
Error Diagnosis in the FreeText Project

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ABSTRACT

This paper presents an overview of the research conducted within the FreeText project to build an automatic error diagnosis system for learners of French as a foreign language. After a brief review of the main features of the project and of the learner corpus collected and used within the project, the paper focuses on the error diagnosis system itself and, more specifically, on two of its components: (a) a syntactic checker making use of two different diagnosis techniques to detect errors of purely grammatical nature and (b) a sentence comparison tool which compares learners' answers with those stored in the system to detect possible semantic discrepancies such as referents or word usage. Advantages of such an automatic system and ideas for further research are then discussed.

KEYWORDS

CALL, Natural Language Processing (NLP), Error Diagnosis, Error Tagging, Intelligent Feedback

1. INTRODUCTION

Computer assisted language learning (CALL) is a field in high demand of natural language processing (NLP) tools. Voice recognition software and speech synthesizers are certainly the most prominent sellable features of current commercial CALL software. However, the need in CALL for error diagnosis and for both intelligent and real-time feedback is great. Reliable error diagnosis systems would allow users/authors to overcome the limitations of multiple choice questions and fill-in-the-blanks types of exercises and to present the more communicative tasks to learners.

Within the FreeText project,¹ in which a complete CALL software for intermediate to advanced learners of French as a foreign language is being developed, we are implementing an error diagnosis system composed of a spell checker, a syntactic checker, and a sentence comparison tool. The techniques used for the syntactic checker and the sentence comparison tool are the focus of this paper and are described in detail. The raw output of the diagnosis system is presented, as well as possible ways to transform it into meaningful feedback for language learners.

The paper is structured as follows. Section 2 presents an overview of the FreeText project. Section 3 describes the French learner corpus FRIDA. Sec-



tion 4 details the error diagnosis techniques developed and implemented within the FreeText project and how the output of the error diagnosis system can be transformed into intelligent feedback. Section 5 presents ideas for further research.

2. THE FREETEXT PROJECT

Work presented in this paper was developed within the FreeText project. This project's aim is to develop a CALL software for intermediate to advanced learners of French as a foreign language. FreeText offers four tutorials containing 16 authentic documents, ranging from texts to audiovisual files, which illustrate different communication acts. The exercises exploiting these documents are based on studies of a learner corpus called FRIDA (see section 3 below) in order to concentrate on errors actually made by the target audience. Moreover, FreeText uses several natural language processing (NLP) tools such as a sentence structure viewer, a speech synthesizer, and an error diagnosis system to provide intelligent feedback for (relatively) free production exercises.

The FreeText consortium groups partners with varying fields of expertise from institutions in four different European countries:

1. The Department of Language Engineering, University of Manchester Institute of Science and Technology (UMIST), United Kingdom, in charge of the didactic contents of the software;
2. The Department of Linguistics, Université de Genève, Switzerland, developing the NLP tools;
3. The Centre for English Corpus Linguistics (CECL), Université Catholique de Louvain, Belgium, responsible for the corpus work and for the validation phases; and
4. Softissimo SA, France, integrating the different components into a user-friendly interface.

FreeText is an open system in which teachers can introduce new exercises and documents to suit the particular needs of their students. The project started in April 2000 and ends in March 2003.²

3. THE FRIDA CORPUS

The French Interlanguage Database (FRIDA) corpus (Granger, this volume; Granger, Vandevanter, & Hamel, 2001) is a corpus of learner French collected and developed by the CECL within the FreeText project. The corpus, which contains about 450,000 words, was gathered from essays of French learners. Once the essays were collected, they were keyed in into electronic format in order to allow for computerized treatment. The data were then coded for errors following an error typology designed specifically for French learner corpora. A trigram of tags was used for each error to indicate an error domain (e.g., form or



grammar), an error category (e.g., diacritics or gender), and the lexical category of the erroneous word (e.g., adjective or verb). About 300,000 words were error tagged in this way.

Once the error tagging was achieved, the CECL computed statistics to determine the most frequent errors in the corpus. Detailed analyses on specific error categories provided information on the specific contexts in which the errors were more likely to occur. These two pieces of information were used to derive exercises targeting problematic areas for language learners and to decide on which error categories the diagnosis system should focus.

