Mental State Adjectives: the Perspective of Generative Lexicon

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Abstract

This paper focusses on mental state adjectives and offers a unified analysis in the theory of *Generative Lexicon* (Pustejovsky, 1991, 1995). We show that, instead of enumerating the various syntactic constructions they enter into, with the different senses which arise, it is possible to give them a rich typed semantic representation which will explain both their semantic and syntactic polymorphism.

1 Introduction

Recently, work in computational semantics and lexical semantics has made an interesting shift. Motivated by a concern for lexical organization and global coherence in the structure of lexicon, some researchers have moved towards more expressive semantic descriptions, as well as more powerful methods of combining them (see for example Pustejovsky, 1991, 1995; Briscoe, 1993).

This article will exploit one of these theories, *The Generative Lexicon* (GL: Pustejovsky, 1995), and extend it for the treatment of French mental adjectives. The following section summarizes the problematic behaviour of these adjectives. The GL approach is then described, and a GL analysis of the data.

2 The Data

Mental adjectives which denote an emotional state or a competence (agent-oriented, following Ernst, 1983) present interesting syntactic and semantic polymorphic behaviour, as noted in the literature (see for example Lehrer, 1990 and Croft, 1984). In this paper, we focus on the representative members of these classes in I and II:

I **Emotional adjectives:** *triste* 'sad', *furieux* 'angry, furious', *irrité* 'irritated', *heureux* 'happy', *ennuyé* 'bored'.

II **Agent-oriented adjectives:** *intelligent, ingénieux* 'clever', *habile* 'skilful', *adroit* 'dextrous'.

Both classes of adjectives exhibit the property of **syntactic polyvalency**, being able to appear in several distinct contexts, with optional complement structures (as illustrated in (1), (2) and (3)). In the case of **agent-oriented** adjectives, the complement expresses the **manifestation** of the state and can be realized as an infinitive with *à/pour* or *de* (examples (2a,b)) or a prepositional phrase (2c): (2a,b,c) means that *somebody is skilful in what he does* or *how he does it* (see Croft, 1984).

(1) Cet homme est triste/habile/furieux
   "This man is sad/clever/angry[1]"

(2) a. Cet homme est habile de partir
      "This man is skilful to leave"

   b. Cet homme est habile à/pour tricher
      "This man is skilful at cheating"

   c. Cet homme est habile au bridge
      "This man is skilful at bridge"

In the case of **emotional state** adjectives, this complement typically expresses the cause of the emotional state and may be realized as an *de*-infinitive or a *que*-sentence: (3a,b), for example, means that *somebody is sad/angry because of something*. Notice however that, in some contexts, the complement can also refer to the **manifestation** of the state, as for agent-oriented adjectives (3c).

(3) a. Cet homme est triste/furieux de partir
      "This man is sad/angry to leave"

   b. Cet homme est triste/furieux que tu partes
      "This man is sad/angry that you are leaving"

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[1] We give in quotes a literal translation of the French examples.

c. Cet homme est triste en jouant au piano
"This man is sad at playing piano"

Another property exhibited by these adjectives is that of **multiple semantic selection**: that is, they are able to predicate of different semantic types (examples (4) to (7)), namely nouns denoting **individuals** (the 'a' examples), **objects** (b) and **events** (c). This can however not be generalized to the whole class of mental states adjectives, as shown by (7), for example.

(4) a. Un homme triste "A sad man"
     b. Un livre triste "A sad book"
     c. Un examen triste "A sad exam"
(5) a. Un homme furieux "An angry man"
     b. Un livre furieux "A furious book"
     c. Une destruction furieuse "A furious destruction"
(6) a. Un homme ingénieux "A clever man"
     b. Un livre ingénieux "An clever book"
     c. Un examen ingénieux "An clever exam"
(7) a. Un homme irrité/ennuyé
        "An irritated/bored man"
     b. *Un livre irrité/ennuyé
        "An irritated/bored book"
     c. *Une destruction irritée/ennuyé
        "An irritated/bored destruction"

Finally, the third interesting property manifested by these adjectives is their pattern of **polysemy**. They exhibit different senses depending on the semantic type of the item modified: when they predicate of an individual, they normally denote the mental state of this individual (8) (but see example (12)).

