Chapter 10

A Computational Semantic Lexicon of French Verbs of Emotion

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Abstract

A computational semantic lexicon of French verbs of feeling, emotion, and psychological states is presented here, as well as *FEELING,* a software program using this lexicon to provide an interpretation and to generate paraphrases. Semantic representations are described by means of a set of feature structures. Sixty newspaper "letters to the Editor" were taken as a domain for the evaluation of this work.

Keywords: semantic lexicon, computational lexicon, emotion, feeling, psychological verbs, semantic classes.

1. Introduction

A computational semantic lexicon of verbs of feeling, emotion and psychological states is presented here, as well as *FEELING,* a software program using this lexicon to provide an interpretation and to generate paraphrases. A prototype-based organization of this lexicon with inheritance mechanism, feeling intensity and antonymy graphs, and a linguistic knowledge database is proposed.

2. Semantic Lexicon Description

A corpus of 950 French words for emotions and psychological states was studied. Of them, 600 are verbs, like *aimer* (to love), *effrayer* (to frighten), and *irriter* (to irritate), whereas 350 are nouns, like *amour* (love) and *colère* (anger). A semantic classification in which verbs and nouns are split into semantic classes according to their meaning is proposed. The hypothesis is that language reflects the way one conceptualizes the world, and that words with close meanings have

similar formal behaviors. This classification is similar to the works on feelings of Johnson-Laird and Oatley (1989) and Wierzbicka (1996).

2.1 Verbs and Semantic Classes

French verbs for feelings and psychological states occur in two kinds of structures, as illustrated in sentences (1) and (2), respectively.

(1)   *Paul irrite Marie*
       Paul irritates Marie

(2)   *Marie hait Paul*
       Marie hates Paul

These structures differ by the syntactic position of the person (*Marie*), called the "experiencer", who has the feeling or the emotion. In (1), the experiencer is the complement, and the subject (*Paul*) is the cause of her feeling (irritation). In (2), the experiencer is the subject and the complement *Paul* is the object of her feeling (hate). About 500 verbs belong to the first category and 100 belong to the second. Since the linguistic behaviors of these verbs are very different, two separate analyses were made. Verbs of the first category (e.g., irriter) were designated psychological verbs and divided into 33 semantic classes (cf. Table 1), with each class including verbs with the same meaning.

18 classes of **NEGATIVE** (or unpleasant) **FEELING**					
/aigrir/ to embitter	/attrister/ to sadden	/décevoir/ to disappoint	/déconcerter/ to disconcert	/dégoûter/ to disgust	/démoraliser/ to demoralize
/déranger/ to disturb	/effarer/ to alarm	/effrayer/ to frighten	/endurcir/ to harden	/irriter/ to irritate	/froisser/ to hurt
/inhiber/ to inhibit	/lasser/ to tire	/meurtrir/ to bruise	/obséder/ to obsess	/révolter/ to revolt	/tracasser/ to worry

13 classes of **POSITIVE** (or pleasant) **FEELING**					
/calmer/ to calm down	/désarmer/ to disarm	/distraire/ to entertain	/émoustiller/ to titillate	/émouvoir/ to move	/épater/ to impress
/fasciner/ to fascinate	/flatter/ to flatter	/intéresser/ to interest	/passionner/ to inspire passion	/rassurer/ to reassure	/satisfaire/ to satisfy
/vivifier/ to invigorate					

2 classes of **NEUTRAL FEELING**		
/indifférer/ to be indifferent to	/étonner/ to astonish	

Table 1. Semantic classes of French psychological verbs.

Two French dictionaries (Le Grand Robert de la Langue Française 2001, Le Trésor de la Langue Française 1971-1994), the Lexicon-Grammar of French Verbs studied by Gross (1975), and a large electronic corpus, Frantext, (2004) which contains 1250 texts from novels and stories, were used to build this classification. A large panel of native speakers verified this classification.

From a prototypical point of view, one verb of a class represents and can replace all the verbs in a class, and it also names the class. This name is written between slashes. For instance, the class /**irriter**/ contains verbs which mean "to cause annoyance", such as to aggravate, to irritate, or to exasperate.

The 33 classes of verbs fall into one of three categories of verbs:
   a) Negative verbs which indicate the experience or causation of a rather unpleasant feeling, such as irritation, fear, or disappointment. They are divided into eighteen classes, for example, /**irriter**/, /**effrayer**/ (= "to cause fear": to affright, to frighten, to scare), or /**attrister**/ (= "to cause a feeling of sadness": to grieve, to sadden).

   b) Positive verbs which mean the experience or the causation of a rather pleasant feeling, such as interest or fascination. They are divided into thirteen classes, for example, /**intéresser**/ (= "to cause interest": to interest) or /**fasciner/** (= "to cause an irresistible attraction or interest": to fascinate).

   c) Neutral verbs which mean the experience or the causation of a feeling that is neither pleasant nor unpleasant, like astonishment or indifference. They belong to two classes: /**étonner**/ (= "to cause a feeling of surprise": to astonish, to surprise) and /**indifférer**/ (to be indifferent to).