4. ERROR DIAGNOSIS

This section presents the automatic error diagnosis currently implemented in the FreeText project. Within the program, users can use the diagnosis tool either for the correction of specific exercises in which they are asked to produce relatively free input, such as a sentence or a short paragraph, or they can use it on their own, outside of any set task, in order to ascertain the grammaticality of their own productions. The error diagnosis consists of three main steps: (a) spell checking, (b) syntactic error diagnosis, and (c) sentence comparison diagnosis.

At each step, errors can be detected and displayed to the users who are then asked to correct their production before moving on to the next step. This process insures that no spelling error remains during the syntactic diagnosis and, likewise, that no grammar or spelling error has been detected before entering the sentence comparison process.

We leave aside spell checking in this paper to concentrate on the syntactic and sentence comparison diagnoses and then to give some information about the interface of the automatic error diagnosis tool.

4.1 Syntactic Diagnosis

The basis of the syntactic diagnosis is the FIPS parser. We will very briefly describe the parser in section 4.1.1 below in order to facilitate understanding of the two diagnosis techniques used for syntactic errors, namely constraint relaxation and phonological reinterpretation. These two techniques will be described more extensively in sections 4.1.2 and 4.1.3.

Error categories which can be treated by the syntactic component of the error diagnosis system are given in Table 1 along with an example for each category.

All errors, apart from homophone errors, are diagnosed by constraint relaxation. Phonological reinterpretation, which is launched after constraint relaxation, takes care of homophone errors.³ Most of the error categories are those of the FRIDA typology. However, given the particularities of the error diagnosis system there are a few exceptions where it seemed possible to refine the categories, for example, for euphony and order errors.



Table 1
Error Categories Treated by Syntactic Diagnosis

Error Category	Acronym	Example ⁴
Homophone	HOM	Elles peuvent maître au monde des enfants.
Class	CLA	Ce montre le problème.
Auxiliary	AUX	Il a tombé.
Gender	GEN	Elle est beau .
Number	NBR	Les souris ont été mangée_.
Person	PER	Je peut partir.
Voice	VOI	Il _ révolte contre la société.
Euphony—Elision	EUFE	ce aspect
Euphony—Contraction	EUFC	de le chat
Euphony—Analogic t	EUFT	A- il mangé?
Adjective complementation	CPA	Il est capable à faire cela.
Verb complementation	CPV	Il est tombé _ la chaise.
Order	ORD	Ils ont les vus.
Adverb order	ORD	C'est lui plutôt qui chasse
	AV	
Adjective order	ORD	un arabe pays.
	AJ	
Redundancy	RED	Il parle beaucoup des langues.
Missing punctuation	OUB	Peut _ il partir?
Negation	NEG	C' _ est pas un problème.

4.1.1 The FIPS Syntactic Parser

The FIPS program, more extensively described elsewhere (Wehrli, 1997), is a syntactic parser based on the Principles and Parameters Theory (Chomsky & Lasnik, 1995). The main goal of the parser is to provide syntactic structures for input sentences. The parsing algorithm is that of attachment to the right corner, and alternatives are treated in a pseudo-parallel way. Well formed constituents are stored in a chart. Scores are given to each structure in order to rank alternatives during parsing and to choose which full analysis to display when parsing is successful. When no complete analysis is found, the parser nevertheless presents partial analyses of the input, also called chunks, retrieved from the chart of well formed constituents. Thus, an output is provided even when the input does not result in a successful parse. The presence of partial analyses implies that the input is either nongrammatical or lies outside the capabilities of the parser. The parsing process is done in three main steps: (a) projection of structures following the X-bar model on the basis of lexical elements, (b) combination of these structures, and (c) application of constraints to reject nongrammatical structures.