(8) Un homme triste/ingénieux/furieux
     "A sad/clever/angry man"
     → which is in a sad/clever/angry state

When they modify an event or an object, they can take either a **causative** (9b) or a **manifestation** sense (9c, 10c and 11c). In the former case, the object or event is the cause of the state, while in the latter it is the manifestation of the state. In some specific contexts, the causative sense is also possible with individuals (12).

(9) Un livre/voyage triste
     "A sad book/travel"
     a. → *which is in a state of sadness
     b. → which causes somebody to be sad
     c. → which is a manifestation of somebody's sadness
(10) Un livre/voyage ingénieux
     "A clever book/journey"
     a. → *which is in a state of cleverness
     b. → *which causes somebody to be clever
     c. → which is a manifestation of the somebody's cleverness

(11) Un(e) livre/destruction furieux(se)
     "A furious book/destruction"
     a. → *which is in a state of anger
     b. → *which causes somebody to be angry
     c. → which is a manifestation of somebody's anger
(12) Un homme triste à voir
     "A sad man to see"
     a. → *who is in a state of sadness
     b. → the sight of whom causes somebody to be sad

A complication arises with respect to the polysemous behaviour of emotion adjectives, in that when they modify an object or an event (9, 10), they can have both the causal and the manifestation senses (9b,c). For some emotion adjectives as *furieux* (11), the manifestation sense is even the only one available (11c).

The remainder of this paper will present an explanation of the syntactic and semantic behaviour of these adjectives within the framework of Generative Lexicon theory (henceforth GL). In particular, instead of enumerating all syntactic constructions and the different senses for these adjectives, we will provide a rich typed semantic representation which explains both the semantic and the syntactic polymorphism associated with these classes. This representation and the way to project it at the syntax level will be the focus of the following section.

3 Mental Adjectives in Generative Lexicon

3.1 General approach

In the rest of the article, we will propose the following approach:

(a) to distinguish **emotion adjectives** and **agent-oriented adjectives** by means of their qualia structure;

(b) to represent the semantic ambiguity of mental adjectives by use of **dotted types** (Pustejovsky 1995, chapter 6.2);

(c) to explain specific semantic selection by the notion of **headedness** (Pustejovsky 1995, chapter 5.3).

The two first points will be the object of section 3.2 and the third one of 3.3. Section 4 will then focus on emotion adjectives.

3.2 Two kinds of adjective with dotted type

The **emotional state** (I) and **agent-oriented** (II) adjectives will be given the GL representations (13) and (14), respectively.

(13)

$$
\begin{bmatrix}
\textbf{emotion\_adj} \\[4pt]
\text{EVENTSTR} = \begin{bmatrix}
\text{E1} = \texttt{e1:state} \\
\text{D\_E1} = \texttt{e2:experiencing\_ev} \\
\text{D\_E2} = \texttt{e3:intellec-act\_ev} \\
\text{RESTR} = \texttt{e2 < e1 < e3}
\end{bmatrix} \\[4pt]
\text{ARGSTR} = \begin{bmatrix}
\text{ARG1} = \texttt{x:human} \\
\text{D\_ARG1} = \texttt{e2/e3}
\end{bmatrix} \\[4pt]
\text{QUALIA} = \begin{bmatrix}
\textbf{(e1.e2).(e1.e3)\_lcp} \\
\text{FORMAL} = \textbf{Adj(e1,x)} \\
\text{TELIC} = \textbf{P(e3,x,...)} \\
\text{AGENTIVE} = \textbf{P(e2,x,...)}
\end{bmatrix}
\end{bmatrix}
$$

