A TEXTUAL CLUES APPROACH FOR GENERATING METAPHORS AS EXPLANATIONS BY AN INTELLIGENT TUTORING SYSTEM

Violaine Prince & Stéphane Ferrari

LIMSI-CNRS
BP 133
F-91403 ORSAY CEDEX
FRANCE
{ prince, ferrari}@limsi.fr

Abstract

This contribution deals with the use of the textual clues approach to detect regularities in metaphor productions in explanations. Our aim is to re-inject the results of a corpora-based study about detection, as heuristics for metaphorical explanations in an intelligent tutoring system, which has already been designed as a first model. Textual clues research is a method which surveys the surface markers of discourse, and tries to focus on the regularities in syntatic and lexical choices of words. It has been tested in student modelling (Pery-Woodley 1990, Daniel et al. 1992), in information-seeking dialogues (Prince and Pernel 1994), as well as in a corpus of collected explanations (Prince 1994). The method and its analysis techniques, have been locally adapted to both metaphor and analogies detection, when they are used in explicitely explanatory texts. A first corpus dedicated to explanation has been collected, and section 2 thoroughly describes the different hypotheses on both cognitive and linguistic aspects we envisaged and tested. Section 3 focuses on the cross-examination of the results obtained from the previously described data analysis: textual clues need to be properly represented by regular heuristics written as a context-dependant 'pseudo-grammar', which will be, in turn evaluated on a larger scale. The exact nature of the cognitive assumptions, derived from the study of the corpus in section 2, is affirmed as a set of hypotheses to test. Another corpus, of a much larger scale is chosen. Details of the technical device being designed for this evaluation are also given in section 3. A first comment of the results aims at highlighting the relationship between the surface marking and the cognitive process underlying the linguistic production, and this relationship could be used in automatic generation of texts.

Key-words
Natural Language Processing, Intelligent Tutoring Systems, Corpus Analysis, Explanation, Analogies, Metaphors, Textual Clues.

1 Introduction

The relationship between metaphors and explanation has been widely examined since the Aristotelian treaty on metaphors. More recently, since Ortony's work (1979) on the structure of psychological processes in uttering metaphoric figures, it has been established that metaphor appears as one of the most naturally used mechanisms when the speaker wants to make himself/herself clear and/or expressive, especially if difficult or complex subjects are discussed. On the linguistic and psycholinguistic sides, the very architecture of metaphoric expressions has been at the core of Lakoff and Johnson's theory (1980), which found a peak in Lakoff's book on "Fire, Women, and Dangerous Things" (1987): metaphors are answers to the requirement of (self-)justification. The confluence of Natural Language Processing by Computers researches with Psychology and Linguistics produced works such as Hobbs' analysis of the metaphoric expression as a selective reasoning process (Hobbs 1981) that can be simulated by abductive rules in knowledge bases (Hobbs 1991). On the other side, raising from the triple problem of using Artificial Intelligence for learning and processing natural language, J.H. Martin mainly concentrated on metaphors (1986). This particular focus gave birth to Martin's conventional metaphoric lexicon (1988), following the Lakoffian perspective.

Our interest in associating metaphors and explanations derived from our personal goal, which was to reinforce a first model of an intelligent tutoring system (ITS) named TEDDI (Pery-Woodley 1990, Daniel et al. 1992). This system, whose most extensive description is consigned in (Prince 1995), is thoroughly "Student-Modelling aimed". Our approach of Student-Modelling was mainly based on language, assuming that discourse and *cognitive organisation in learning* (that is, the "mental model" that the student possesses about the domain, but we prefer another terminology because we do not completely agree with the conclusions of the Mental Model Theory) were largely entangled phenomena. This led us to built an approach based on textual clues to derive, from the student discourse, information about his/her knowledge level. Textual clues research is a method largely developed by Pery-Woodley (1990), which surveys the surface markers of discourse, and tries to focus on the regularities in syntatic and lexical choices of words.

To use this method for building an ITS meant a heavy use of student discourse corpora, collected in different situations of teaching. The mentioned publications have widely dissertated about both our results, which partly confirmed the relationship between the linguistic style and the cognitive organisation in learning.

