

Alexandra BALAHUR *
Paul BALAHUR **

What Does the World Think About You? Opinion Mining and Sentiment Analysis in the Social Web

Abstract. The recent growth in access to technology and the Internet, together with the development of the Web 2.0 (Social Web), has led to the birth of new and interesting social phenomena. On the one hand, the possibility to express opinion “by anyone, anywhere, on anything”, in blogs, forums, review sites has made it possible for people all around the world to take better and more informed decisions at the time of buying products and contracting services. On the other hand, the companies and public persons are more informed on the impact they have on people, because the large amount of opinions expressed on them offers a direct and unbiased, global feedback. The other side of the coin is that uncontrolled expression of opinions has given way to proliferation of violent messages, instigation to anti-social and other negative behaviour. Due to the large volumes of such data, automatic systems must be built to deal with it. We present different approaches for the machine treatment of subjective communication (opinion mining) and show our findings, discussing their implications.

Keywords: sentiment analysis, opinion mining, communication techniques.

1. Introduction

Humans are social beings. They cannot reach the level of what we call “human” unless they develop in organised societies, where they are taught norms, rules and laws governing the existence and co-existence of people. Although most of the times unconsciously, we continuously shape our behaviour and attitudes on the basis of these social conventions, of public and private opinions and events of the world surrounding us. We give and accept advice as part of our every-day lives, as part of a ritual to knowing, better under-

standing and integrating into our surrounding reality. Our reactions are based on what we expect. Moreover, norms of what is allowed and what is not, what is generally expected to be done or not in a context, trigger our own emotional response and our attitude towards the situations (Ratner, 2000), (Goleman, 1995).

Together with the development of technology and the growing access to information, we have witnessed the birth of a new type of society - that of the interaction and communication (Wiberg, 2004). In this new context, the role of emotion has become crucial. Facts determine emotion in people, who absorb facts and express the effect these facts have on them. Other persons have access to these

* Universitatea Alicante, Spania.

** Universitatea „Al. I. Cuza”, Iași.

expressions of sentiments and facts, which they, in their turn, transform under the influence of their own emotional perception. Practically, access to information has also given way to access to emotional response to information, in the light of which information changes. Thus, people react to both facts and attitude on facts. And while society is changing, norms are changing along with it, and world attitude shapes new norms, under which societies further change. We can think of numerous examples of facts, on which the society's and the people's opinion has changed over time and we can also think of facts that remain taboo subjects in many communities around the world. It is thus both interesting, as well as challenging to see what the opinion is on certain subjects, so that trends can be predicted and the right measures taken.

The automatic processing of texts to detect opinion expressed therein, as a unitary body of research, has been denominated *opinion mining* or *sentiment analysis*. Most work on sentiment analysis has been carried out on highly subjective text types such as blogs and product or movie reviews. Authors of such text types mostly express their opinions quite freely. News articles have received much less attention, although news bias across different news sources has been discussed by a few and some initial efforts have concentrated on sentiment analysis in the news area (Fortuna et al., 2009), (Belyaeva and Van der Goot, 2009). News articles and other media reports typically contain much less clearly stated opinions. Although support or criticism are sometimes expressed, the bias or sentiment of the journalist is often expressed indirectly, for instance by highlighting some facts while possibly omitting others or by the choice of words.

2. Motivation for opinion mining and sentiment analysis research

At the economic level, the globalization of markets combined with the fact that people can freely express their opinion on any product or company on forums, blogs or e-commerce sites led to a change in the companies' marketing strategies, in the rise of awareness for client needs and complaints, and a special attention for brand trust and reputation. Specialists in market analysis, but also IT fields such as Natural Language Processing, demonstrated that in the context of the newly created opinion phenomena, decisions for economic action are not only given by factual information, but are highly affected by rumours and negative opinions. Studies showed that financial information presented in news articles have a high correlation to social phenomena, on which opinions are expressed in blogs, forums or reviews. On the other hand, many tasks that involved extensive efforts from the companies' marketing departments are easier to perform. An example is related to market research for business intelligence and competitive vigilance. New forms of expression on the web made it easier to collect information of interest, which can help to detect changes in the market attitude, discover new technologies, machines, markets where products are needed and detect threats. On the other hand, using the opinion information, companies can spot the market segments their products are best associated with and can enhance their knowledge on the clients they are addressing and on competitors. The analysis of the data flow on the web can lead to the spotting of differences between the companies' products and the necessities expressed by clients and between the companies' capacities

and those of the competitors. Last, but not least, the interpretation of the large amounts of data and their associated opinions can give companies the capacity to support decision through the detection of new ideas and new solutions to their technological or economic problems.