(14)

$$
\begin{bmatrix}
\textbf{agent-oriented\_adj} \\[4pt]
\text{EVENTSTR} = \begin{bmatrix}
\text{E1} = \texttt{e1:state} \\
\text{D\_E1} = \texttt{e3:intellec-act\_ev} \\
\text{RESTR} = \texttt{e1 < e3}
\end{bmatrix} \\[4pt]
\text{ARGSTR} = \begin{bmatrix}
\text{ARG1} = \texttt{x:human} \\
\text{D\_ARG1} = \texttt{e3}
\end{bmatrix} \\[4pt]
\text{QUALIA} = \begin{bmatrix}
\textbf{e1.e3\_lcp} \\
\text{FORMAL} = \textbf{Adj(e1,x)} \\
\text{TELIC} = \textbf{P(e3,x,y)}
\end{bmatrix}
\end{bmatrix}
$$

These structures encode several different aspects of the semantics for these adjectives.

The **event structure** (EVENTSTR) indicates that mental adjectives have a complex event structure. They denote mental state $(e1)$ (examples (1) to (3)), but they are also able to make reference to **events**, the cause of the state $(e2)$ and/or its manifestation $(e3)$ (as shown in examples (4) to (7)). The *Restr(iction)* relation indicates the temporal precedence between the state and the two events: the cause $(e2)$ must precede the state and the manifestation $(e3)$ must follow it. The two events are default events, as the adjective remains a state, even when it has a causative sense, contrary to real transitions (accomplishment or achievement), like *couler* 'sink', for example (as pointed out in Pustejovsky, 1995, chapter 10)

The **argument structure** (ARGSTR) specifies that mental adjectives select for two arguments, one for **human** $(arg1)$ and a second for **event** (see Croft, 1984, for a similar view). The second is a default argument (D_arg1) as it need not to be present at the syntactic level (as shown in examples (1)). As **agent-oriented adjectives** refer to the manifestation of the state (examples (2)), the second argument is $e3$, the event which follows the state. It is subtyped as an intellectual act. For **emotion adjectives**, the second argument is $e2$ or $e3$, as they can refer either to the manifestation of the state (example (3c)) or its cause (examples (3a,b)). $e2$ is subtyped as an experiencing event, as we consider that the cause of an emotion corresponds to the experiencing of something. Following Croft (1990), we think that there are two processes implied in a causal emotional state: an experiencer must direct his or her attention to a stimulus and this causes the experiencer to enter

in a mental state.

The **qualia structure** (QUALIA) encodes the basic semantic type of a word (its Lexical Conceptual Paradigm, or *LCP*) and specifies how it is linked to other events and arguments of the event and argument structures (see Pustejovsky, 1995, chapter 6). To do this, it can use four possible different roles: the FORMAL role encoding the basic semantic type(s) of the word, the CONSTITUTIVE role its constitutive elements, the TELIC role its purpose or function and the AGENTIVE role the factors involved in bringing it about. In terms of temporal relations, the qualia encode specific constraints on the relative temporal ordering of the values of the qualia. That is, the event involved in the AGENTIVE role precedes that state existing in the FORMAL, and the associated CONSTITUTIVE value, should there be one. Finally, the TELIC role is inherently a temporal consequence of the FORMAL, cf. (15).

(15) AGENTIVE $<$ FORMAL and CONST $\leq$ TELIC

In the case of mental adjectives, the qualia in (13) and (14) makes explicit that they denote a complex or **dotted** type (written *type.type*), which is the product of basic types, $e1$ and $e3$ for agent-oriented adjectives and $e1$, $e2$ and $e3$ for emotive ones. Each of these types can be projected independently, if no other constraints apply (see 3.3). The **state** $e1$ is encoded in the FORMAL; an event encoded in the AGENTIVE role $(e2)$ denotes the **cause** or origin of the state, i.e. the experiencing event; encoded in the TELIC role $(e3)$, it denotes then the **manifestation** of the state, i.e. the intellectual act.

In other words, the GL representation for emotion adjectives (13) stipulates that somebody (x) is in a state because of an experiencing event $(e2)$, which can have a further manifestation $(e3)$;[2] that for **agent-oriented** adjectives (14) specifies that somebody is in a state which can have a manifestation.