However, we had an unilateral point of view in the system: we were able to analyse students' text as input, but the generation part was still reduced to a plan. Thus, we turned our attention towards the system model seen as the 'teacher' or the 'expert'. Doing this, we could not avoid working on explanations. Explanation is in itself a very complete and complex task (Greboval and Kassel 1994), and explanation in natural language, by an ITS, is still heavier because it involves specific representations of Human-machine dialogue (Charnay 1996). Therefore, we tried to collect a corpus where explanations were given by "experts" (or people standling for that designation) to novices.

From our previous experience, we were very concerned with the particular relationship between analogies and explanations (Prince 1993). Moreover, some of our fellow psychologist researchers (Marie-Dominique Gineste and Veronique Lhomme from the Human Cognition team in our laboratory) were eager to collaborate in order to find out if we could provide some automated or semi-automated techniques in detecting metaphoric figures in explanations given by teachers or experts. Gineste has been working for a long time with Bipin Indurkhya, whose interest in metaphors, AI and cognitive psychology produced some interesting theoretical issues (Indurkhya 1988).

All these elements led to the research that is presently being described in this contribution. The method and analysis techniques, largely inspired from Pery-Woodley's approach, although locally adapted to both metaphor detection and explanation structure spotting, are detailed in the following section. Also, the regularities we found in our first collected corpus are thoroughly described, as well as the different hypotheses we envisaged and tested. Section 3 focuses on the cross-examination of the results obtained from the previously described data analysis: textual clues need to be properly represented by regular heuristics written as a context-dependant 'pseudo-grammar', which will be, in turn evaluated on a larger scale. The exact nature of the cognitive assumptions, derived from the study of the corpus in section 2, is affirmed as a set of hypotheses to test. Another corpus, of a much larger scale, is chosen. Details of the technical device being designed for this evaluation are also given in section 3. A first comment of the results aims at highlighting the relationship between the surface marking and the cognitive process underlying the linguistic production. The assumptions derived from the first corpus are partly validated, and need furthermore experiments to be refined. This last proposition makes the transition towards our conclusion about some recommandations for further experiments in order to generate specifically education-oriented metaphors, in an intelligent tutoring system.

2.Corpus analysis and textual clues detection

In this section, our aim is to show the following fact: in explanations provided from an expert to a novice, analogies and metaphors are assumed to be present. Thus, studying the emergence of metaphoric expressions could be helpful in modelling explanations for an ITS and this is done in 2.1 “Corpus Analysis”. Semantic considerations have been, until now, the sole aspect of metaphor that has been largely examined by the aforementioned authors. From what we determined in our data, we plead in favour of a ‘surface analysis’, which is more likely to grant a regular set of heuristics for automated systems. It does not mean that semantics need to be dropped. On the contrary, we try to associate semantic assumptions with morphosyntactic and lexical evidences. Convergences are then added to the set of enhanced heuristics. The first subsection therefore focuses on validating the ‘textual clues approach’ as a relevant method in data analysis for metaphors and analogies detection.

2.1 Corpus and Assumption

The corpus we collected consists in 26 texts in French, of about 200 words each. They are explanations from experts in computer science to novices, answering briefly to the following question :

“What is a computer, and what is it used for ?”

As we mentioned in introduction, our main hypothesis was that metaphors and analogies are bound to occur in such explanations. Moreover, we expected that our own knowledge of this domain would help understand the possible implicit comparisons on which metaphors are sometimes founded. The first positive result of our analysis is that analogies and metaphors are actually used by most of the subjects. The second one is that these analogies and metaphors can be characterised by regularities. Two different kinds of regularities can be observed concerning the use of metaphors : semantic regularities and lexical/syntactic markers.

Note: in order to simplify the reading of the following, the word *metaphors* will now be used alone to denote *metaphors* as well as *analogies*.

2.2 Semantic regularities

Metaphors in language can be considered as reflecting a more generic cognitive process. Such a process consists in creating a relation between a *target* concept, the one to be described, and a *source* concept, the one used to describe. It can apply to different medium of communication, such as painting, music, language, etc. This explains, partially, why metaphors are sometimes seen as ‘conceptual metaphors’ (Lakoff and Johnson 1980). Some conceptual metaphors are conventional ones. When restricting the study of language to a specific domain, conceptual metaphors can be found in the specialised lexicon related to this semantic domain (Martin 1988, Ferrari 1996b). In the domain of computer science, the metaphors concerning both *artificial* ***intelligence*** (AI) and *human-machine* ***communication*** can be considered conventional conceptual metaphors.