The advantage and, at the same time, issue related to these new capabilities is the large amount of information available and its fast growing rate. Lack of information on markets and their corresponding social and economical data, leads to wrong or late decisions and finally to important financial losses. The solution is an automatic system delivering the pertinent information needed, corroborating information pertaining to different environments (newspapers, magazines, internet sources, blogs, forums, etc.) to support the decision process.

Secondly, the development of social networks and communication between their members led to the development of interesting phenomena, whose effects are both positive and negative and which are difficult to assess. Within social networks gathered around the most peculiar topics, people talk about subjects that they would not address in their everyday life and with their friends or family. Under the hidden identity on the web, however, they are free to express their innermost fears and desires. That is why, allowing and supporting free communication led to the birth of sites where violence is predicated and encouraged, where people with psychological problems or tendencies towards suicide, addictions etc. talk to one another and encourage their negative behaviours. For many people such cases are perceived as generating a serious problem with both legal and ethical valences: if and how such sites must be discovered and socially controlled, in order to keep under

control different social issues that may arise from the described potentially conflictive phenomena.

While the growing volume of data allows for the key organizations and companies, as well as the general public, to be more informed on “what is going on” and “what the world thinks about it”, the quantity of information to be analyzed outperforms the human processing capacity. Thus, specialized systems must be built to gather and extract the relevant opinion data and present the interested users with a summary of its contents. The large volume of data contained in these resources requires for Natural Language Processing systems to be built in order to automatically analyze them. Thus, recent years have marked the beginning and expansion of a large research initiative in the field of NLP towards what is generally denominated as “opinion mining”, “sentiment analysis”, “subjectivity analysis”, “review mining” or “appraisal extraction” (Pang and Lee, 2008). In the following sections, we show the possible applications of this task for different textual genres and for distinct purposes.

3. Applications

Research has been conducted in the field of opinion mining, aimed at improving different social, economical, political and psychological aspects of every-day human life. There are many applications of opinion mining systems to realworld scenarios. Some of these applications are already available online (www.swooty.com, www.wefeelfine.org, www.twendz.com), others are still under research and other directions and developments in the field are merely appearing. There are sites like “swooty.com”, which mine, classify and summarize opinions

from reviews on products on the e-commerce sites, which people can use for comparison, advice or recommendation.

Other applications of the task, directly related to the commerce and competitive markets of companies, use opinion mining from the web for obtaining direct, sincere and unbiased market feedback, about their own products (business intelligence), and of the products of their market competition (competitive vigilance). Companies, as well as public figures, use opinion mining to monitor their public image and reputation (trust). Authors can benefit from opinion mining to track their literary reputation. It was demonstrated that fluctuation in public opinion correlates to fluctuations of stock prices for the targeted companies (Devitt and Ahmad, 2007). Thus, opinion mining can be used to track opinion across time for market and financial studies, for early action in predicted crisis situations or for the issuing of alerts.

Recent developments of the Social Web technologies and the growing number of people writing and reading social media (blogs, forums etc.) also allows for the monitoring and analysis of social phenomena, for the spotting of potentially dangerous situations and determining the general mood of the blogosphere. Examples of sites implementing these concepts are “wefeelfine.org” or “twends.com”. Yet another application of sentiment analysis is the tracking of political view, to detect consistency and inconsistency between statements and action at the governing level. It was recently stated that election results could be better predicted by following the discussion threads in blogs.

eRulemaking, as a democratic way of consulting the whole targeted population

when a law or policy is to be implemented, can also highly benefit from sentiment analysis, as method to spot and classify a large quantity of subjective data. This task is also performed when tracking views on laws from legal blogs (blawgs).

Last, but not least, studying affect related phenomena is basic for Human-Computer Interaction (Picard, 1995), as most reactions and interactions are not only rationality-based, but heavily rely on emotion.

