

Applying a Culture Dependent Emotion Triggers Database for Text Valence and Emotion Classification

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Abstract. This paper presents a method to automatically spot and classify the valence and emotions present in written text, based on a concept we introduced - of emotion triggers. The first step consists of incrementally building a culture dependent lexical database of emotion triggers, emerging from the theory of relevance from pragmatics, Maslow's theory of human needs from psychology and Neef's theory of human needs in economics. We start from a core of terms and expand them using lexical resources such as WordNet, 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: Affective Text test data and their corresponding translation to Spanish. The results and improvements are presented together with an argument on the strong and weak points of the method and the directions for future work.

1 INTRODUCTION

In recent years, there has been growing interest in studying the methods through which subjectivity is expressed in written text. Whether it is mining for customer opinions, or tracing attitudes towards different topics of interest, tools and applications aiming at discovering subjectivity, spotting and, moreover, interpreting emotion in text are highly applicable to various natural language processing areas. Some important examples include word sense disambiguation [24], multi-document summarization, multi-perspective question answering and speech generation. Moreover, in the context of the interactive web, computers can no longer remain static tools, but must become capable of detecting user-specific characteristics, attitudes and emotions and responding appropriately, thus creating a close to human-human interaction environment. Furthermore, being able to spot specificities of different users can ease the search for appropriate entertainment – beneficial to the user-, and help create personalized advertisement by communicating in a manner persuasive to each user individually – beneficial to the advertised companies. Last, but not least, recent findings have shown that emotional agents, replicating the human, emotion influenced decision process, outperform pure rational agents [7], in that

emotion-based decision making better captures the entire process of human reasoning.

Present work in the field has focussed on determining methods to capture emotion and opinion arising from written text, at a word level – identifying positive or negative sentiment of words – in [5], sentence or phrase level- in [9], and document level – in [7]. Lexical resources born from these contributions are WordNet Affect, presented in [22] and SentiWordNet, presented in [4], both for English. Lexical databases were in turn completed in several approaches toward sentiment analysis with lexical and commonsense knowledge databases such as ConceptNet [13], word similarity measures using WordNet [6], rules for determining text polarity using word and part-of-speech composition rules [1], statistical and machine learning methods [26]. To our knowledge, there has been little work done towards obtaining lexical databases of affective terms for languages other than English [19] and no approach including motivational, human-need oriented or relevance directed theories in the study of affect in text. We found that such theories can help spot the emotion inducing terms in text and prioritize their being interpreted, based on their level of importance for human existence. Also, discovering the source that is producing emotion to a reader is directly applicable to real-life, culture dependent situations through projection on commonsense knowledgebases of the considered language.

The observation we set off from is that, on the one hand, there are general terms that trigger emotion in all people – such as war, hunger, freedom, mother, children and, on the other hand, that people are different with respect to social context, values, interests, experience and so on. Therefore, their reaction and interpretations of texts are different. Indeed, when seeing a news headline like "Government approves new taxes for car imports", one reader will remain neutral, another will be infuriated, a car seller might be glad. Or in the case of a news title such as "The Spanish Civil War now a computer game", a Spaniard could feel offended, another outraged, another amused, a person of another nationality might feel neutral and a computer games' addict very happy. On the other hand, a title such as "Children killed in bomb attack" will most certainly produce a general feeling of sadness and/or fear to the readers.

Finally, relating all these observations, we ask ourselves: What are the causes of these different interpretations? Are there general terms that trigger emotion indifferent of the reader's culture, social and cultural background? Are there particular terms that trigger emotion only to a group of people; how can we identify those? Is it correct or practically usable to draw a general emotion from a given text? The answer we give is that it depends on what the intention in reading the text is. It is important to notice the clear distinction between the cognitive and emotional aspect of a text. When the text is read as information, the emotion reflected is that of the persons and

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actions behind the text, the events that it speaks about. However, when interpreting a text from a reader's point of view, the front-end of the text, is more purposeful to try to spot the reason for the different interpretations, following the general to particular manner, and replicate them in a computer environment.

Thus, we start from the premises that text alone bears no emotional content, at any level, but can contain what we call "emotion triggers".