A difficulty is that the polarity of the verbs belonging to /**étonner**/class depends on the context. For example, in the sentence *La hauteur de la tour Eiffel surprend les touristes* (The Eiffel Tower's height surprises the tourists), the surprise felt by the tourist is neutral, whereas the meaning of *Le cadeau d'anniversaire de Paul surprend Marie* (Paul's birthday gift surprises Marie) is rather pleasant if usually Paul forgets Marie's birthday, and the meaning of *La cruauté de Paul surprend Marie* (Paul's cruelty surprises Marie) is rather unpleasant. Clearly, the classification of /**étonner**/ as a neutral class does not resolve this problem, which is why the current research is directed towards taking context into account.

2.2 Relationships between Semantic Classes

Semantic classes are linked by three types of relationships: meaning, intensity, and antonymy, which are represented with simple graphs.

Intensity and meaning graphs are connected graphs, shown partially in Figure 1. The figure is divided into three parts: the "unpleasant" classes, with a negative polarity, to the left, the classes with a positive polarity stand to the right, and the neutral classes are in the middle (the /**indifférer/** class is not represented in Figure 1). The intensity graph is oriented according to intensity of experienced feeling.

There is a "no feeling state" represented by a white circle noted NFS. Labeled arcs join this state to semantic classes. These arcs can be labeled by more specific features like "admiration", or by intensity degree represented by the symbol ▶ .

For example, the arc labeled "intérêt" (interest) joins the no feeling state to the **/intéresser/** class (to interest, to attract, to tempt, to entice, etc.). An interest increase on **/intéresser/** class verbs is described by **/passionner/** (to inspire passion) class verbs (to devour, to excite, to overexcite, to electrify, to fire, to carry away, to enthuse, etc.).

A stronger emotion of passion is reflected by /**fasciner/** class verbs (to fascinate, to intoxicate, to hypnotize, to mesmerize, etc.).

A graph contains antonymy links between classes. A subset is given in Figure 2, where the antonymy between classes is represented with an arc and the symbol ↔. As an example, the /**irriter/** class is antonymous with the /**calmer/** (to calm) class, meaning that each verb in the first class is antonymous with at least one verb in the second class (to mellow, to calm down, to relax, etc.) and vice versa.
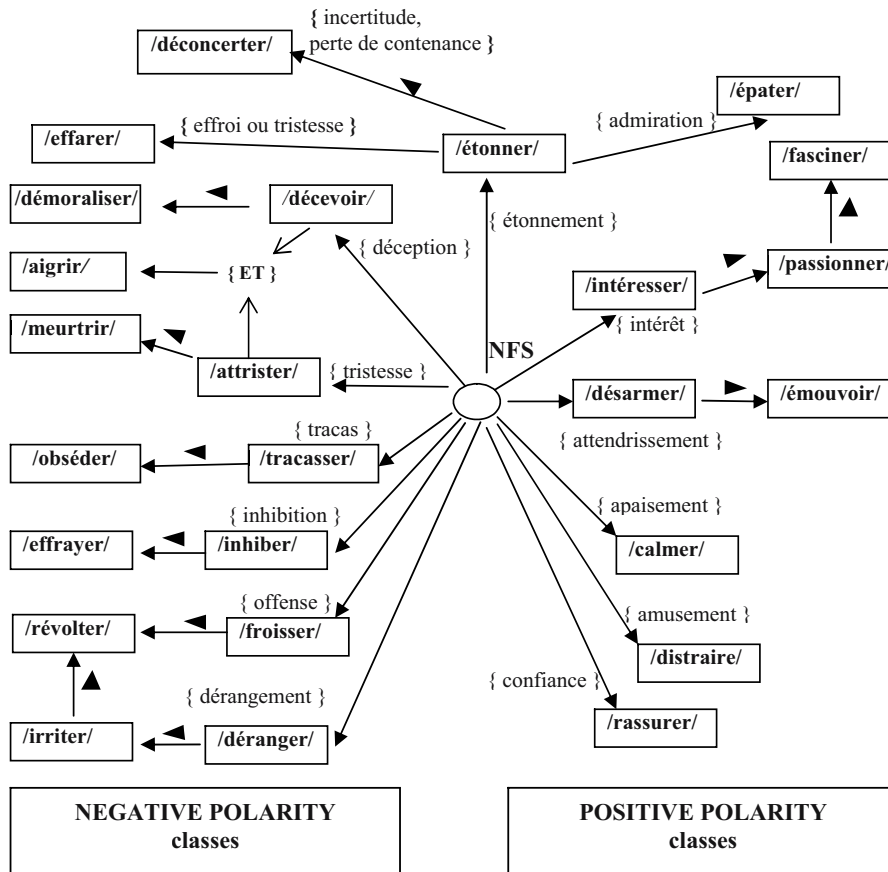