4. Definitions of the task

Several definitions of opinion mining have been proposed in the literature. Although there is no universally agreed definition of the task, some research directions have been described.

Subjectivity analysis is defined by J. Wiebe (Wiebe, 1994) as the “linguistic expression of somebody’s opinions, sentiments, emotions, evaluations, beliefs and speculations”. In her definition, the author was inspired by the work of the linguist Ann Banfield (Banfield, 1982), who defines as subjective the “sentences that take a character’s point of view and that present private states” (i.e. states that are not open to objective observation or verification) of an experiencer, holding an attitude, optionally towards an object. Subjectivity is opposed to objectivity, which is the expression of facts.

A. Esuli and F. Sebastiani (2006) define opinion mining as a recent discipline at the crossroads of information retrieval and computational linguistics which is concerned not with the topic a document is about, but with the opinion it expresses. This is a very broad definition, which targets opinions expressed at a document level. However, for example, news articles contain mentions of different persons and

events, the topic in itself might involve a negative tonality and both the author of the text, as well as the facts presented or the interpretation they are given by the reader may lead to a different categorisation of the document.

In an operational framework (Dave et al., 2003), an opinion mining system is defined as one that is able to “process a set of search results for a given item, generating a list of product attributes (quality, features, etc.) and aggregating opinions about each of them (poor, mixed, good).” Opinion mining, in this context, aims therefore at extracting and analysing judgements on various aspects of given products. A similar paradigm is sometimes entitled *feature-based opinion mining*.

Adopting a more analytical perspective, S.M. Kim and F. Hovy (Kim and Hovy, 2005) define opinion as a quadruple (Topic, Holder, Claim, Sentiment), in which the Holder believes a Claim about the Topic, and in many cases associates a Sentiment, such as good or bad, with the belief. The authors distinguish among opinions with sentiment and opinions without sentiment and between directly and indirectly expressed opinions with sentiment.

In the SemEval 2007 No. 14 Affective Text Task (Mihalcea and Strapparava, 2007), the systems were supposed to classify 1000 newspaper titles according to their valence and emotion contained. A title such as “Scientists proved that men’s perspiration raises women’s hormone levels” or “100 killed in bomb attack” were classified as negative.

In other approaches, capturing favourability versus unfavourability, support versus opposition, criticism versus appreciation, liking versus disliking, even bad versus good news classification were considered to be *sentiment analysis*.

5. Experiments

The experiments we conducted in the field of opinion mining aimed at discovering the specific aspects that define the task of opinion mining in different textual genres. As we could notice, the expression of subjective content is dependent on the target of the discourse and the public it is addressed to, as well as the context in which it is written (informal text types – blogs, reviews, forums – versus traditional text types – newspaper articles, titles, reported speech).

5.1. Newspaper article titles

In a first effort (Balahur and Montoyo, 2008a), we draw the attention upon the difference between the *cognitive* and *emotional* aspects of text, as theoretically explained by the *Theory of Emotivism* (Stevenson, 1963) and investigate a method to obtain a database of terms that being related to human needs and motivations. We define a new concept, called “emotion trigger”, whose definition can be summarized by: “An “*emotion trigger*” is a word or idea that is connected to general human needs and motivations or that depending on the reader’s interests, cultural, educational and social factors, relates to general human needs and motivations and thus leads to an emotional interpretation of a given text. (e.g. war, freedom, mother, bomb)”. The approach is theoretically underpinned by the Theory of relevance (Sperber and Wilson, 2004) – giving different importance of emotion triggers according to “relevance”. The core of “emotion triggers” is taken from Abraham Maslow’s Pyramid of human motivations (Maslow, 1943) and from Manfred Max-Neef’s matrix of human needs and satisfiers (Max-Neef, 1991).

The first one contains the general human motivations in a hierarchy of 5 levels, from the 3 bottom levels that are basic, to the upper 2 levels containing the higher needs. Max-Neef's matrix contains terms organized according to 4 existential categories and 9 categories of needs (therefore having different relevance). The core of terms is expanded using lexical resources such as WordNet and WordNet Affect, completed by NomLex, sense number disambiguated using the Relevant Domains concept. The mapping among languages is accomplished using EuroWordNet and the completion and projection to different cultures is done through language-specific commonsense knowledgebases. Subsequently, we show the manner in which the constructed database can be used to mine texts for valence (polarity) and affective meaning. An evaluation is performed on the Semeval Task No. 14, obtaining better results than the systems participating in the competition, showing that the effect of text (on a reader), obtained through the use of specific terms, is a different problem from the determination of affect in text.