We define the notion of "emotion trigger" as a word or concept expressing an idea, that depending on the reader's world of interest, cultural, educational and social factors, leads to an emotional interpretation of the text content or not. Examples of emotion triggers are "freedom", "salary", "employment", "sale", "pride", "esteem", "family" and so on. We will use this defined notion to build a database of such emotion triggers, classify them and integrate them in a system which spots and classifies text valence and emotion.

It is a demonstrated fact that rationality is influenced by emotion [8] and thus, emotion triggers can lead to shifts in the process of inference, based on what motivations and needs they trigger. We call "emotional inference" the process of conferring an emotional interpretation on a text on the basis of the most relevant emotion triggers of a given context.

Our method was developed in view of a novel perspective of emotion detection and interpretation, based on the defined notions of "emotion triggers" and "emotional inference", from a cultural specific perspective. In the end, we try to offer possible answers to the following questions:

1. Does a reader react to all emotional stimuli in a text?
2. From a text with different emotional stimuli, which are the ones that a specific reader will be sensitive to?
3. What makes those emotion triggers be picked for interpretation?
4. To what extent are emotion triggers culture dependent?
5. How can the general/culture-specific emotion triggers be obtained?
6. What feelings are evoked by the different emotion triggers?
7. What influence will the interpretation of the picked emotion triggers have on the further interpretation of the text?

In order to answer these questions, we will further present a method to construct a database of emotion triggers, the proposed model for a text valence and emotion spotting system and the method to integrate the emotion triggers database as part of the system conforming to the proposed model to automatically spot and classify the valence and emotions present in written text.

This paper is organized as follows: we shortly present the theories that lay at the foundation of our proposed method, together with a motivation for their use in Section 2. Further on, in Section 3, we present the model of the system we propose for text valence and emotion spotting. In Section 4, we show the practical steps performed for building the cultural dependent lexical database of emotion triggers and the method used to assign them valence and emotional value. In Section 5, we show the method used for the implementation of the system presented, as well as the resources, cognitive model and computational theory used. We follow by describing the experiment we performed on the system, the evaluation it was subjected to and the results obtained. In Section 6, we compare the obtained results with those obtained by similar systems. Finally, we

conclude on the method used and present the lines for future investigation and improvement.

2 THEORIES AND RESOURCES

This section briefly describes the theories lying at the foundation of our text valence and emotion spotting system.

The motivation for introducing the concept of "emotion triggers" is found in the assumptions and principles of the relevance theory from pragmatics. Abraham Maslow's theory of human motivation and its corresponding pyramid of human needs offer the method to classify the emotion triggers and create rules of emotion trigger interaction. In parallel, we apply Neef's matrix of fundamental human needs to create a need-satisfier system of emotion triggers, in view of an alternative set of rules for emotional inference.

2.1 THEORY OF RELEVANCE

There are two ways to conceive of how thoughts can be communicated from one person to another. The first way is through the use of strict coding and decoding, which makes explicit use of symbols, rules, and language. The second way is by making interpretive inferences, which communicate to the hearer information that is left implicit². Relevance theory [21] seeks to explain the second method of communication: implicit inferences. It argues that the human mind will instinctively react to an encoded message by considering information that it conceives to be relevant to the message. By "relevance" it is meant whatever allows the most new information to be transmitted in that context on the basis of the least amount of effort required to convey it. "The Theory of Relevance", arises from pragmatics, and states in the cognitive principle that "human cognition tends to be geared toward the maximization of relevance", that is, from the multiple stimuli present in a communication, be it written or spoken, a reader will choose the one with highest significance to their world of interest. In general, a person will act towards the maximization of the quantity of information it holds, activating the stimuli whose interpretation could bring them a piece of important information and inhibiting those they hold as unimportant. Furthermore, relevance is considered as relative or subjective, as it depends upon the state of knowledge of a hearer when they encounter an utterance. These statements, together with the principles of the relevance theory, can be seen to explain also the process of emotionally interpreting a text, since of all possible terms that could constitute in emotional reactions, the reader will only choose the most important to his/her interest and react to it and the relativity and subjectivity can be considered as cultural and social background specific emotion triggers and their corresponding inferences.