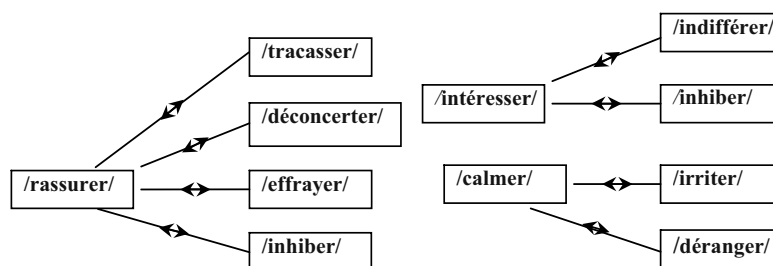*Figure 1. Subset of Meaning and Intensity relationships between classes.*

Figure 2. Subset of Antonymy relationships between semantic classes.

2.3 Linguistic Properties of Verbs

The linguistic properties of verbs and classes were examined. Among them, 15 are binary, while others are more complex such as arguments selection or arguments structure. Described here is a subset of these two types of properties (for a full description see Mathieu (2000)).

2.3.1 Simple Properties

A subset of these properties for the /**irriter**/ class is shown in Table 2. The first row represents the whole class (e.g. /**irriter**/), then each following row is a verb (*agacer*, *courroucer*, etc.), and each column is a property. A plus sign indicates that a verb accepts the property or is accepted in a given sentence form.

A brief description of these properties follows:

   - [*Nominalization*]. For each verb (noted *V*), a nominalization (or deverbal, noted *V-n*) is associated, if it exists, as in *irriter/irritation*. This noun denotes either the feeling or emotion felt by the experiencer (*irritation*), or a noun qualifying the subject: in *Luc charme/séduit Marie* (Luc charms Marie), the charm is Luc's charm.

   - [N_0 *agentive*]. All the psychological verbs accept a non agentive subject. Some accept an agentive one also. The subject is noted N_0. A plus sign for this property indicates that a sentence like *Luc effraye Marie* (Luc frightens Marie) has two possible meanings: that Luc frightens Marie because he wants (the subject is agentive), or he frightens her unintentionally, by his behavior or his appearance, or something else (the subject is non agentive).

   - [*Metaphor*]. Some verbs have a psychological meaning only, like *aimer*, while others, such as *irriter*, have two meanings: one that is "basic" (3), and one that is psychological by metaphor (4):

(3)   *Le soleil irrite Marie (sa peau)*
      The sun irritates Marie (her skin)

(4)   *Paul irrite Marie* (par son comportement)
      Paul irritates Marie (by his behavior)

		Nominalization (V–n) = feeling felt by N_1	N_0 agentive	Metaphor	Intensifier	$N_1\,V$	$N_1\,se\,V$	N_1 est Vpp (de ce) que P	N_1 est Vpp de N_0	N_1 est un N (N = Vppadj)
/irriter/									+	
agacer	agacement		+	-	neutral	-	+	-	+	-
courroucer	courroux		+	-	*high*	-	-	+	+	-
crisper	crispation		+	+	neutral	-	+	+	+	+
énerver	énervement		+	+	neutral	-	+	+	+	+
enquiquiner			+	-	neutral	-	-	-	+	-
enrager	rage		+	-	*high*	+	-	-	+	-
exaspérer	exaspération		+	-	*high*	-	+	+	+	-
excéder			+	-	*high*	-	-	-	+	-
fâcher			+	-	neutral	-	+	+	+	-
hérisser			-	+	*high*	-	-	+	+	-
horripiler			-	-	*high*	-	+	-	+	-
impatienter	impatience		-	-	*high*	-	-	+	+	-
irriter	irritation		+	+	neutral	-	+	+	+	-
offusquer			-	-	neutral	-	+	-	+	-
stresser	stress		+	-	neutral	+	-	-	+	-
ulcérer			-	+	*high*	-	-	-	+	-

(Row label, left side, rotated:) IRRITATION

Table 2. Simple properties.

- [***Intensifier***]. Intensity relationships link verbs inside each class, with an order relation. Thus, *exaspérer* (to exasperate) and *irriter* are in the same /**irriter**/ class, but *exaspérer* is stronger than *irriter*. These internal intensity relationships between verbs are described by the property *Intensifier* with the value "neutral" for *irriter*, and the value "high" for *exaspérer*.

The next properties indicates that a verb *V* can occur in a construction with the complement (= the experiencer N_1) in subject position.