4.1.2 Constraint Relaxation

Constraint relaxation is a widely used error diagnosis technique, and there



are several versions of it; to name only a few, Weischedel and Black (1980, p. 108) spoke of “failable” constraints, Matthews (1993) of principle violation, and Heinecke, Kunze, Menzel, and Schröder (1998) of graded constraints. Although some differences exist among these versions of the technique, the underlying principles are the same: normally, partial structures can combine only if some constraints or conditions are met such as subject-verb agreement for number and person; when the constraints are relaxed, attachment is allowed even if the constraint is not satisfied. To be useful as a diagnosis system, the relaxed constraint must be marked on the structure so that the type and position of the detected error can be indicated later on. Thanks to the specific relaxation of a constraint, proper labelling of where the analysis has been able to proceed forms the basis of the error diagnosis (Felshin, 1995). Most systems using constraint relaxation can relax constraints separately from each other and relax them only when they cannot be satisfied. One of the advantages of constraint relaxation is that it provides both a diagnosis and a complete analysis of the input sentence.

We illustrate the technique with the sentence in example (1) containing a gender error (taken from the FRIDA corpus). Gender errors on adjectives rank in sixth position and represent 2.81% of the errors of the corpus.

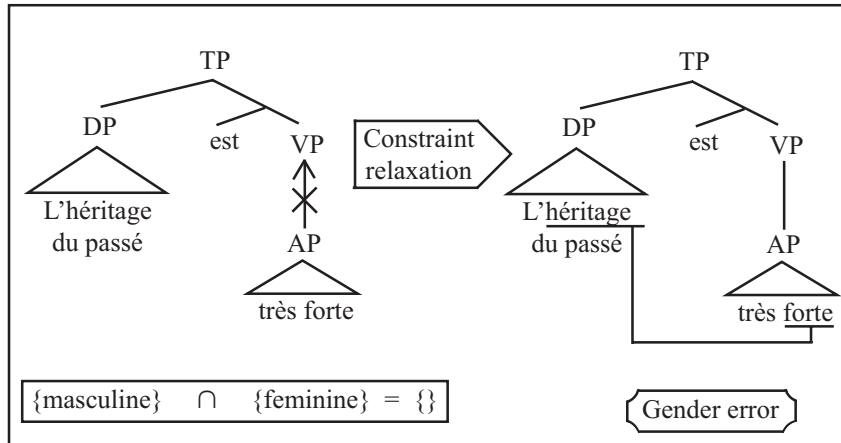
- (1) **L'héritage du passé est très forte et le sexisme est toujours présent.*
The heritage-MASC of-the past is very strong-FEM and the sexism is always present.

In order for the adjectival phrase (AP) *très forte* to attach to the verb phrase as an attribute, it must agree in gender and number with the subject of the sentence (TP), the determiner phrase (DP) *l'héritage du passé*. The checking of gender agreement is performed by taking the intersection of the gender sets of the two constituents. If the result is the empty set, it means that the two elements do not agree, that the sentence is ungrammatical, and that the sentence should be rejected. However, when constraint relaxation is activated, if a set intersection results in the empty set, the specific constraint is relaxed and the union of the two sets is taken instead, thus allowing for the constituents to attach despite the detected error. The location of the constraint relaxation is marked in the structure in order to be later displayed to the user. This procedure is schematized in Figure 1.

Practically, however, the use of constraint relaxation leads to massive overgeneration of analyses. In order to circumvent this problem and to identify the analysis which best reflects the learner's intention, three enhancements were added to the existing analysis ranking system: (a) a set of heuristic rules to eliminate highly implausible analyses, (b) ranking measures based on word frequency, and (c) ranking measures based on error type frequency. An algorithm was developed to identify the preferred analysis on the basis of the resulting values (Potter, 2002).



Figure 1
 Schema of a Gender Agreement Constraint Relaxation (Simplified Structures)



4.1.3 Phonological Reinterpretation

Phonological reinterpretation is based on the idea that some words are homophones and that language learners might confuse words with similar pronunciations. Replacing some words by their homophones can allow the system to reach a full analysis for a given sentence. The system still provides an error diagnosis—with the limitation that only the erroneous use of homophones of different lexical categories can be detected because, as Vosse (1992, p. 112) puts it, “unfortunately, a parser cannot detect substitutions by homophones which have the same syntactic properties.”