The theory of relevance contains no explicit mentioning or classification of what could constitute stimuli to a person. In that respect, and starting from what we showed in the introductory examples, we considered a good classification the one made by

²http://en.wikipedia.org/wiki/Relevance_theory

Abraham Maslow, under the form of a 5-level pyramid of human needs (motivations). We now explain more in depth the basics of this theory:

2.2 MASLOW'S PYRAMID OF NEEDS

Abraham Maslow, in [17], classified the human needs and motivational factors into a 5-level pyramid, from the basic, physiological ones, to the more education and personal level of development dependent ones. Needs such as food, shelter, peace are at the bottom of the pyramid, whereas needs for self achievement, fame, glory are at the top. The basic needs are the general human ones; as we move towards the top, we find the more individual dependent ones.

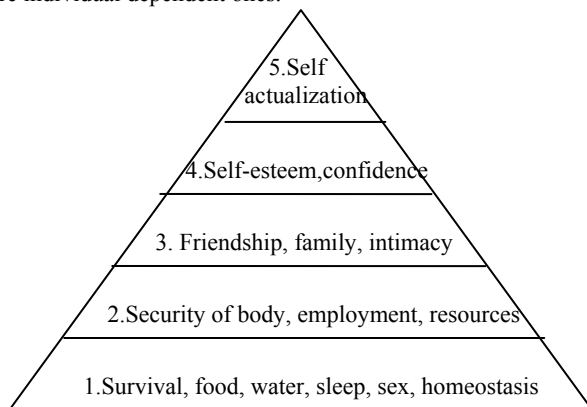


Figure 1. Maslow's pyramid of human needs and motivations

Maslow also defines a set of rules capturing the change in emotion triggers, based on the basic needs being met or not. Examples of such rules are:

1. If some needs are not fulfilled, a human's physiological needs take the highest priority.
2. Physiological needs can control thoughts and behaviours, and can cause people to feel sickness, pain, and discomfort.
3. When physiological needs are met, the need for safety will emerge.
4. When one stage is fulfilled, a person naturally moves to the next.

We consider the terms in Maslow's pyramid levels as primary emotion triggers, very general notions that express ideas that are fundamental to all human beings. Their projection to concrete notions, for example – food -> pizza, hot dog etc.; war -> Independence war, civil war is culture dependent.

In order to exploit this classification, we build a lexical database of emotion triggers at the 5 levels. The words found in the five levels are nouns, verbs, adjectives and adverbs.

2.3 NEEF'S MATRIX OF FUNDAMENTAL NEEDS

Among the critics of the Maslow theory of human needs is Manfred Max Neef, in [18]. In turn, Neef's theory is rooted in the economical perspective of fundamental human needs, complemented by their corresponding satisfiers. In the author's

view³, human needs are equally important, few, finite and classifiable (and are different from the economical "wants" that are infinite and insatiable) and constant through all human cultures and across historical time periods. Neef states that the only aspect changing over time and between cultures is the way these needs are satisfied. Human needs, according to Neef, are understood as a system - i.e. they are interrelated and interactive. Max-Neef classifies the fundamental human needs as: subsistence, protection, affection, understanding, participation, recreation (in the sense of leisure, time to reflect, or idleness), creation, identity and freedom. Needs are also defined according to the existential categories of being, having, doing and interacting, and from these dimensions, a 36 cell matrix is developed which can be filled with examples of satisfiers for those needs⁴.

Therefore, starting in parallel from the matrix of fundamental human needs as primary emotion triggers, we see, on one hand, if a classification of emotion triggers is better than a flat model with rules of inference, and on the other hand, can build a fine-grained taxonomy of terms indicating the precise category in which each type of emotion trigger influences the human affect.

3 EMOTION TRIGGER METHOD

Our emotion trigger method starts from the idea that words in text themselves carry no affectivity, but become emotionally charged depending on the interpretation they are given by each reader's world of interest and the intention and world of interest of the author. This world of interest is made up of general, personal needs and motivation factors, notions satisfying these needs, knowledge on the historical and social facts, information vehiculated in the media and so on. We call this collection of factors "bag of knowledge", and believe that by uncovering it, we move an important step forward "to try to uncover which are the latent semantic boundaries of human communication" [14].