- [***$N_1\,V$***]. The construction is intransitive, as in *Paul enrage* (lit. Paul enrages) or *Paul déprime* (lit. Paul depresses).

- [***$N_1\,se\,V$***]. The verb becomes a reflexive, as in *Paul s'énerve* or *Paul s'irrite* (lit. Paul irritates himself). Reflexive verbs are common in French: about one third of psychological verbs are reflexive.

- [***N_1 est Vpp de ce que P***], [***N_1 est Vpp de N_0***]. The verb past participle is noted *Vpp,* and *P* represents a sentence. The passive form with the preposition *par* (by) as in *Paul est exaspéré par*

l'attitude de Marie (Paul is exasperated by Marie's behavior), is possible for all the verbs. This property is implicit. For some verbs, the preposition *de* (of) can also appear in passive constructions, like *Paul est exaspéré de l'attitude de Marie, Paul est exaspéré (de ce) que Marie ait cette attitude* (lit. Paul is exasperated of Marie's behavior, lit. Paul is exasperated of that Marie has this behaviour). The sequence *de ce* is within parentheses because it can be omitted.

- **[N_1 est un N (N=Vppadj)]**. The noun *N* is a conversion of the verb's adjectival past participle *Vppadj*, like *Paul est un énervé* (lit. Paul is an irritated). Adjectival past participles are past participles which have the properties of qualifying adjectives (See also, Kerleroux 1996, Mathieu 2000).

2.3.2 Complex Properties

Whereas simple properties are attribute-value pairs, others are more complex such as argument selection and argument structure.

The form of the subject of the French psychological verbs is free; it can be a sentence, an abstract or concrete noun phrase, or an infinitive.

The complement (= the experiencer) is always a person, like Marie in the sentence (1) *Paul irrite Marie*, or some metonymical expressions referring to a person. The form of these expressions is preferentially "Det N de Nhum" (Determinant Noun of Human-noun). There are three main categories of noun (N), according to how distant the metonymy is from the person (Nhum); it can be (*i*) a body part (or "soul part") like *coeur* (heart) ou *esprit* (mind), (*ii*) a feeling or quality name (anger, vanity, etc.), or (*iii*) a noun such as hopes, convictions, etc.

Some verbs select nouns of the first category only, like *briser* (to break) in *Marie a brisé le coeur de Luc* (Marie broke Luc's heart), some verbs select nouns of the second category also, like *apaiser* or *calmer* in *La chanson a apaisé/calmé la colère de Marie* (The song calmed down Marie's anger), or *blesser* in *Les moqueries de Paul ont blessé l'orgueil de Marie* (Paul's taunts wounded Marie's pride), and other verbs accept nouns of the third category, such as *satisfaire* (to satisfy) in *Les paroles de Marie ont satisfait les espoirs de Luc* (Marie's words satisfied Luc's hopes). Moreover, 110 verbs like *irriter* or *déconcerter* (to disconcert) accept non-human complements, although with difficulty.

The subject and object are linked semantically, as shown by sentences (5) and (6), where a question mark indicates a sentence accepted with difficulty.

(5) a   *La jalousie/ passion ronge le cœur de Marie*
         Jealousy/passion gnaws at Marie's heart

   b   *? La jalousie/ passion ronge l'esprit de Marie*
        ? Jealousy/passion gnaws at Marie's mind

(6) a   *? La peur du chômage ronge le cœur de Marie*
         ? Unemployment fear gnaws at Marie's heart

   b   *La peur du chômage ronge l'esprit de Marie*
        Unemployment fear gnaws at Marie's mind

Even if it is not easy to determine the semantic link between subject and object, one can say that nouns of feeling in the subject position are associated preferentially to the metonymy *le coeur* (the heart) rather than *l'esprit* (the mind), and that to the complement *l'esprit* an abstract subject like a thought is preferentially associated.

3. *FEELING* System

The *FEELING* system is a software program that uses the semantic lexicon to provide an interpretation and to generate paraphrases. It contains four main components: (1) a communication interface, (2) a semantic knowledge database, (3) an inheritance mechanism, and (4) a knowledge treatment module. The following describes how the knowledge is formalized in the database, which knowledge this database contains, and which mechanisms apply to this knowledge (inheritance and inference engine).

3.1 Knowledge Representation

The semantic database contains the knowledge of the classes and verbs, represented in prototype-based format (Rosch, 1975; Kleiber, 1990), and the graphs describing the relationships between classes and a set of rules.

3.1.1 Prototype and Inheritance Mechanism

Studies in cognitive psychology have shown that, for human beings, the real world objects are structured into categories (Rosch, 1975). However, all items from the same category are not equally representative: a prototype is chosen as the medium item, considered the better representative of the category. A set of features shared by most category items characterizes this prototype.

