is good").

M2.3 The certainty degrees of opinion expressions in the scope of epistemic *devoir* and *falloir* are the same.

M3.1 `Mod_D` alters the strength of opinion expressions in its scope. Hence, strength varies according to the verb: *pouvoir* reduces the strength of the opinion, whereas *devoir* and *falloir* boost it.

M3.2 The strengths of opinion expressions in the scope of deontic *devoir* and *falloir* are the same.

4.2   The experimental setup

We empirically validated the previous hypotheses through the same methodology as for negation. We designed three protocols, Protocol 1 for M1, Protocol 2 for M2.1 to M2.3, and Protocol 3 for M3.1 and M3.2.

Protocol 1. In this protocol, five questions are proposed. In one of them, the subject is presented an opinionated sentence without modality. In each of the other questions, we present a subjective sentence with buletic modality. For each question, we then ask the subject to specify whether the author of the sentence has an established opinion (positive or negative), e.g., "I saw this movie yesterday. I *hope* it will be a blockbuster.", or "The movie is interesting.", or hasn't an established opinion yet "I hope this movie is interesting". 78 native French speakers participated in this protocol.

Protocol 2. Eight questions are proposed to subjects. In each question we present an opinionated sentence. The first one is a sentence without modality, e.g. "The movie is good". Each of the other sentences contains an epistemic modality of different certainty degree, either "uncertain" or "certain". 111 native French speakers were asked whether the modal sentence was less, more or as certain as the sentence without modality.

Protocol 3. Four questions are presented. In each question we show a pair of opinionated sentences:
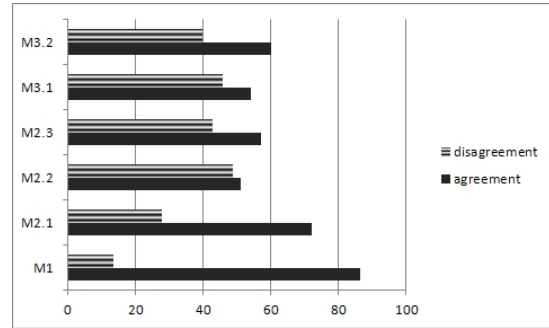

Figure 2: Empirical validation of M1 to M3.2.

one sentence without modality, and another one with a deontic modality, as in "Go see this movie, it is good" and "You *should* go see this movie, it is good". We ask subjects compare the strengths of the sentences in each pair. A set of 78 native French speakers participated in this study.

4.3   Results

We show the results of these assessments in Figure 2. M1 is validated at 86.5 %. More specifically, when the phrase in the scope of the buletic modality denotes an event, all subjects consider it to vehiculate an opinion. This, in French at least, usually corresponds to an implicit opinion[3]. Moreover, according to all subjects, buletic modality cancels the opinion in its scope, when the phrase expressing the latter denotes a state. Therefore, subjective words do not make sentences like "I hope her husband is kind" opinionated.

M2.1 is validated at around 72 % for both certainty degrees ("certain" and "uncertain"), which shows that, in addition to polarity and strength, certainty is a relevant feature of an opinion expression. Concerning M2.2, almost 79 % of the subjects validated that a phrase when outscoped by "pouvoir" is less certain than when outscoped by "devoir", whereas only 23 % of them consider that "devoir" lowers the certainty degree of the phrase in its scope. M2.3 is validated at around 57 % overall since for "devoir" ("have to") and "falloir" ("need to"/"must") subjects considered them as having the

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[3]Implicit opinions, also called opinionated sentences (Liu, 2010), are sentences that express positive or negative opinions and do not contain any explicit subjective clues. Here are some examples: "The movie is not bad, although some persons left the auditorium" or "Laborious and copy/paste of the first part".

same effect.

M3.1 is validated to a lesser extent: 54 %. 62.5 % of the subjects agreed with the hypothesis that deontic "pouvoir" ("may"/"can") reduces the strength of the opinion in its scope. This might be explained by the ambiguity between deontic and epistemic readings of these three verbs. The strengths of "devoir" and "falloir" are deemed identical (M3.2) at 60 %. The rest of 40 % are evenly split between "devoir" being stronger than "falloir" and vice versa.

5 Conclusion

In this paper, we showed that the effects of modality and negation on opinion expressions in their scope depend on the type of these operators. Based on a set of protocols, we empirically validated that negation affects both polarity and strength, and that negative quantifiers and multiple negations boost the strength of the negation. We also empirically validate that modality affects the strength, in case of deontic modality, and the certainty degree for buletic and epistemic modality. Our approach is novel in two ways:

- Our treatment of negation goes beyond the approaches of (Wilson et al., 2009)(Taboada et al., 2011) and (Liu and Seneff, 2009) since we propose a specific treatment for negative polarity items and for multiple negatives. In addition, our results for negative operators confirm, as in (Taboada et al., 2011) and (Liu and Seneff, 2009), that the strength of an opinion expression in the scope of a negation, is not greater than of the opinion expression alone.

- For modality, to our knowledge, our approach is the first study dealing with the semantics of modality for sentiment analysis.

The empirical results reported in this paper provide a basis for future opinion analysis systems that have to compute the sentiment orientation at the sentence or at the clause level.

In further work, we plan to study the effect of cumulative modalities, as in "you definitely must see this movie", and of co-occurring negation and modality, as in " you should not go see this movie", on opinion expressions. We also plan to evaluate to what extent our empirical results extrapolate to other languages. Finally, we will plug our results to a computational model in order to determine the contextual polarity of opinion expressions at the sentence or clause level.

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References

Anne Abeillé and Danièle Godard. 2010. The grande grammaire du français project. In *Proceedings of LREC'10*.