Phonological reinterpretation uses the following algorithm:

1. A first parse of the sentence results only in partial analyses;
2. Words at the boundaries of the partial analyses are retrieved;
3. For each of the retrieved words:
 - 3.1 Its phonological representation is looked-up in the dictionary;
 - 3.2 All the words with the same phonological representation are retrieved from the dictionary and inserted into the parser’s chart;
4. The sentence is parsed again with all the new word alternatives; and
5. If a full analysis is now found for the sentence, the reinterpreted words employed can be proposed as possible corrections.

This error diagnosis technique requires the dictionary used by the parser to contain the phonological representation of all its words and to be searchable on the basis of this information. Moreover, the parser used must be nondeterministic and accept word alternatives.

Consider the sentence in example (2):⁵

- (2) a. **Il faut maître les enfants au monde.*
 One must master-NOUN the children to-the world.



b. *Il faut mettre les enfants au monde.*

One must put the children to-the world. (One must give birth to children).

c. [TP Il faut maître] [DP les enfants au monde]

Parsing the erroneous sentence in (2a), corrected in (2b), results in the two chunks given in (2c). The two words at the boundaries of the chunks, i.e. *maître* and *les*, are thus reinterpreted, providing the words *mettre* 'put' and *mètre* 'meter' for *maître*, and none for *les*.⁶ A second parse of the sentence, including the reinterpreted words, is able to provide a full analysis of the sentence by using *mettre* instead of *maître*. Thus, the homophone error is detected and diagnosed, and a correction can be proposed.

4.2 Sentence Comparison Diagnosis

In the field of error diagnosis, syntactic checking alone is sometimes not accurate enough to provide a correct feedback for the answer to an open question. For instance learners of French, and even native speakers, often mix up the plural demonstrative determiner *ces* 'these' with the plural possessive determiner *ses* 'his/her,' which are homophones. Let us consider a comprehension exercise about a text where learners have to answer the question in (3a) with the expected answer (3b). If learners type the answer in (3c), no syntactic error will be detected.

- (3) a. *Qu'est-ce que Paul a fait?*
What is it that Paul has done?
b. *Il a lu ses livres.*
He has read his/her books.
c. *Il a lu ces livres.*
He has read these books.

We can also imagine pronominalization exercises where the expected answer is (4a) and the learner's answer is (4b). This answer is grammatically correct since the agreement rule for the past participle with an accusative pronoun placed before it is respected, but the answer (4b) is not correct with regards to the exercise.

- (4) a. *Je les ai vues.*
I have seen-FEM-PL them-FEM-PL.
b. *Je les ai vus.*
I have seen-MASC-PL them-MASC-PL.

Therefore, another error diagnosis method might be useful. In the FreeText project, we tried to implement another technique called *sentence comparison diagnosis*.⁷ In most CALL software systems, tutors need to enter model answers with a complex pattern matching formula taking a wide range of possible answers into consideration. This task can be tedious, and some responses might be overlooked. With the system we propose, tutors have to enter only one model



sentence in the exercise database. Then, the system extracts a deep “semantic” structure for the tutor’s and learners’ sentences, compares them with each other, and provides feedback. This technique can be used with active/passive or declarative/interrogative transformations, topicalization, pronominalization, nominal/complete sentences, infinitive/imperative, and agreement exercises.

The structures used to compare sentences are called *pseudo-semantic structures* (PSS). They are automatically derived from FIPS output structures and are used as the input of the syntactic generator GBGen (Etchegoyhen & Wehrle, 1998). This system is mainly used for machine translation (L’haire, Mengon, & Laenzlinger, 2000). PSSs are hybrid structures which combine both abstract semantic information and lexical items.