3.3 The notion of head

However, not all mental adjectives will be able to project the two types they denote (i.e. state and event), depending on the event headedness. In GL, the notion of *head* provides a way of indicating a type of foregrounding and backgrounding of event arguments. In doing this, it specifies how to project the qualia representation and acts as a filter to constrain the set of projectable qualia: the headed event projects the formula associated with that event and it is this formula which needs to be saturated at the syntax level (Pustejovsky, 1995, Chapter 6.2.5).

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[2] For a similar view see Anscombres (1995) who distinguishes internal feeling and external attitude. He considers then that a feeling can have a external manifestation.

For mental adjectives, two kinds of headedness are possible. The adjective can be headed either on the state or the event it denotes. Moreover, some adjectives will be unspecified regarding the head and will therefore be able to be headed on any of the subevents of the event structure. In the following, we will first focus on the two different kinds of headedness, applying to the state or one of the events, and then show the consequences of an headless structure.

3.3.1 Event structure headed on the state

The adjective is projected via the template $P(e1,x)$ in the formal role. It therefore denotes the mental state of an individual (16a, 17a) and requires only one argument x of type *human*. Complements are however possible if they make direct reference to the agentive (as in (16b,c), where the complement is the cause of the emotional state) or telic roles (as in (17b,c), where it is the manifestation).

(16) a. Je suis triste/furieux "I'm sad/furious"
   b. Je suis triste/furieux de partir
    "I'm sad/furious at leaving"
   c. Je suis triste/furieux que tu partes
    "I'm sad/furious that you are leaving"
(17) a. Je suis ingénieux "I'm clever"
   b. Je suis ingénieux aux échecs
    "I'm clever at playing chess"
   c. Je suis ingénieux de partir
    "I'm clever to leave"

The qualia representation is rich enough to explain the syntactic **polyvalency** shown in (16) and (17). There are indeed two ways of referring to a quale role:

Direct saturation of a quale role. The complement is identified as a subtype of the experiencing event or the intellectual act. In (16b) and (17b), for example, the complement directly saturates the event $e2$ or $e3$ (as the qualia structures in (18) and (19) make explicit). *Partir* is indeed a subtype of the experiencing event sort (*partir* $<$ *experiencing_event*) and *les échecs* (chess) of the intellectual act one (*les échecs* $<$ *creative-intellectual_act*). By contrast, in order for (20) to be an acceptable sentence, *être malade* 'be ill' must be reconstructed, non-standardly, as an intellectual act.

(18)
$$\begin{bmatrix} \text{FORMAL} = \textbf{triste(e1,je)} \\ \text{TELIC} = \textbf{P(e3,je)} \\ \text{AGENTIVE} = \textbf{partir(e2,je)} \end{bmatrix}$$

(19)
$$\begin{bmatrix} \text{FORMAL} = \textbf{ingénieux(e1,je)} \\ \text{TELIC} = \textbf{jouer(e3,je,échecs)} \end{bmatrix}$$

(20) *Je suis habile à être malade
   "I'm skilful at being ill"

Saturation of the object of the experiencing or intellectual act event. In (16c) and (17c), the complement is the object (y) of an implicit event and the saturation of the quale is only possible because the complement can be coerced to the type expected for the complement (the experiencing event or intellectual act): (16c) means that *I'm sad/furious because I experience your leaving* (as (21) makes explicit) and (17c) that *I'm ingenious at performing the intellectual act whose object is the departure* (as in (22)). There is no further specification available for the *exp_ev* or *intellectual-act_ev* variable.

(21)
$$\begin{bmatrix} \text{FORMAL} = \textbf{triste(e1,je)} \\ \text{TELIC} = \textbf{P(e3,je)} \\ \text{AGENTIVE} = \textbf{exp\_ev(e2,je,que-tu-partes)} \end{bmatrix}$$

(22)
$$\begin{bmatrix} \text{FORMAL} = \textbf{ingénieux(e1,je)} \\ \text{TELIC} = \textbf{intellec-act\_ev(e3,je,partir)} \end{bmatrix}$$

These two ways of saturating a quale explain what Croft (Croft, 1984) and Ernst (1985) have called the verbal/factive ambiguity of two arguments agent-oriented adjectives (see also Kiparsky and Kiparsky, 1979). When the event is saturated, we get the eventual sense: in (17b), cleverness is predicated of the manner of playing chess (structure 19); when the object of the event is saturated, we get the factive sense so that in (17c) cleverness is predicated of the fact of leaving (structure 22).