In the corpus we analysed, most of the metaphors fall in the scope of these two conventional ones. This means that at the semantic level, different terms used metaphorically are included in one of the two domain : intelligence and communication. For example, terms like *to say*, *to ask, to command*, are frequently used. Extensions can be found when speaking about the *organs* a computer can use to communicate. These semantic regularities may help generating metaphors: they draw the underlying net of relations between the source and the target conceptual domains. Nonetheless, we also note that such a net is not totally well-defined by the ‘root’ conceptual metaphor (e.g. ‘intelligence’, in the case of AI). For instance, the word *brain* was found two times, one time related to the processor, the other time to the central unit. In the two cases, it fell in the scope of the *intelligence* root metaphor of AI. But the word *brain* itself is rarely used in this domain, and the way it can be used metaphorically is not well defined.

Thereby, semantic regularities are to be considered with caution when text generation is contemplated. On one hand, they can help the analyst finding the relations between the source domain and the target domain. On the other hand, the limits of this set of relations are not always well defined, and the extensions of the root metaphor must be studied with care in order not to introduce ambiguities when using source terms far from the root concept. An easy way to handle this problem is to use explicit one-to-one terms relations only. Such use is called ***in praesentia*** **metaphors** by linguists (Ricoeur 1975): both source and target are present, and the relationship is explicit.This point will be detailled further in the following subsection concerning other kinds of regularities found in the corpus, most of them being related to this particular kind of explicit metaphors.

2.3 Surface regularities: textual clues

If semantic regularities such as the ones exposed in the previous subsection have already been observed, the second kind of regularities has not yet been studied in relation with metaphors. These regularities are textual clues, obvious surface regularities that are used frequently when expressing metaphors (Ferrari 1996b).

Surface regularities, or textual clues, according to Pery-Woodley, can be of different kinds :

- a recurring syntactic structure (e.g., [Subject +Verb + "like a" + Object])
- a particular lexical marker
- a particular morphological discriminant (such as the use of a suffix like -ish in English, in 'reddish, fiftyish', or 'an',etc.)

and so forth.

2.3.1 Processes underlying metaphor introduction and their surface clues

In the corpus we analysed, textual clues were used 31 times to introduce a metaphor. They can be characterised by different underlying processses: **comparison**, **identification**, **opposition** and **emphasis**.

Comparison explains a concept B by indicating in what it resembles concept A (which is supposed to be known to the student), and in what it differs.

example(1) [1]:

A rat is **like** a mouse, but bigg**er** and silli**er**.

A is a known subject (the mouse)
B is comparable to A and the differences are higlighted.

Identification pushes comparison to its uttermost boundaries: B is an A with respect to the context of explanation.

example (2):

'everything went **as if** we were falling on Earth from a wall 40 meters high'.

(*A schoolmaster explaining a problem of gravitation on other planets to children about nine years old)*.

A is an effect of gravitation
B is the event of a fall.
The linking between A and B is explicitely pushed to its limits (by everything).

Opposition is a 'negative' comparison or identification : it insists on what B is not with respect to A.

example (3):

This is **not** a plan , this is a bush!

(*A teacher complaining about the unstructured homework of one of her students*).

[1]These examples are extracted from sentences uttered by teachers or scientists in oral communications and noted in (Prince 1993). The examples from the corpus are presented afterwards.

This example is double: it contains both an oppostion and an identification, but the metaphor is not introduced before the identification is uttered, therefore, it is impossible in this example to dissociate them[2].

A is supposed to be a clean structure (hidden), probably a tree.

B is not a clean structure, thus it is a 'bush' (an unstructured plant) by opposition to the neat tree-like structure.

Last, *emphasis* enhances the scope of a particular property of B with respect to A.

example(4):

- How was the banquet ?

-'Falstaffish'[3].

Concept A deals about the quantity of food.

Concept B is a caricatural representation of over-alimentation.

Examples from the corpus (Ferrari 1996b):

<u>*Comparison*</u> :

Comme le tracteur est un outil qui permet de réaliser **plus** rapidement ce que l'homme faisait pour cultiver et traiter la terre, l'ordinateur est un outil qui permet de traiter des informations que l'homme [lui] donne [...].