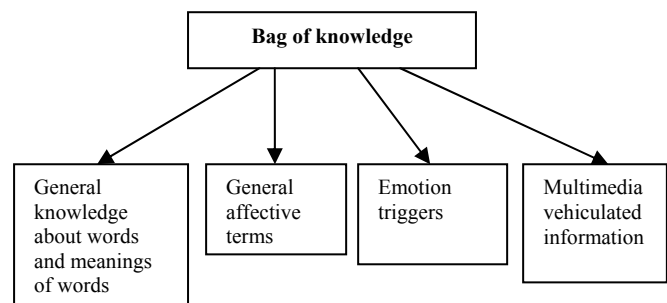


Figure 2. Model for the analysis of emotion in text

The first component of the bag of knowledge is made up of general knowledge about words and meanings of words. It contains what words can mean, the manner in which they are linked, how they change their meaning. The second component is formed of general affective terms, as "kind-hearted", "furious", "anxious", "fear" and so on. They express emotion, but do not necessarily induce emotion. For example, a title such as "Feared

³http://en.wikipedia.org/wiki/Fundamental_human_needs

⁴<http://www.rainforestinfo.org.au/background/maxneef.htm>

opponents, defeated without problems” has no connection to the idea of fear. Such classification of words can be found in lexical affective resources such as WordNet Affect or SentiWordNet. The third component is made up of emotion triggers. It contains the terms that carry in themselves an emotion or a conjunct of emotions, each in a certain percentage. Such a resource has not been built so far and constructing it is the starting point of our method. The fourth component is period, culture and place dependent. It consists of the concepts that become emotion triggers due to the degree of importance they are given in the media, in addition to the emotions they are associated with. Also, important events in the history or recent past of an individual, as well as society are considered as being emotion triggers. Examples of such emotion triggers are “9/11”, “Second World War”, etc. It is important to make the observation that these four components are not disjoint sets, neither are they fixed as components or constant among individuals. On the contrary, each can evolve in time, when ordinary words become emotion triggers and when emotion triggers in the fourth component lose impact and become ordinary words. Furthermore, by using the principles of the theory of relevance, we state that the “bag of knowledge” (BK) consists of different levels of factors, different in importance and by assigning this importance quotient, a system analyzing text will be able to tell the difference between relevant and irrelevant information. We further consider that the interpretation is also dependent on the source of the text and the relation the reader has with it or the a priori knowledge on the degree of trust, reliability of the text source or the attitude of agreement or disagreement of the reader towards the latter. Figure 3 shows the model for the analysis of emotion in text:

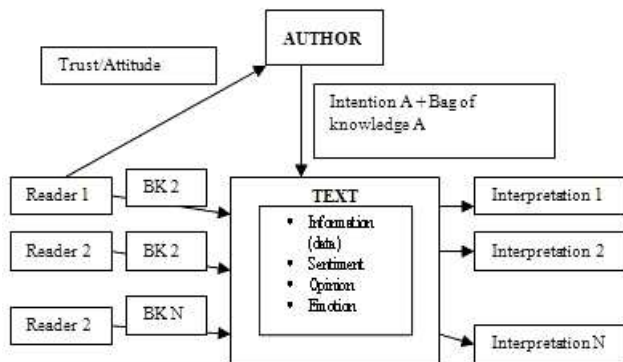


Figure 3. Model for the analysis of emotion in text

The system implemented by following the above model identifies the corresponding “bag of knowledge” of a reader and uses it to spot and classify text valence and emotion according to it.

In the following subsections, we start by presenting the steps we performed in order to build the lexical databases of emotion triggers for English and Spanish, the process of mapping the concepts found in English to their correspondents in Spanish and the process of projection to culture dependent knowledgebases for both languages. Further, we explain the method used for assigning valence and classifying emotion induced by emotion triggers. We then present the words and rules that influence the basic valence and emotion in a context and finally the rules of emotional inference derived from the theories underlying this method.

3.1 Constructing and Expanding the Core of Emotion Triggers

The core of English emotion triggers is built, at the first stage, of the approximately 37 terms found in Maslow’s pyramid of human needs, structured on 5 levels starting from the terms corresponding to the deficiency needs, found on the four bottom levels and having on top the growth needs terms, of achieving the personal potential, on level 5.