Each class is represented by its prototype, and each verb is a prototype specialisation. An inheritance mechanism allows sharing knowledge between a class and its verbs.

A root prototype contains the knowledge shared by all verb classes, like [the object is human] or the passive construction [N_1 est Vpp par N_0]. An analogy is drawn between semantic classes and prototypes. Each verb is derived from and inherits properties and rules from one prototype. An example is given in Figure 3.

The /**irriter**/ prototype (or semantic class), which has the [subject is agentive] and [Intensifier neutral] properties, inherits the [object is human] property from the root prototype. Each /**irriter**/ class verb, like *exaspérer, énerver,* etc. inherits these two properties. The inheritance is not monotonic: the verb *exaspérer* has the value "high" for the Intensifier, and this value hides the inherited neutral value (written in bold in Figure 3).
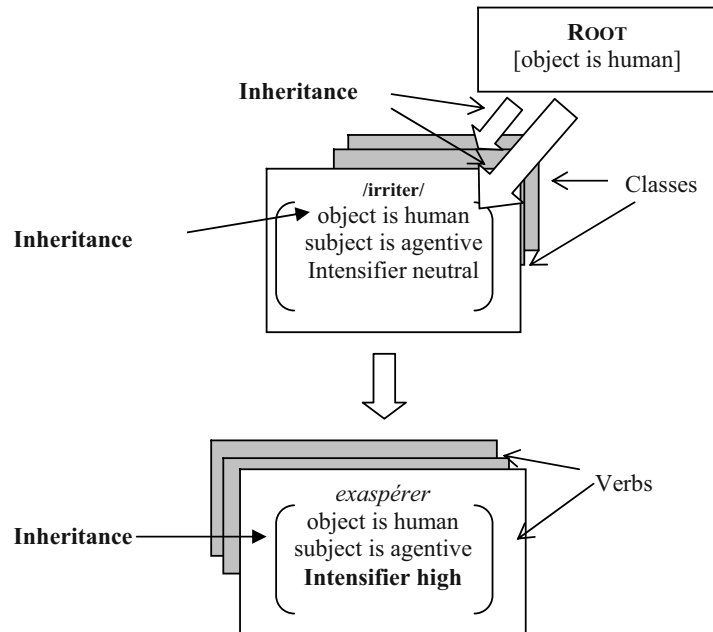
Figure 3. Inheritance.

3.1.2 Inference Engine and Pathfinding Algorithms

An inference engine processes a set of production rules describing conditions to generate well formed paraphrases. These rules are written in declarative format **[Si** (if) condition(s) **Alors** (then) conclusion(s)**]**, without linkage. Simple pathfinding algorithms are associated with the different graphs.

Inheritance mechanisms, inference engines, and pathfinding algorithms are used to exploit the knowledge database.

3.2 Knowledge Database

The knowledge is described by attribute-value pairs and lists, ordered or not ordered, depending on the data type.

3.2.1 Knowledge Associated with Each Class

Each class is characterized by (1) its semantic polarity: negative (unpleasant feeling), neutral (feeling neither unpleasant nor pleasant), or positive (pleasant feeling), (2) the feeling expressed, (3) its antonymous classes, (4) which verbs its contains, (5) the semantic category of the complement (the experiencer metonymy) when a metonymy is possible (is it a complete

metonymy, like heart or soul, or a sentiment or a quality ?), (6) a set of simple linguistic properties, with, for each, the value of the representative verb of the class (the prototype), and (7) a list of paraphrasing rules. Each verb is characterized by a set of linguistic properties whose values are different from class values.

3.2.2 Graphs and Rules

The knowledge database also contains the meaning, intensity and antonymy graphs, and a set of 40 paraphrasing rules. Two types of paraphrasing are considered: synonymous words substitution and syntactic restructuring (Mel'čuk, 1992).

Paraphrasing with synonymic substitution does not modify the syntactic structure. In the initial sentence, the verb is exchanged for a verb belonging to the same semantic class. The intensity of the feeling is preserved, either with verbs that have the same value for the property [Intensifier], or with verbs with a different value for this property and with the adjunction of a modifier like *beaucoup* (much), *très* (very), or *peu* (little).

For example, if the verb has an intensity level "high," like *exaspérer*, its synonyms are *excéder, horripiler, hérisser, ulcérer,* etc., or verbs with an intensity level "neutral" and the modifier *beaucoup* like *énerver beaucoup*, *agacer beaucoup*, etc.

Three types of paraphrasing with syntactic restructuring were used: reflexive sentences (*Paul s'exaspère*) (lit. Paul exasperates himself), nominalization, with complement deletion (*Paul éprouve de l'exaspération*, lit. Paul feels exasperation) or without (*Paul éprouve de l'exaspération devant l'attitude de Marie*, lit. Paul is feeling exasperation at Marie's attitude), and passivization.