The same way a tractor is a tool that enables man to perform **more** quickly what he did to cultivate and process soil, a computer is a tool that allows the processing of information given by man.

<u>*Identification (via apposition) and typographic emphasis*</u>:

Un ordinateur [...] est généralement composé [...] d'une mémoire, et d'un processeur**,** le **"**cerveau**"** de la machine.

A computer […] is generally composed […] of a memory, a processor**,** the **'**brain**'** of the machine.

<u>*Opposition :*</u>

[drawing of a brain with eyes and ears, and the following text]

c'est-à-dire un cerveau qui **ne serait pas** humain car incapable d'effectuer une tâche pour laquelle il n'est pas conçu.

that is, a brain which **would not be** human, because unable to perform a task for which it has not been designed.[4]

Typographic emphasis, such as the use of quotes, bold, italic or other special fonts, were not initially considered as textual clues, and not listed in our categories. However, they are sometimes used for reinforcing a linguistic clue. This part is not studied in this paper. Depending on the output of the interface of the intelligent tutoring system used, this kind of visual emphasis can be used for designing multimodal answers. Such emphasis can be considered as a kind of information *criticity*, notion introduced in (Ferrari 1994), and integrated for multimodal interaction design, in (Bellik et al. 1995).

2.3.2 First results

The four mentioned cognitive processes led to a categorisation of the textual clues related to metaphor, depending on the way they are introduced in language, as well as their frequency of occurence in the corpus :

A . Comparisons via syntactic structures (e.g. *more/less ADJ/ADV than*) .

B . Comparisons via a lexical marker (e.g. *similar to, like*)

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[2] In fact, we will remark in the following lines that the markers of opposition and identification belong to the same group.

[3]An approximation of the French 'gargantuesque'.

[4]Please, note at the same time that explanation is itself marked by the introduction of 'that is', then followed by 'because'. A thorough study of textual clues in detecting and building explanations has been provided in (Prince 1994).

C. Identifications and oppositions (e.g. through apposition, attribute position)
D. Emphasis (e.g. via markers such as *litteraly*, *famous*,...)

Groups A and B have been separated in order to study the use of a lexical marker in opposition to the use of a syntactic regularity only. In regard of this classification, the clues found in the corpus were distributed as shown in the table 3.2-1 below.

Group	A	B	C	D
Type of underlying process	comparison	compari-son	identifica-tion□/ opposition	emphasis
Number of occurrences	2	17	9	3

Table . Distribution of the use of textual clues

We note that some clues are used quite more frequently than others in the corpus. Let us examine the nature of these clues in order to explain this distribution.

First, groups A, B and C correspond to structures allowing for *in praesentia* metaphors. As said previously, such metaphors make it possible to find the target concept in the text (most of the times in the sentence) where the metaphor appears. In opposition to this, group D corresponds to markers related to metaphors for which only the source is explicit. Such markers can be combined with one from the other groups to emphasise the clue. This appeared also in our corpus. We then can observe that most of the clues used to introduce a metaphor in the explanatory corpus are very explicit ones, allowing for easily finding the target of the metaphor, and therefore reducing the risk of misunderstanding of the sources used.

Second, it seems that texts whose purpose is explicitely explanatory, use explicit comparisons (scores of groups A and B). Is there a relationship between the surface style and the purpose of the text ? This is a possible hypothesis that we will re-examine in the following section when moving towards vulgarisation texts.

Last, let us note that all types of underlying processes are present in this collected corpus, although differently weighed. This is interpretable in terms of intentions: if the speaker intently aims at explaining a concept to a novice, he/she will try to use all

In conclusion about this section, the corpus analysis allows us to consider the generic notion of textual clues as a relevant one for introducing metaphors in an explicit and natural manner. In the next section, we propose a model for representing these clues, in order to be able to produce sentences including metaphors. We also consider the problem of the validity of the clues we have found, as well as the tool developed for evaluation.

3.Textual clues: representation and evaluation

In order to describe the textual clues we found, and being able to generate sentences in natural language using these clues, we propose an object-oriented representation detailed in 3.1. This more abstract representation of textual clues is than cross-examined on a corpus of 450,000 occurrences. The aim of this section is to refine the representation, and get the most robust set of heuristics for metaphor and analogy generation.