5.2. Reviews

Reviews are written mostly in e-commerce sites, which people consult in order to purchase a product or another or contract a service or another (travel, restaurants, hotels etc.). The opinions, in this type of texts, are expressed around the characteristics (features) of the "object" of the review. For example, if the object is a digital camera, the opinions will concentrate on the resolution of the pictures, on the modes, on the screen size, the price, etc. Besides these expressions of direct opinion, people tend to present factual data to bring arguments for their opin-

ions: e.g. "It broke in two days", "The night pictures are blurry". Moreover, affect expressions are used to underline the positive or negative opinion: e.g. "I love this book", "I hated every moment of using this camera". In our approach (Balahur and Montoyo, 2008b), for each product class we first automatically extract general features (characteristics describing any product, such as price, size, design), for each product we then extract specific features (as picture resolution in the case of a digital camera) and feature attributes (adjectives grading the characteristics, as for example high or low for price, small or big for size and modern or faddy for design). Further on, we assign a polarity (positive or negative) to each of the feature attributes using a previously annotated corpus and Support Vector Machines Sequential Minimal Optimization (Platt, 1998) machine learning with the Normalized Google Distance (Cilibrasi and Vitanyi, 2006) and Latent Semantic Analysis (Deerwester et al., 1990), as well as patterns of affect expressions.

5.3. Political debates

In another research (Balahur et al., 2009), we investigated different approaches we developed in order to classify opinion and discover opinion sources from text, using affect, opinion and attitude lexicon. We apply these approaches on a corpus of American Congressional speech data. We propose three methods to classify opinion at the speech segment level, firstly using similarity measures to the affect, opinion and attitude lexicon, secondly dependency analysis and thirdly SVM machine learning (Platt, 1998). Further, we study the impact of taking into consideration the source of opinion and the consistency in the opinion expressed,

and propose three methods to classify opinion at the speaker intervention level, showing improvements over the classification of individual text segments. Finally, we propose a method to identify the party the opinion belongs to, through the identification of specific affective and non-affective lexicon used in the argumentations. We show that argumentation is highly related to the use of affective terms and “emotion triggers”- relating to the needs and motivations of the different participants in the discussions (as a party member, as a person interested in the economic welfare of his country, of his family etc.).

5.4. Newspaper articles

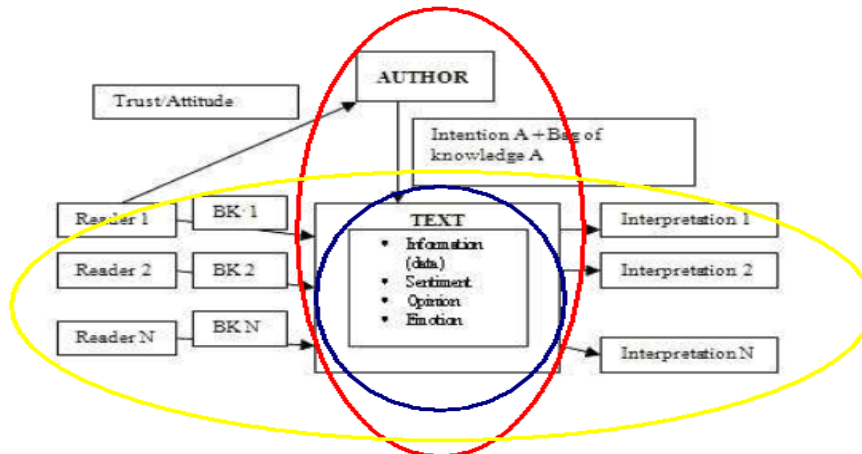
Applying the perspective proposed in our analytical model (Balahur and Montoyo, 2008a) and following the effort to classify opinion in newspaper articles, we defined a 3-layer model of opinion in traditional news (Balahur and Steinberger, 2009): author, text and reader (Figure 1).