There are three types of passivization:

   - with complement deletion as in *Paul est exaspéré* (lit. Paul is exasperated),

   - with complement introduced by p*ar* (by) as in *Paul est exaspéré **par** l'attitude de Marie* (Paul is exasperated by Marie's behavior),

   - and with complement introduced by *de* (of) like *Paul est exaspéré **de** l'attitude de Marie* (lit. Paul is exasperated of Marie's behavior).

The semantics of the verb and its arguments constrain the possibility of paraphrases. Thus, when the subject of the active form is a human name, as *Paul* in *Paul déçoit Luc* (Paul disappoints Luc) or *Paul énerve Luc* (Paul irritates Luc), the passive sentence with "de" is possible only for some verbs. One can say *Luc est déçu de Paul* (lit. Luc is disappointed of Paul) but not **Luc est énervé de Paul*[1] (*Luc is irritated of Paul). An example of such a rule is **Rule *Passiv1*** given in Figure 4.

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[1] "*" before a sentence means the sentence is ungrammatical.

1.	**Si**	la phrase à analyser est de la forme $N_0\ V\ N_1$
	If	the sentence to be analyzed has the form $N_0\ V\ N_1$
2.	**Et si**	N_0 est une *infinitive*
	and if	N_0 is an *infinitive*
3.	**Et si**	*V* est accepté dans la construction N_1 *est Vpp par le fait de* N_0
	and if	V is accepted in the construction N_1 *est Vpp par le fait de* N_0
4.	**Et si**	*V* est accepté dans la construction N_1 *est Vpp de* N_0
	Alors	la paraphrase N_1 *est Vpp par le fait de* N_0 est valide
	Then	the paraphrase N_1 *est Vpp par le fait de* N_0 is valid
	Et	la paraphrase N_1 *est Vpp de* N_0 est valide

Figure 4. Rule Passiv1.

Conditions 3 and 4 are redundant and are mentioned here for the reader; **Passiv1** is activated only if the verb *V* analyzed verifies these 2 conditions.

If **Passiv1** is applied to the sentence *Voir Luc partir exapère Marie* (lit. To see Luc leaving is exasperating Marie), the subject N_0 is an infinitive (= *Voir Luc partir*), the object N_1 is *Marie,* and the verb *V* is *exaspérer* which is accepted in the two constructions (cf. Table 2). Given these conditions, the paraphrases are:

Marie est exaspérée par le fait de voir Luc partir (= N_1 *est Vpp par le fait de* N_0)
lit. Marie is exasperated by the fact of to see Luc leaving

Marie est exaspérée de voir Luc partir (= N_1 *est Vpp de* N_0)
lit. Marie is exasperated of to see Luc leaving

3.3 *FEELING* Analysis

In order to process a sentence, each token has to be described with its grammatical category (noun, verb) and function (subject, object). For example, **Luc exaspère Marie** is analyzed as:

{ Subject : Luc, *human proper noun ;*
Verb exaspérer ;
Object : Marie, *human proper noun}.*

We rely on Bourigault (2002) and Fabre and Bourigault (2001) to get such syntactic information. The results of the *FEELING* analysis are shown in Figure 5. Given this sentence, *FEELING* provides an interpretation that describes what kind of feeling is expressed (I), then it provides synonymous and antonymous sentences (II and III), it generates several well formed paraphrases (IV), and finally, *FEELING* provides sentences expressing increased and/or decreased feeling (V). Comments (in italics) are added below each category of answer, explaining which knowledge is used by *FEELING*.

I. INTERPRÉTATION (Meaning)
Le sentiment est éprouvé par *Marie*
(The feeling is experienced by *Marie*)

La cause est *Luc*
(The cause is *Luc*)

Le sentiment éprouvé est *plutôt désagréable (négatif)*
(The experienced feeling is **rather unpleasant (negative)**)

Le sentiment éprouvé est *l'exaspération*
(The experienced feeling is **exasperation)**

Comments:
*Exaspérer is a verb of the /**irriter**/ class, a negative class of unpleasant feeling.*
The value of exaspérer for the property [Nominalization] is exaspération which is the feeling experienced by the experiencer.

II. PHRASES SYNONYMES : (Synonymous sentences)
a) *Luc énerve beaucoup Marie*
b) *Luc (courrouce / enrage / excède / hérisse / horripile / ulcère) Marie*

III. PHRASES ANTONYMES (Antonymous sentences**)**
     Luc apaise Marie
     Luc calme marie

Comments:
*IIa) = verbs of the same semantic class as /**irriter**/ with a neutral intensity and the modifier "beaucoup" to keep the same level of intensity*
*IIb) verbs of the same semantic class as /**irriter**/ with the same intensity level (high)*
III) verbs of antonymous classes

IV. PARAPHRASES
     Marie éprouve de l'exaspération envers Luc
     Marie éprouve beaucoup d'énervement envers Luc
     Marie est (exaspérée / très énervée)
     Marie est (exaspérée / très énervée) par Luc
     Marie éprouve de l'exaspération
     Marie éprouve beaucoup d'énervement
     Marie s'exaspère

Comments:
Application of paraphrasing rules.