3.3.2 Event structure headed on an event

Recall that the adjective denotes one or two events, i.e. $e2$ or $e3$ in (13) and (14). When the event structure is headed on one of these, the adjective is projected via the agentive or the telic role, i.e. the template $P(e2, x, \ldots)$ or $P(e3, x, \ldots)$. It therefore selects for an event and gets the causative or manifestation sense (examples (23) and (24)). However, that does not mean that the noun must be an event, but only that its semantic representation, or general knowledge concerning its semantic type, should provide an event, as shown in the next examples (23) and (24).

(23) Ce livre est triste "The book is sad"
   a. → whose **reading** causes somebody to be sad
   b. → whose **writing** causes somebody to be sad
   c. → whose **writing** is the manifestation of somebody's sadness
(24) Ce sapin est triste "The pine tree is sad"
   a. → whose **experiencing** causes somebody to be sad

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In (23), the modification by the adjective is possible as *livre* (book) contains in its qualia structure two events, namely *lire* (to read) (telic of *livre*) and *écrire* (to write) (agentive of *livre*) (see Pustejovsky and Bouillon, 1995, for the qualia representation of *livre*). Two causative interpretations (23a,b) and one manifestation (23c) are therefore possible. Notice that when the events are defined in the lexical semantics of the word, the experiencing and the manifestation are intentional and controlled (the experiencing is active, following Lehrer, 1990).

In (24) on the other hand, there is nothing contributed by the *tree* per se to how the experiencing is achieved (as the noun has no telic nor agentive), except for it being a physically manifested object with extension. In this case, it is the properties inherited through the formal (and not the lexical semantics of the word) that suggests how it can be experienced. For this reason, the experiencing is not controlled, nor intentional (it is stative). The manifestation sense is impossible as *sapin* (versus *book*) has no intellectual act in its qualia.

3.3.3 Unheaded event structure.

If certain adjectives can be restricted to be headed either on the event or the state, others can be left underspecified regarding the head. In this last case, the adjective can then be projected via the formal or the telic/agentive roles and combines the two or three different senses: stative, causative and/or manifestation, depending on the number of events it can refer to (one for agent-oriented adjectives (see (14)), two for emotional ones (see (13))). This is the case of the adjectives *triste* and *ingénieux* which will get respectively the three and two senses, as illustrated in (8) to (10); in (8), *triste* and *ingénieux* have the head on the formal role and the adjectives have a stative sense; in (9c) and (10c) on the telic: they have a manifestation sense. In (9b), *triste* has the head on the agentive and receives its causative sense. Their semantic polymorphism is then explained, without having to list the different senses.

Remember however that all emotional state adjectives which combine a stative and a eventual meaning will not be able to get the three meanings: the emotion adjective *furieux*, for example, cannot have the head on the agentive, as shown in (11b): *un livre furieux* cannot get the causative meaning. The question is then what prevents this adjective from having the head on the agentive role? A first attempt at tackling the problem follows from the observation that most emotion adjectives ending in *-eux* (with causal complement and not derived from psychological verbs, as *ennuyeux*, *outrageux*, etc.) behave in the same way (see the list in (25)) and that, more generally, the suffix plays a crucial role in restricting the head (see Anscombres, 1995, for a similar view and section 4 for other examples of the influence of the

suffix). It seems therefore not too preliminary to think that the *-eux* suffix acts as a filter on the head for this kind of adjectives. However, the formal representation of the suffixes and the way it interacts with the representation of the stem remain to be investigated.

(25) *heureux, anxieux, malheureux, honteux, soucieux*, etc.