Since most of the words are general notions and their number is relatively small (37), we disambiguate them with the sense numbers they have in WordNet 2.1, in order to ensure that further on, the added words will remain with the intended meaning. For each term, we add all the senses and all grammatical categories that are valid in the context of Maslow’s pyramid levels. We then add to these words the corresponding synonyms and hyponyms from WordNet. For the verbs considered, we also add the entailed actions. We consider as having a negative value the emotion triggers that are antonyms of the nouns found. For each of the nouns and verbs, we further add the corresponding nouns and verbs, respectively, using NomLex [15]. Since NomLex does not assign sense numbers to distinguish between the possible semantics of the nouns and verbs in the collection, we use the Relevant domain concept and corresponding repository [25] to preserve the intended meaning, by taking the top relevant domain of each word sense and assigning the corresponding verb or noun in NomLex the sense number that has the same top relevant domain. If more such senses exist, they are all added.

On the other hand, another core of English words is completed with the terms found in Max Neef’s matrix of fundamental human needs. This matrix is built according to the four main characteristics of the individual: being, having, doing and interacting, for which terms are assigned in order to nine categories of needs: identity, subsistence, affection, creation, protection, freedom, participation, leisure and understanding. When building the core of words corresponding to the taxonomy proposed by Neef, we apply the same method as the one presented above for the concepts extracted from Maslow’s 5-level pyramid.

3.2 Mapping of Concepts

Using EuroWordNet⁵, we map the words in the English lexical database of emotion triggers to their Spanish correspondents, preserving the meaning through the WordNet sense numbers.

3.3 Adding World Knowledge to the Lexical Databases

The final step in building the lexical databases consists of adding real-world situations, cultural-dependent contexts terms to the two lexical databases. For English, we use the ConceptNet to add culture specific actions and terms related to the considered

⁵<http://en.wikipedia.org/wiki/EuroWordNet>

core of words. For Spanish, we add the cultural context by using the Larousse Ideologic Dictionary of the Spanish Language. Certainly, most words will overlap, since notions like "house" related to "live" and "sleep" related to "bed" are commonsense in both cultures. However, there are important details that in real-world texts are significantly culturally different, as for example that "gazpacho" or "bizcocho" are types of "food".

3.3.1 ConceptNet

ConceptNet⁶ is a freely available commonsense knowledgebase and natural-language-processing toolkit which supports many practical textual-reasoning tasks over real-world documents right out-of-the-box (without additional statistical training) including topic-gisting, affect-sensing, analogy-making, text summarization, contextual expansion, causal projection, cold document classification, and other context-oriented inferences. Commonsense knowledge in ConceptNet encompasses the spatial, physical, social, temporal, and psychological aspects of everyday life. It contains relations such as CapableOf, ConceptuallyRelatedTo, IsA, LocationOf etc.. For the purpose of maintaining the originally intended meaning of the emotional triggers in the lexical database constructed so far, we chose to project the the emotion triggers only based on the relations DefinedAs, LocationOf, CapableOf, PropertyOf and UsedFor.

3.3.2 Larousse Dictionary of the Spanish Language

The Larousse Ideologic Dictionary of the Spanish Language (LIDSL) [2] is made up of four parts: a general classification frame, a synoptic part, an analogic part and an alphabetic index. The Dictionary offers a two-way view on words and ideas they express, thus semantically relating terms pertaining to the same idea and also, given one idea, gathering in frames all concepts related to it. In using this resource, we start from the parallel core of Maslow and Neef concepts representing the levels of needs and motivations, completed as stated before with the synonyms, hyponyms and antonyms found in WordNet, and add the Spanish culture specific terms related to them. For example, from the general concept of "comida" ("food"), we find as subordinated concepts "carne" ("meat"), "fruta" ("fruit"), "verdura" ("vegetables") etc. These concepts are further refined to specific notions that are types of meat found in the real world: In the case of "carne", some examples are "vaca", "ternera", "carnero", "cordero", "matanza", "chicha".

3.4 Adding Valence and Classifying Emotion

Having at hand a lexical database of emotion triggers constitutes the first step towards the building of a system conforming to the model described in Figure 3, which spots possible emotional

interpretation of texts in a culturally specific way, starting from the general motivational traits applicable to the whole human species.