3.1 An Object-Oriented description

Textual clues can be characterised by two main attributes: both a lexical marker and a syntactic structure related to the grammatical category of the latter. In addition to these attributes, the description of a textual clue related to metaphors should also contain information about the source, and possibly the target, of the metaphor. This is why we propose to consider the object-oriented hierarchy, where a class of objects with the two attributes *SSP (Surface Syntactic Pattern)* and *LM (Lexical Marker)* will correspond to the generic notion of textual marker. The subclass of such a class, specifically related to clues for metaphors, will possess at least the two additional attributes *source* and *target*, linked to the elements of the SSP that are involved in the source and in the target of the potentially marked metaphor. Thereby, the representation of a textual marker related to metaphors will be an object like the following one:

SSP Comparative structures using adjectives, including element Adj0. *e.g. GN_1 V1 GAdj0, where GN1 is a subject nominal group, V1 a state verb, and GAdj0 an adjectival group.*
LM List of adjectives that are relevant for introducing metaphors. *e.g. Adj0 in {pareil, semblable, tel}*
source Elements involved in the SSP *e.g. GN2 such that GAdj0 = Adj0 [prep] GN2*
target Elements involved in the SSP *e.g. GN1*

A sentence like :

Pierre est **semblable à** une statue
(Pierre is **similar to** a statue)

corresponds to the previous examples, with 'Pierre' and 'statue' being the target and the source of a potential metaphor. The SSP attribute is a set of similar syntactic structures allowing a comparison between a nominal group and another using an adjective. The example illustrates the use of the adjectival position 'attribute of the subject'. Other position should also be concerned, like 'attribute of the object', 'apposition'. The whole set of positions constitutes a single SSP attribute.

Under each group of textual clues found in the corpus we analysed, we have proposed a representation for each lexical marker and each syntactic structures we have found. But we also have generalised these two attributes, in order to obtain a larger covering of the phenomenon.

The protocol for **attributes generalisation** assumes that if any of the three following points is detected (or has to be generated), it involves the presence of a metaphor or an analogy:

- syntactic structures similar to the ones found (see the previous comments on the SSP attribute)
- lexical markers of the same grammatical category as the ones found in 2.3.2, with a similar meaning (e.g. 'vrai' (true) gives 'réel' and 'véritable' (real, genuine))
- lexical markers from different grammatical categories, but inside the same terminology (e.g. 'vrai' (true) gives 'vraiment' (truly))

At this point, it becomes necessary to evaluate each clue proposed, as well as the ones found. A protocol of evaluation has been defined, and a tool developed for its implementation.

3.2 Evaluation on a larger-scale corpus

The size of the corpus we analysed was not large enough to validate the clues found. Furthermore, the markers obtained by generalisation (such as explained in the preceding paragraph) are not necessarily real clues. This is why an evaluation of every proposed marker had to be made. To be able to compare multiple uses of a same marker, we first decided to use large corpora for this evaluation phase. The corpus we use is a set of extracts from the newspaper "Le Monde" on CD-ROM, representing approximately 600 articles on Economics, or 450 000 words.

What is particularly interesting about such a corpus when compared to our collected and oriented corpus, is the following list of its properties:

- the subject is different from the original 'computer science' that we collected. We have implicitely assumed that metaphoric processes are not domain dependent, even if metaphoric sources are typically so. That is, we think that comparison, identification, opposition and emphasis are processes that would be instantiated in many domains, whenever explanation is involved. This is the particular advantage of looking for surface marking instead of relying on semantic regularities. It is easier to spread the technique to multiple domains. It has been made in (Daniel et al. 1992) where experiments concerning three different topics (computer science, cognitive psychology and management) have shown the robustness of the textual clues approach. Can we here assume this hypothesis is true? This is one of the subjects of §3.2.1.

- Newspaper articles are also rather short texts, when compared to books for instance. Therefore, journalists need to be very expressive within restricted boundaries in terms of lines. This is a factor that may enhance the presence of metaphors and analogies.

- Newspaper articles are, by essence, explanatory texts, even if they are not presented as such. We call them **implicitely explanatory** by opposition to explicit explanations (that is in education and teaching, or answers to explanation requests). Without being considered as teachers, journalists still undergo a partially educationally-oriented task: they try to summarise a given subject, and provide the reader, ignorant by default, with notions and results about a particular topic. The latter is a priori assumed not to be known by the reader, otherwise the topic would not raise interest. Thus, to suspect the presence of explanations, and possibly related to analogies and metaphors, in journalistic papers, does not sound as an unreasonable hypothesis. But are metaphors only explanatory or do they fulfill another purpose? This is also dealt with in § 3.2.1.