While *the author* might convey certain opinions, by omitting or stressing upon some aspect of the text and by thus inserting their own opinion towards the

facts, the spotting of such phenomena is outside the aim of sentiment analysis as we have defined it. Instead, such phenomena should be analysed as part of work on perspective determination or news bias research. From the *reader's point of view*, the interpretations of the text can be multiple and they depend on the personal background knowledge, culture, social class, religion etc. as far as what is normal (expected) and what is not are concerned. Lastly, the opinion stated *strictly in the text* is the one that one should concentrate on at this level, being expressed directly or indirectly, by the target, towards the source, with all the information needed to draw this conclusion on polarity present in the text.

From the author and the reader's perspective and not from the text's pure informational point of view, opinion is conveyed through facts that are interpretable by the emotion they convey. However, emotions are not universal in their meaning. They are determined socially, culturally and historically. There are general emotions, but most of the times they relate to the norms, their significance and the cultural environment. Emotions imply an evaluation, which is both cognitive and

Figure 1: The three components of text opinion



affective, of a behaviour, with respect to a norm and the mutual expectation it raises. Some norms are common sense and are accepted and understood by all. Normative expectations link the behaviour (reaction) to a meaning and on this ground, by the understanding it is given. From the reader's point of view, sentiment analysis would be defined as *the assessment of a "target"*, based on its characteristics and factual information related to it, according to whether or not the results of the assessments are "according to" or "against" the "norm".

From the author's point of view, news bias or perspective determination should be concerned with discovering the ways in which expression of facts, word choice, omissions, debate limitations, story framing, selection and use of sources of quotes and the quote boundaries, for example, conveys a certain sentiment or not. The sentiment content of the text, finally, is what is expressly stated, and not what is left to be understood between the lines. Although pragmatics, through the speech act or other theories would argue there is no text that has no intended meaning, the sentiment or factual information conveyed is different from reader to reader and can thus not be done at a general level, as sentiment analysis intends to. For example, the text "The results of the match between Juventus Torino and Real Madrid last night are 3-0." would maybe be interpreted as something positive, a motive for pride in an Italian newspaper, it would be a negative, sad thing if reported by a Spanish source, it would be bad or good depending on whether or not an interested reader were pro or against the two teams and it would constitute just factual news from the strict point of view of the text. Given these three views one must be aware of at the time of con-

structing a sentiment analysis system for news, we can see that the task becomes much clearer and the agreement at the time of annotating texts, implementing and evaluating systems is higher.

Should one want to discover the possible interpretations of texts, sources' and readers' profiles must be defined and taken into consideration, for a whole understanding of the possible sentiment effects text has or is intended to have, and not just a general, often misunderstood one.

6. Conclusions and future work

In this article, we presented an overview of some of the problematics and proposed solutions in the field of sentiment analysis, within the larger frame of affect computing. Subjectivity and sentiment analysis are very new, but "hot" research topics at the moment, due to the worldwide impact of the large and expanding quantity of subjective data on the web and the demonstrated effect it has on public opinion and social or economic behaviour. In the field of NLP, research in this areas have bloomed in the past few years and a substantial body of applications have already been approached, with interesting results and discoveries. However, there are many challenges associated to these affect-related tasks that have not been tackled yet or do not have a clear definition. While some of the tasks have been intensively researched, due to their economic implications (e.g. opinion mining of product reviews), other applications have just been discovered and their challenges as far from being resolved. Another conclusion that we were able to draw from our research is that not all resources and methods that are currently used are appropriate for all the tasks they are

applied to. For some settings, different annotations schemes and guidelines must be produced, that better specify the special characteristics of the task at hand. An example of such a problem is annotating opinion in blogs, newspapers or reviews, where the difference in text structures, the integration of various sources or the high probability that text will contain news that is in itself bad or good has to be better understood and contemplated by NLP systems. Last, but not least, although performance of systems is constantly growing, the conclusion that we could draw from our research was that a deeper level of analysis is needed and knowledge from other fields with a longer tradition of studying these phenomena should be integrated, as affect resides not in words or phrases, but is highly related to the under-

standing and interpretation of meaning. (Balahur P., 2006). Needless to say, affect is specific to living beings (not only humans, as many would argue) and, as studies in neuroscience, cognitive science, psychology or biology have shown, its content and expression are linked to many components that are impossible to capture entirely by the study of language. There is a limitation to every task where such an intricate puzzle as emotion is concerned and our aim should not be to replicate it artificially or create “fake” beings, however tempting it might sound. Nonetheless, understanding how affect is expressed and formed, by studying its different components can help people to better understand one another and communicate more effectively and efficiently.