V. VARIATION DE L'INTENSITÉ du sentiment exprimé (Feeling intensity variation)

Diminution continue de l'intensité du verbe *exaspérer* (<<) :
(Continuous decreasing intensity of *exaspérer* verb)

a) *Luc (agace / crispe /énerve / fâche / irrite) Marie*

b) << Luc (dérange / désoblige / emmerde) Marie

c) << *Luc (ennuie / enquiquine /gêne / importune / incommode / indispose) Marie*

Augmentation continue de l'intensité du verbe *exaspérer* (>>) :
(Continuous increasing intensity of *exaspérer* verb)

d) >> *Luc (braque / choque / écœure / scandalise) Marie*
e) >> *Luc (indigne / rebelle / révolte) Marie*

Comments:
Pathfinding of the intensity graph, then inside each class, taking into account the intensity of feeling expressed by the verbs (low, neutral or high).

The order relation between these 3 classes is reviewed below:

/déranger/ → /irriter/ → /révolter/

Va) /irriter/ class verbs with neutral intensity (Intensifier property value = neutral)
Vb) /déranger/ class verbs with high intensity (Intensifier property value = high)
Vc) /déranger/ class verbs with neutral intensity (Intensifier property value = neutral)
(there is no verb with a low intensity in the class)
Vd) /révolter/ class verbs with neutral intensity (Intensifier property value = neutral)
Ve) /révolter/ class verbs with high intensity (Intensifier property value = high)

Figure 5. FEELING results.

3.4 FEELING Extension

A *FEELING* system extension, *FEELING-G*, uses the same knowledge database and mechanisms, but produces an oriented-feeling representation, which can be used to process textual data.

Given a sentence, *FEELING-G*, provides a semantic representation of the feelings or psychological states expressed. This representation is a set of complex feature structures: a matrix of attributes with exactly one value assigned to each. Attributes have atomic values but also more complex values, like a complex feature structure. There are three categories of features:

   - ***Sentiment*** features describe the meaning, the intensity, and the linguistics properties of the emotion or psychological state,

- Experiencer features identify the person (feature **ident**) whose feeling or state is being expressed, and which sentiment he or she feels. The description of this feeling is unified with the *Sentiment* features. This unification mechanism is represented by **#1** in Figure 6.

- Causeobject are features showing the cause or the object of feeling or psychological state.

Given the sentence already analyzed *Luc exaspère Marie, FEELING-G* provides a semantic representation shown partially in Figure 6.
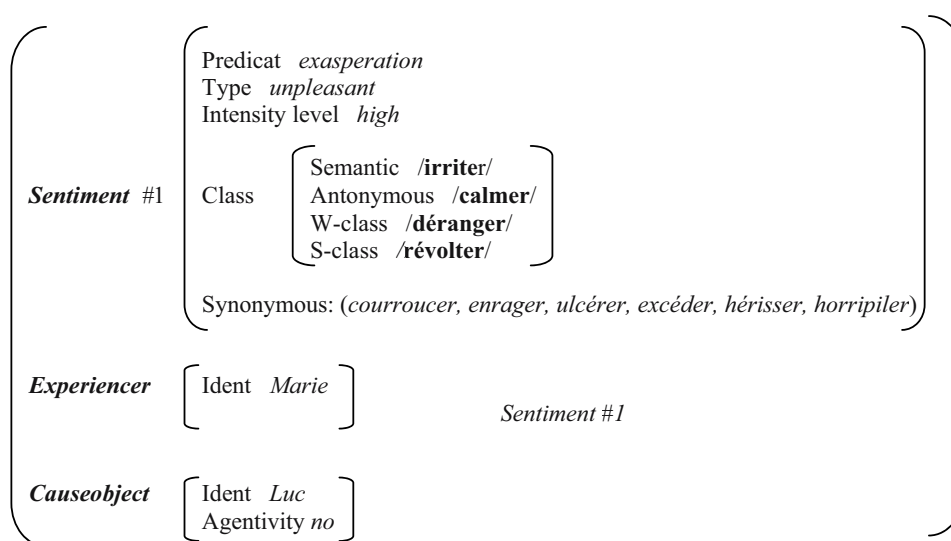

Figure 6. Semantic representation.