The next step consists in assigning valence and emotion to the terms in the database. This is done with the following rules, both for the terms in Maslow's pyramid as well as for those in Neef's matrix:

1. The primary emotion triggers are assigned the maximum positive valence (100).
2. The terms (also emotion triggers in the final lexical database) synonyms and hyponyms of the primary emotion triggers, as well as the entailed verbs are assigned the maximum positive valence (100).
3. The terms opposed and antonym of those from 1. and 2. are assigned a maximum negative valence(-100).
4. Emotion triggers added further on inherit the valence from the emotion trigger they are related to in case of synonyms, hyponyms and entailment and change their valence from positive to negative or negative to positive in the case of antonyms.
5. Value of all emotion triggers is modified according to the valence shifters they are determined by.

For example, "shelter" from level 1 in Maslow's pyramid has the valence 100, whereas "homeless", which is opposed to it, has the valence -100. These values will be weighted according to the pyramid level they are found on (this process is explained in section 4).

Further on, we assign an emotion triggers a value on each of the 6 categories of emotion proposed for classification in the SemEval Task No. 14 – joy, sadness, anger, fear, disgust and surprise, using the following rules:

1. The emotion triggers found in the levels of Maslow's pyramid of needs and those found in the components of Neef's matrix of fundamental human needs are manually annotated with scores for each of the 6 categories.
2. The terms (also emotion triggers in the final lexical database) synonym and hyponym of the primary emotion triggers, as well as the entailed verbs are assigned the same scores as the terms they are related to.
3. The terms opposed and antonym of those from 1 and 2.. are assigned initial values.
4. Emotion triggers added further on inherit the valence from the emotion trigger they are related to in case of synonyms, hyponyms and entailment and change their value from positive to negative or negative to positive in the case of antonyms.
5. Value of all emotions of an emotion triggers is modified according to the valence shifters they are determined by.
6. If any of the values calculated in 5. is higher than 100, it is set to 100; if it is lower than -100, it is set to -100.

3.5 Valence Shifters

In order to be able to recognize the change in meaning of emotion triggers due to modifiers, we have defined a set of

⁶ <http://web.media.mit.edu/~hugo/conceptnet/>

valence shifters – words that negate the emotion triggers, intensify or diminish their sense. The set contains:

- Words that introduce negation (no, never, not, doesn't, don't and negated modal verbs)
- A set of adjectives that intensify the meaning of the nouns they modify – big, more, better etc.
- A set of adjectives that diminish the meaning of the nouns they modify – small, less, worse etc.
- The set of modal verbs and conditional of modal verbs that introduce uncertainty to the active verb they determine- can, could, might, should, would
- The set of modal verbs that stress on the meaning of the verb they determine - must
- A set of adverbs that stress the overall valence and intensify emotion of the context – surely, definitely etc
- A set of adverbs that shift the valence and diminish emotion of the context – maybe, possibly etc

For each of the valence shifters, we define a weight of 1.5 for the meaning intensifiers and 0.5 for the meaning diminishers. These are coefficients that will be multiplied with the weight assigned to the emotion trigger level and emotions- level association ratio corresponding to the given emotion trigger in the case of emotion triggers built from Maslow's pyramid. In the case of emotion triggers stemming from Neef's matrix of fundamental human needs, the weights of the valence shifters are multiplied with the emotion-category association ratio, computed for each emotion trigger and each of the four existential categories. The valence shifters for Spanish are determined by translating the English valence shifters and adding synonymous terms and expressions.

3.6 Emotion Trigger Association Ratio

The association ratio score provides a significance score information of the most relevant and common domain of a word. The formula for calculating it is:

$$AR(w; D) = \Pr(w, D) \log_2 \frac{\Pr(w, D)}{\Pr(w) \Pr(D)}, \text{ where:}$$

- $\Pr(w, D)$ is the probability of the word in the given domain
- $\Pr(w)$ is the probability of the word
- $\Pr(D)$ is the probability of the domain

In our approach, besides quantifying the importance of each emotion trigger in a manner appropriate to the level and emotion it conveys, we propose to use a variant of the association ratio that we call emotion association level. This score will provide the significance information of the most relevant emotion to each level. The corresponding formula is therefore:

$$AR(e; L) = \Pr(e, L) \log_2 \frac{\Pr(e, L)}{\Pr(e) \Pr(L)}, \text{ where:}$$

- $\Pr(e, L)$ is the probability of the emotion in the given level
- $\Pr(e)$ is the probability of the emotion
- $\Pr(L)$ is the probability of the level

3.7 The Construction-Integration Model

The Construction-Integration Model is a psychological model of text comprehension [10], based on the idea that while reading a text, a person will activate the features of words that are appropriate to the context and inhibit those that are not.