References

- Balahur, A. and Montoyo, A. (2008a). Applying a culture dependent emotion triggers database for text valence and emotion classification. *Procesamiento del Lenguaje Natural*, 40 (40).
- Balahur, A. and Montoyo, A. (2008b). Determining the semantic orientation of opinions on products - a comparative analysis. *Procesamiento del Lenguaje Natural*, 41(41).
- Balahur, A., Kozareva, Z., and Montoyo, A. (2009). Determining the polarity and source of opinions expressed in political debates. *Lecture Notes in Computer Science*, 5449.
- Balahur, A., Steinberger, R. (2009). Rethinking opinion mining in the news: from theory to practice and back. *Proceedings of the 1st Workshop on Opinion Mining and Sentiment Analysis (WOMSA 2009), held in conjunction with CAEPLA 2009*.
- Balahur, P. (2006), *Problematologie și comunicare*, Editura Universitatii ALI.Cuza Iași.
- Banfield, A. (1982). *Unspeakable sentences: Narration and Representation in the Language of Fiction*. Routledge and Kegan Paul.
- Cilibrasi, D. and Vitanyi, P. (2006a). Automatic Meaning Discovery Using Google. *IEEE Journal of Transactions on Knowledge and Data Engineering*.
- Deerwester, S., Dumais, S., Furnas, G. W., Landauer, T. K., and Harshman, R. (1990). Indexing by latent semantic analysis. *Journal of the American Society for Information Science*, 3(41).
- Devitt, A. and Ahmad, K. (2007). A lexicon for polarity: Affective content in financial news text. In *Proceedings of the Conference on Language for Special Purposes 2007*.
- Esuli, A. and Sebastiani, F. (2006). Sentiwordnet: A publicly available resource for opinion mining. In *Proceedings of the 6th International Conference on Language Resources and Evaluation*
- Fortuna Blaz, Carolina Galleguillos and Nello Cristianini (2009). *Detecting the bias in media with statistical learning methods Text Mining: Theory and Applications*, Taylor and Francis Publisher.

- Goleman, D. (1995). *Emotional Intelligence*. Bantam Books.
- K. Dave, S. Lawrence, and D. M. Pennock, "Mining the peanut gallery: Opinion extraction and semantic classification of product reviews," in *Proceedings of WWW*, pp. 519–528, 2003.
- Kim, S.-M. and Hovy, E. (2004). Determining the Sentiment of Opinions. In *Proceedings of COLING 2004*.
- Maslow, A. (1943/ 1970). *A theory of human motivation* (originally published in 1943). In *Motivation and personality*, Harper and Row, New York, 1970
- Max-Neef, M. A. (1991). *Human scale development: conception, application and further reflections*. The Apex Press, New York.
- Pang, B. and Lee, L. (2008). Opinion mining and sentiment analysis. In *Foundations and Trends in Information Retrieval*.
- Picard, R. (1997). *Affective Computing*. MIT Press.
- Platt, J. (1998). *Sequential minimal optimization: A fast algorithm for training support vector machines*. Microsoft Research Technical Report MSR-TR-98-14.
- Ratner, C. (2000). A cultural-psychological analysis of emotions. *Culture and Psychology*, (6).
- Sperber, D. and Wilson, D. (1995). *Relevance Theory*, Handbook of Pragmatics. Oxford University Press.
- Stevenson, C. (1963). *Facts and Values: Studies in Ethical Analysis*. Yale University Press, New Haven, USA.
- Strapparava, C. and Mihalcea, R. (2007). Semeval 2007 task 14: Affective text. In *Proceedings of ACL 2007*.
- Uspensky, B. (1973). *A Poetics of Composition*. University of California Press, Berkeley, California.
- Wiberg, M. (2004). *The Interaction Society: Theories Practice and Supportive Technologies*. Idea Group Inc.
- Wiebe, J. (1994). Tracking point of view in narrative. *Computational Linguistics*, 20.