In conclusion, our first representation of metaphor-sensitive textual clues could only resist better to other tests if it is refined by the use of such a corpus. At least, we will be able to know if *explicitely explanatory texts* such as in Corpus 1 (the 26 texts mentioned in section 2) are different from *implicitely explanatory texts* such as the newspaper articles of Corpus 2.

3.2.1 Domain or style dependency: some assumptions to test

The assumptions that were being at stake were the following:

- *(1) Are the four metaphor production processes domain dependent?*

Our assumption is that it is not so, because of what we found in previous research. But a previous result always needs to be re-confirmed. Corpus 2 is too different from Corpus 1 to evaluate properly this hypothesis and isolate its local variables. We would then need another explanatory corpus about an economical concept to compare processes one-to-one. However, we will consider that if we, at least, find any of these processes present as soon as a metaphor is used in order to explain, we will consider this hypothesis to be (partially) satisfied.

- *(H2) Is their use, or frequency of use style dependent (i.e. newspaper article versus definition, versus explicit explanation)?*

In (Pery-Woodley 1990) and (Daniel et al. 1992), we have pointed out that textual clues were able to feature regularities in the linguistic style of a person given a particular task of defining a concept. In (Prince and Pernel 1994), we have shown that a particular task, like an information-seeking dialogue, was characterised by very strict textual clues. Can we generalise the characterisation by textual clues saying that the style of a text may reinforce 'preferences' in some types of clues when metaphors or analogies are used? In other words, will newspaper article, in general, rely more on identification or on emphasis, with respect to the texts of Corpus 1? This, provided that textual clues hint at one major process at a time adn are sufficiently discriminant.

- *(H3) Does our generalisation protocol about the corresponding textual clues resist to the cross-examination on Corpus 2?*

This last hypothesis questions the beforementioned assumption 'are textual clues sufficiently discriminant ?' of a particular process. We think it may not be so obvious. In (Prince 1994), when we tried to classify explanations in terms of processes characterised by textual clues, we arrived to the conclusion that if we can use textual clues as an analysis bottom-up method with some success, this sucess was not total, because the defined classes were rather sets, and some clues suffered from multiple inheritance. Discrimination was not completely satisfactory. However, an explanation is intself a too complex process to be embedded in only a textual-clues model. This is why we think that metaphors and analogies, whose scope at the intentional level is much narrower than a whole explanation, may resist better the evaluation on multiple corpora.

- *(H4) Are all metaphors explanatory in implicitely explanatory texts, by opposition to explicit explanations?*

In other words, the metaphors detected in Corpus 1 were in a very impressive majority, dedicated to explanation. They represented an effort made by the speaker (or writer) to trasmit his/her knowledge to the listener (or reader). In text that partly need to explain because their main purpose involves local explanations, and that we called implicitely explanatory texts, is this relationship maintained so mightily or not ?

3.2.2 Evaluation Protocol description

The evaluation protocol consists in extracting the sentences in which a lexical marker - belonging to the list of metaphor-sensitive markers determined in section 2 - occurs, and determining the frequency of its use in a metaphoric context. This value is called the **relevance** of the marker, and added as an attribute in our object-oriented representation. In case of irrelevance of a lexical marker alone, it is possible to examine the multiple combinations of this marker with different syntactic structures in order to determine if some would be relevant as clues.

In order to partially automate this evaluation, a tool has been developed for large corpora analysis. The current prototype, STK, allows for tokenising, tagging, and extracting sentences. The tagger used is the one developed by Brill (Brill 1992) that has been trained for our purpose on a French corpus. A large lexicon is added for improving the results of the training, BDLEX, developed by Pérennou and De Calmes, IRIT, France. BDLEX contains about 26 000 terms, or 250 000 lexical entries. The tokeniser follows the tagger's requirements: each lexical unit separed by spaces, one sentence per line.