4. Evaluation

An evaluation of this work was conducted in two ways. First, a comparison between usual dictionaries and the *FEELING* lexicon was made. A large part of the lexicon, more than 10 percent, contains words which are not described by usual dictionaries as psychological nouns or verbs, like *bétonner* (to concrete) which means *endurcir* (to harden), whereas these words have been found in texts with a psychological meaning.

Secondly, newspaper "letters to the Editor" were analyzed by both *FEELING* and human readers. Three human evaluators classified 60 letters. Those evaluators were instructed to classify sentences as reflecting a "pleasant", an "unpleasant," or a "neutral" feeling, and to give an intensity level of this feeling, on a scale from 1 to 3, with 1 being weak feeling, 2 being medium, and 3 being strong. With the hypothesis that human evaluators do not make mistakes, a comparison between their answers and *FEELING* analysis was made. Without taking Intensity level into account, *FEELING* classified correctly 49 letters and made 11 errors. In taking Intensity level into account, *FEELING* classified correctly 39 letters and made 21 errors.

	Without taking Intensity level into account	Taking Intensity level into account
T: Number of Letters (= correct answers of human evaluators)	60	60
C: Correct answers of *FEELING*:	49	39
Incorrect answers of *FEELING*	11	21
Precision *C/T*	0.81	0.65

Table 3. Comparison between FEELING analysis and Human Evaluations.

Let *T* be the number of letters (the number of correct answers) and *C* the number of *FEELING* correct answers. The precision is defined as *Precision=C/T*. The results are given in Table 3.

All letters submitted to *FEELING* contain at least one psychological verb, allowing an interpretation for each letter. If a letter contains several verbs, *FEELING* analyzes only the first one. This is the origin of several errors, when the feeling of the first verb is modified by others which follow it in the letter. Another source of error is the meaning of /**étonner**/ class verbs, whose polarity varies depending on the context. To *FEELING* these verbs are always neutral, whereas human readers are able to interpret the context.

5. Related Work

This approach differs from Wordnet (Fellbaum, 1998) on two points. First, the organization principles are different. For instance, there are no heritage or intensity relationships in Wordnet. Second, Wordnet is a large database resource with no associated knowledge.

The only similar work on French is Mel'čuk's dictionary (1992) in which each word description consists of its linguistics properties and lexical rules. The perspective is rather different in that the focus is on a very detailed description in a semantic field with associated software, whereas Mel'čuk's study is about general language. Furthermore, no system uses the dictionary knowledge.

6. Conclusion

Thus far, *FEELING* analyses only apply to single sentences, as in a text being analyzed as a set of independent sentences. Ongoing work is directed towards extending these analyses to short texts in order to build semantic representations shared by several sentences.

7. Bibliography

Bourigault, D. (2002) Upery : Un Outil d'Analyse Distributionnelle Etendue pour la Construction d'Ontologies à Partir de Corpus. In *Actes de la 9ème Conférence Annuelle Sur le Traitement Automatique des Langues (TALN 2002).* 75-84. Nancy.

Fabre, C. and Bourigault, D. (2001) Linguistic Clues for Corpus-Based Acquisition of Lexical Dependencies. In *Proceedings of the Corpus Linguistics 2001 Conference, UCREL Technical Papers (vol 13),* 176-184. Lancaster University.

Fellbaum, C. (Ed). (1998) *Wordnet: An Electronic Lexical Database*. MIT Press, Cambridge.

Frantext. (2004) Base Textuelle Informatisée. CNRS – Atilf. http://atilf.atilf.fr/frantext.htm.
Gross, M. (1975) *Méthodes en Syntaxe*. Hermann, Paris.

Johnson-Laird, P.N., and Oatley, K. (1989) The Language of Emotions: An Analysis of a Semantic Field. *Cognition and Emotion, 3,* 81-123.

Kerleroux, F. (1996) *La Coupure Invisible*. Presses Universitaires du Septentrion, Paris.

Kleiber, G. (1990) *La Sémantique du Prototype*. Puf, Collection Linguistique Nouvelle. Paris.
Le Grand Robert de la Langue Française 6 volumes. (2001) Le Robert, Paris.

Le Trésor de la Langue Française, 16 volumes. (1971-1994) CNRS Edition, Paris.

Mathieu, Y. Y. (2000) *Les Verbes de Sentiment*. CNRS Edition, Paris.

Mathieu, Y. Y. (1999) Les Prédicats de Sentiment. *Langages, 136*, 41-52.

Mel'čuk, I. (1992) DEC. Dictionnaire Explicatif et Combinatoire du Français Contemporain. Recherches Lexico-Sémantiques III. Les Presses de l'Université de Montréal, Montréal.

Rosch, E. (1975) Cognitive Representations of Semantic Categories. *Journal of Experimental Psychology 104/3*.

Wierzbicka, A. (1996) *Semantics, Primes and Universals*. Oxford University Press, Oxford.