The construction-integration model has been so far successfully used in the field of Natural Language Processing for anaphora resolution, generation of representations of word meanings from dictionaries [20] and automatic assessment of summarizations [12]. Also, the author proposed a computational method for metaphor comprehension [11] based on this cognitive model.

The process of text comprehension consists of two phases. The first one – the construction - uses rules in the form of a production system to generate, from the linguistic representation of words, a propositional network of related mental elements. Further, adding the knowledge experience of the reader, a more elaborated propositional network is created.

The second phase – integration- takes as input the crude representation of text in the form of the elaborated propositional network, with nodes linked with positive and negative connections meant to represent the relations between them, and tunes it using connectionist relaxation techniques.

4 SYSTEM FOR VALENCE AND EMOTION

The final system built to classify text at valence and emotion level follows the scheme depicted in Figure 4:

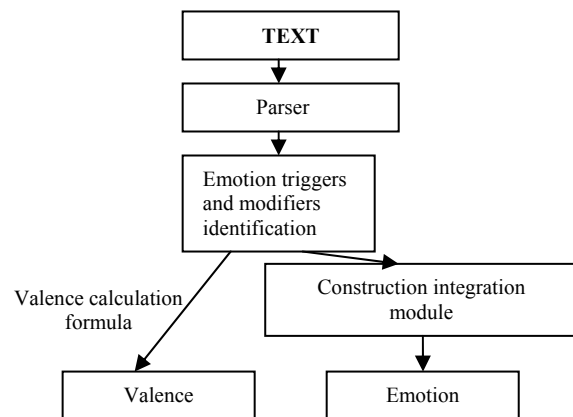


Figure 4. System for valence and emotion classification-components

First, the input text is parsed with Minipar for English and FreeLing⁷ for Spanish to obtain for each word the grammatical category, the lemma and its modifiers. Further on, the emotion triggers in the text are identified, together with their corresponding modifiers.

We calculate the valence of the text on the basis of the identified emotion triggers and their modifiers, using the formulas described in what follows.

In the case of emotion triggers obtained from Maslow's pyramid, we calculate a score called weighted valence of emotion trigger (wv) using the following formula:

⁷<http://www.lsi.upc.es/~nlp/freeling/>

$$wv(et_{ij}) = w(m) * w(l_j) * v(et_i) \quad , \text{ where}$$

- $w(m)$ is the weight of modifier
- $w(l_j)$ is the weight of level
- $v(et_i)$ is the emotion trigger valence
- i is the index of the emotion trigger
- j is the number of the level

The weight of the level is 1 for level 1, 0.8 for level 2, 0.6 for level 3, 0.4 for level 4 and 0.2 for level 5.

In the case of emotion triggers obtained from Neef’s matrix, we calculate a score called weighted valence of emotion trigger (wv) using the following formula:

$$wv(et_i) = w(m) * v(et_i) \quad , \text{ where}$$

- $w(m)$ is the weight of modifier
- $v(et_i)$ is the emotion trigger valence
- i is the index of the level

The total valence of the text equals the sum of all weighted valences of all emotion triggers, mapped to -1, if the value is below -50, to 0, if the value is between -50 and 50 and to 1 if the value is above 50. The mapping is done because the final evaluation is done on a coarse (-1,0,1) level.

We will show an example of computation for the headline: “More sleep, healthier slimmer children”.

The emotion triggers found in the text are “sleep”, “healthier” and “children”. The first two terms belong to level 1 in Maslow’s pyramid and are among the core terms; therefore, their values will be 100. The term “sleep” is also determined by the meaning intensifier “more” and thus its final weighted valence is 150. The term “children” is related to the term “family” on level 3, therefore its value will be 60. The sum of these three values is above 50, so the valence of the headline is 1.