Using the results of the tagger, we searched for the clues and the tag describing their grammatical category, to avoid lexical ambiguity. The current version makes it possible to extract sentences. Therefore, it may be difficult to evaluate the metaphoric meaning, when ignoring the topic of the corpus. Hypertext links are under development to solve this problem: the whole corpus is marked with SGML markers, including HTML usual features. By this mean, we hope to simplify the task of the evaluator by making it possible for him to find back the context of a marker in a sentence just by clicking on this sentence, using a classical HTML browser.

3.2.3 First results

The first results of the evaluation needs some comments. Some clues, especially the ones from group D, issuing both from the Corpus 1 or from the generalisation protocol, are particularly relevant. It means that **emphasis** is very present in the expressions used by journalists, at least on its surface level. For instance, the adverb "littéralement" (literally speaking) has a value of 35/36. The writer really warns the reader of the importance of what is following, although the latter is generally a 'non literal' approximation, as in every metaphor or analogy, at the opposite to what has been asserted!

Thus, cognitive processes underlying metaphor and analogy production in explanation do resist, at least partially, to the modification of subject. (H1) is partly validated by Corpus 2. Let us note that emphasis as a preference is not very amazing in journalistic style.

Thus we continued furthermore, trying to search evidence for (H2): is there a really prefered style? To this question, we are inclined to answer positively. If group D clues are present, and also appended with particular punctuation or morphological features (capital letters, quotes, affixes or suffixes), clues from groups A and B are not relevant to the journalistic corpus. Comparisons are used for what they are, and not in a metaphoric style, and not for the sake of explanation.

So Corpus 1 denotes that explicit explanatory texts need to favour analogies and metaphors by comparison, whereas newspaper articles of Corpus 2 tend to prefer emphasis as a process to produce metaphors.

(H3) was more difficult to examine because the clues of group D introduce metaphors in which the target is implicit. In the journalistic style, metaphors do not have to be as explicit as they are when used for teaching. The discriminant aspect of the group D clues can be considered as a sufficent condition of detection, but is it a necessary or a sufficient condition for generation? We think not. Group C clues were present, but identification and opposition when the target is implicit, are difficult to detect automatically. However, these can be used by a computer for generation, and the human user will understand the meaning of a group C, especially if combined with a group D clue, as a strikingly explanatory metaphor.

Last, the (H4) hypothesis is also difficult to assert automatically. However, a manual analysis is possible. It seems that in newspapers articles metaphors are either explanatory or they are used just to draw attention to what is being said, giving an additional stress or flavour to the main points. In opposition to this style, in teaching, or in an explanatory context, they are used for introducing new concepts, forcing an analogy between the taught concept and a well-known one.

Conclusion

Let us summarise some of the achievements of our project in studying the role of the textual clues approach to metaphors detection and furthermore to metaphors generation by computers. When semantic regularities only showed to what structure the metaphorical expression used by speakers or writers could possibly point at, the study of surface markers indicated that four underlying cognitive processes were constitutive of the metaphorical discourse. In this, it seems that surface marking goes much deeper in the cognitive side of language than the semantic approach. In fact, this still validates the assumption on which we built the first model of our intelligent tuoring system TEDDI: linguistic expression in its outermost fashion (surface markers and syntax) is the most representative of the innermost cognitive organisation (underlying production mechanisms).

The fact that the use of these processes varies in style, and domains does not infirm their existence. We have studied this variation by examining the heuristics defined in both section 2 and formally presented in the beginning of section 3 under the 'crude' light of Corpus 2. Discourse is not so easily put in a nutshell, even metaphorical discourse, and people handle it according to their purpose and intentions.

This last thought reflects the fact that pragmatics must not be underestimated when apparently semantic phenomena, such as metaphors, are at stake. On the contrary, it seems that the speaker's intention about his/her discourse, his/her interlocutor, and further more, his/her knowledge about this interlocutor, are very higly sollicitated. Therefore, if one needs to make an intelligent tutoring system generate metaphors as explanations, only a student-modelling aimed ITS is likely to generate the most efficient metaphors in this context. The ITS needs to 'know' wether the 'cognitive preferences' of his student, such as we defined in (Daniel et al. 1992, Prince 1995) are compatible with comparison, with identification, with oppostion, or are more easily stressed by emphasis. If this knowledge is possible, then the choice of the surface marking of the metaphor, even the choice of the presence or absence of the target or the source, are easy to make. In this sense, another study about the relationship between the cognitive style of the student and the metaphor generation processes must be undergone to efficiently answer this question.

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