In this section, we explained the polyvalency of mental adjectives. We are now able to show how the head distinction is relevant to classify emotional states adjectives and explain their semantic selection.

4 Semantic selection: the case of emotion adjectives

On the basis on the headedness configuration, we will distinguish three classes of French emotion adjectives, exemplified in (26), (27) and (28):

(26) **Adjectives headed on the state:**

fâché 'angry', *ennuyé* 'bored', *irrité* 'irritated', etc.

(27) **Adjectives headed on the agentive:**

ennuyant 'boring', *préoccupant* 'worrying', *agréable* 'nice', *admirable* 'wonderful', *effroyable* 'appalling', etc.

(28) **Headless adjectives:**

triste 'sad', *heureux* 'happy', *furieux* 'angry', 'furious', etc.

Those in (26) will have the head on the state and will get only the stative sense. As predicted, they will not be able to modify an event or an object, as illustrated in (29).

(29) *Un livre fâché/ennuyé/irrité
"An angry/bored/irritated book"

The ones in (27) will have the head on the agentive and will receive only a causative sense. As a result, they will keep this causative sense, even when they modify a noun of type *human* (30).

(30) Un homme ennuyant/préoccupant/
admirable/effroyable
→ which causes somebody's trouble/
anxiety/admiration/fright

Finally, those in (28) will not be specified regarding the head (they are headless) and will be able to combine the three senses (except when the suffix acts as a filter, as shown in (25)). They can therefore modify nouns of type *human*, *object* and *event* (5) and will be ambiguous when they modify a noun of type *human*, as an human can be either in a mental state or the object of an experiencing event (31a,b). In the case of ambiguity, it is striking to see that French syntax distinguishes clearly the two senses. In (31a), it is the prenominal position of the adjective and in (31c) the choice of the

preposition *à* (versus *de* as in (5b)) which give rise to the causative sense (versus the stative one).

(31) a. De tristes enfants "Sad children to see"
→ which cause the sadness of the persons which experience them
b. Des enfants tristes "Sad children"
→ which are in a sad state
c. Un homme triste à voir
"A sad man to see"
→ which causes the sadness of the persons which see him

As a result of this, (32a) (vs. (32b)) will be impossible: in (32a), the prenominal position of the adjective forces the causative sense, giving rise to an incompatibility as two different nouns (namely *enfant* (children) and *mort de leur mère* (death of the mother)) try to saturate the same variable y, i.e. the object of the experiencing.

(32) a. *De tristes enfants de la mort de leur mère
b. Des enfants tristes de la mort de leur mère

To finish, notice that in (28), (29) and (30), the role of the suffix appears clearly: for emotion adjectives, the *-é* suffix constrains the head to be on the state and *-ant/-able* on the causative event. It also explains possible divergences between French and English.

5 Conclusion

In this article, we extended GL to the treatment of French mental state adjectives. We showed how GL can adequately account for the following:

(a) **Avoiding the multiplication of entries.** The different senses of the mental adjectives (examples (11) to (14)) and their polyvalency (examples (3) to (5)) follows from the qualia representation.

(b) **Explaining the links between the different senses of mental adjectives.** The qualia structure we proposed in (15) and (16) makes explicit the links between the different senses of mental adjectives (mental state of an individual, causative and manifestation). In (15), the qualia structure specifies that emotional states are caused by a causal event and can have a further manifestation; in (16), that the agent-oriented state can have a further manifestation.

(c) **Explaining the semantic selection of mental state adjectives.** The specific semantic selection of mental adjectives follows from the headedness system.

(d) **Distinguishing two kinds of adjectives:** those which denote simple type (*rouge* (red), *grand* (big), etc.) and those like mental adjectives which denote dotted type. This distinc-

tion is in accordance with the classical distinction drawn between stative adjectives and dynamic ones, which, following Quirk et al., 1994:434, denote qualities that are thought to be subject to control by possessor. GL allows this distinction to be characterized and given a more formal representation, an adjective being dynamic if it refers to the cause or its further manifestation.

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