Further, we calculate the emotions present in the text, by the following method:

- for each emotion trigger stemming from Maslow’s pyramid, we compute the emotion to level association ratio
- for each emotion trigger stemming from Neef’s matrix, we compute the emotion to category association ratio

We then apply the Construction Integration Model in a manner similar to that described in [12] and construct a spreading activation network. We consider the working memory as being composed of the set of emotion triggers and their emotion association ratio value multiplied with the values for emotions of the emotion trigger, which is considered as activation value. The semantic memory is set up of the modifiers and the top 5 synonyms and antonyms of emotion triggers with their AR value. The number was set empirically in order to prevent a high number of nodes in the network. We set the value of each emotion trigger to 1. We create a link between all concepts in the semantic memory with all the emotion triggers. We consider the strength of link the higher of the two Emotion trigger Association Ratio scores.

The text is processed in the order in which emotion triggers appear and finally we obtain the activation value for each emotion trigger.

The output for the values of the emotions in text is obtained by multiplying the activation values with 100 and adding the scores obtained for the same emotion from different emotion

triggers when it is the case. Values of emotions above 50 are set to 1 and values of emotions not exceeding this threshold are considered 0.

5 EXPERIMENTS AND EVALUATION

The evaluation of the system presented was done using the test data provided within the SemEval Task No. 14: Affective Text test set [22] and its Spanish translation. In the task proposed in SemEval, the objective was to assign valence – positive or negative - and classify emotion of 1000 news headlines provided as test set that were previously extracted from news web sites according to 6 given emotions: joy, fear, sadness, anger, surprise and disgust and their translation to Spanish. The results we obtained in the coarse-grained evaluation are presented in Table 1 for valence classification and in Table 2 for one of the 6 emotions- fear :

	Acc	Prec	Rec	F
English	70.15	75.23	65.01	69.74
Spanish	65.02	71.1	66.13	68.52

Table 1. System results for valence annotation

	Acc	Prec	Rec	F
English	95.16	47.21	45.37	46.27
Spanish	95.2	46.01	43.84	44.89

Table 2. System results for emotion annotation for “fear”

For the F measure we considered alpha 0.5.

In the competition, the best results achieved for coarse-grained valence classification were of 55.10 in Accuracy, 61.42 in Precision for one system and Recall 66.38 and an F-measure of 42.43 for another system, whose first two scores were lower. In case of coarse-grained classification of emotion, the best result for Accuracy was 87.9 and Precision 33.33 in a system which however had a very low recall and F measure score. Higher scores for Recall and F-measure were obtained by another system, which had only 75.30 Accuracy and 16.23 Precision. Although the results show relevant improvements over the ones obtained by previously built systems, in using such a complex system, one could and should use a more complex set of emotions. The set of emotions is rather limited and sometimes does not allow for an accurate assignment of the appropriate emotion for the emotion triggers, but according to a conventional classification assigned to remain within the given set of 6 emotions.

6 RELATED WORK

In the field of sentiment analysis, as far as we know, there is no similar approach to the one presented in this paper.

Work in sentiment analysis was done for languages other than English. For example, [24] propose an empirical method of sentiment analysis for Chinese and [2] presents an approach for multilingual sentiment analysis based on SentiWordNet and performs an evaluation on German movie reviews.

However, the difference in our approach is not given by the fact that we study sentiment in Spanish. The novelty consists firstly in the fact that we determine words that until now have not been

thought of as “sentiment-bearing” words, and show that their emotional value is given by their close link to human needs and motivations – the factors that determine to a high extent emotion. Secondly, our approach signals the distinction between the cognitive and the emotional aspects of sentiment analysis. Whereas others concentrated on seeking emotion in text in order to discover the sentiment present in the events described, we concentrated on the emotion raised by the text to the reader.

7 CONCLUSIONS & FUTURE WORK

In this paper we presented a method to assign valence and classify emotion in text starting with a database of cultural dependent emotion triggers derived from a theory in pragmatics and two motivational and need-based theories. The final classification of texts was done using the cognitive model of construction and integration, the emotion to level and emotion to category association ratio and taking into account valence shifters. It was observed that the system outperformed previously obtained results. In order for the system to be complete, we should also build the fourth component of the system, by applying the system on large corpora of news and of world and culture specific data. Part of the future work is thus applying the described method to classify valence and emotions from recent news texts and also world and culture dependent historical facts describing texts. Another direction for future work consists in applying a larger set of emotions for classification.

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