Farah Benamara, Carmine Cesarano, Antonio Picariello, Diego Reforgiato, and V. S. Subrahmanian. 2007. Sentiment analysis: Adjectives and adverbs are better than adjectives alone. In *Proceedings of ICWSM*.

Farah Benamara, Baptiste Chardon, Yannick Mathieu, and Vladimir Popescu. 2011. Towards context-based subjectivity analysis. In *Proceedings of 5th International Joint Conference on Natural Language Processing*, pages 1180–1188.

Yejin Choi and Claire Cardie. 2008. Learning with compositional semantics as structural inference for subsentential sentiment analysis. In *Proceedings of EMNLP'08*, pages 793–801.

Francis Corblin and Lucia Tovena. 2003. L'expression de la négation dans les langues romanes. In D. Godard., editor, *Les langues romanes : problèmes de la phrase simple*. Paris: CNRS Editions.

V. Ganter and M. Strube. 2009. Finding hedges by chasing weasels: Hedge detection using wikipedia tags and shallow linguistic features. In *Proceedings of ACL-IJCNLP'09*, pages 173–176.

Anastasia Giannakidou. 2011. Positive polarity items and negative polarity items: variation, licensing, and compositionality. *Semantics: An International Handbook of Natural Language Meaning*.

Danièle Godard. to appear. Les négateurs. In *La Grande Grammaire du français*, chapter 10.

Stephan Greene and Philip Resnik. 2009. More than words: Syntactic packaging and implicit sentiment. In *Proceedings of HLT-NAACL'09*, pages 503–511.

Laurence Horn. 1989. *A natural history of negation*. University of Chicago Press.

Alistair Kennedy and Diana Inkpen. 2006. Sentiment classification of movie and product reviews using contextual valence shifters. *Computational Intelligence*, 22(2):110–125.

Takeshi S. Kobayakawa, Tadashi Kumano, Hideki Tanaka, Naoaki Okazaki, Jin-Dong Kim, and Jun ichi Tsujii. 2009. Opinion classification with tree kernel svm using linguistic modality analysis. In *Proceedings of CIKM'09*, pages 1791–1794.

Paul Larreya. 2004. L'expression de la modalité en français et en anglais (domaine verbal). *Revue belge de philologie et d'histoire*, 82(3):733–762.

Jingjing Liu and Stephanie Seneff. 2009. Review sentiment scoring via a parse-and-paraphrase paradigm. In *Proceedings of EMNLP'09*, pages 161–169.

Bing Liu. 2010. Sentiment analysis and subjectivity. In Nitin Indurkhya and Fred J. Damerau, editors, *Handbook of Natural Language Processing, Second Edition*. CRC Press, Taylor and Francis Group, Boca Raton, FL.

J. Lyons. 1977. *Semantics. vol. 2*. Cambridge University Press.

Jacques Moeschler. 1992. The pragmatic aspects of linguistic negation: Speech act, argumentation and pragmatic inference. *Argumentation*, 6(1):51–76.

Karo Moilanen and Stephen Pulman. 2007. Sentiment composition. In *Proceedings of RANLP'07*, pages 378–382.

Claude Muller. 1991. *La négation en français. Syntaxe, sémantique et éléments de comparaison avec les autres langues romanes:*. Droz, Genève.

Livia Polanyi and Annie Zaenen. 2006. Contextual valence shifters. In *Computing Attitude and Affect in Text: Theory and Applications*, The Information Retrieval Series, pages 1–10. Springer-Verlag.

Paul Portner. 2009. *Modality*, volume 1. Oxford University Press, USA.

Nairn Rowan, Cleo Condoravdi, and Lauri Karttunen. 2006. Computing relative polarity for textual inference. In *Proceedings of ICoS-5*.

Victoria Rubin. 2010. Epistemic modality: From uncertainty to certainty in the context of information seeking as interactions with texts. *Information Processing and Management*, 46(5):533–540.

Roser Saurí and James Pustejovsky. 2009. FactBank: a corpus annotated with event factuality. *Language Resources and Evaluation*, 43(3):227–268.

Henriette De Swart. 2010. Expression and interpretation of negation. An OT typology. *Studies in Natural Language and Linguistic Theory*, 77.

Maite Taboada, Julian Brooke, Milan Tofiloski, Kimberly Voll, and Manfred Stede. 2011. Lexicon-based methods for sentiment analysis. *Computational Linguistics*, 37:267–307.

V. Vincze, G. Szarvas, R. Farkas, G. Móra, and J. Csirik. 2008. The bioscope corpus: biomedical texts annotated for uncertainty, negation and their scopes. *BMC bioinformatics*, 9(Suppl 11):S9.

Michael Wiegand, Alexandra Balahur, Benjamin Roth, Dietrich Klakow, and Andrés Montoyo. 2010. A survey on the role of negation in sentiment analysis. In *Proceedings of the Workshop on Negation and Speculation in Natural Language Processing*, pages 60–68.

Theresa Wilson, Janyce Wiebe, and Paul Hoffmann. 2005. Recognizing contextual polarity in phrase-level sentiment analysis. In *Proceedings of HLT'05*, pages 347–354.

Theresa Wilson, Janyce Wiebe, and Paul Hoffmann. 2009. Recognizing contextual polarity: An exploration of features for phrase-level sentiment analysis. *Computational Linguistics*, 35(3):399–433.

Ainur Yessenalina and Claire Cardie. 2011. Compositional matrix-space models for sentiment analysis. In *Proceedings of EMNLP'11*, pages 172–182.

Q. Zhao, C. Sun, B. Liu, and Y. Cheng. 2010. Learning to detect hedges and their scope using crf. In *Proceedings of CoNLL'10*, pages 100–105.