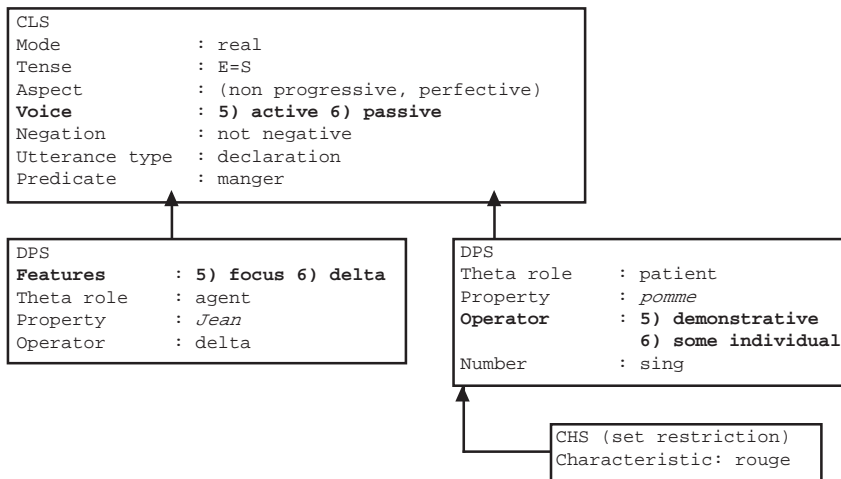
PSSs are divided into three subtypes: CLSs (clause structures), which correspond to states and events and contain verbs and adjectives; DPSs (DP-Structures), which correspond to nominal structures and contain nouns; and CHSs (Characteristic structures), which correspond to phrase modifiers and contain adjectives and adverbials. PSSs can combine into hierarchical structures; they contain an unordered list of other PSSs, called *satellites*, containing verb arguments, adjuncts, phrase modifiers, and so forth.

Figure 2 shows a simplified PSS schema for the sentences in (5) and (6).

- (5) *C’est Jean qui a mangé cette pomme rouge.*
It is John who has eaten this apple red.
- (6) *Une pomme rouge a été mangée par Jean.*
An apple red has been eaten by John.

A similar PSS structure can be derived from both sentences. Fields which differ are highlighted in bold face. The term “delta” means that a property is undefined, and arrows denote the relation “is-satellite-of.”

Figure 2
Simplified PSS Schema for Examples (5) and (6)





As we can see, only a few features differ between the two sentences, sentences which do not have identical syntactic structures. The modified fields in the PSS are "Voice," "Feature," and "Operator." For an interrogative sentence, the field "Utterance type" would be modified, "Negation" for a negative sentence, and so on. Table 2 shows some constructions which can be treated by the system and the feedback to be provided:

Table 2
Constructions Treated by the Sentence Comparison Diagnosis Tool

Construction	Model Answer	Learner's Sentence	Feedback
Incorrect use of clitic pronoun	Je les ai vues.	Je les ai vus.	Gender error on pronoun
Meaning error	La grosse souris est grise.	La grosse souris est blanche.	Meaning error on adjective
Global question (yes/no)	Jean a-t-il lu ce livre?	Est-ce que Jean a lu ce livre?	No feedback: equivalent construction ⁷
Partial questions	Quel livre est-ce que Jean lit?	Quel livre Jean lit-il?	No feedback: equivalent construction
Voice error	Le chat poursuit la souris.	La souris est poursuivie par le chat.	Voice error on verb
Relative clauses	La soeur du capitaine qui a été tué e.	La soeur du capitaine qui a été tué .	Agreement error on verb of relative clause ⁸
Cleft construction	C'est Pierre que Jean a vu.	Jean a vu Pierre.	Error on cleft construction
Topicalization	Avec ses jumelles, Jean a observé cet homme.	Jean a observé cet homme avec ses jumelles	Error on topicalization
Adjunction	Jean a regardé l'homme avec ses jumelles.	Jean a regardé l'homme.	Missing constituent
Raising	Jean semble dormir.	Il semble que Jean dort.	No feedback: equivalent construction
Pronominalization	Le chien est blanc est noir	Il est blanc et noir	Warning on pronoun
Elipsis	Le chien est blanc et noir.	Blanc et noir.	Warning: missing verb

PSSs are really well suited for our purpose: they are very simple and can be easily compared. Tutors need only enter one model answer, as complete as possible, and the system will be able to treat cases as shown above. This tool can prove useful within a CALL software.

Since the sentence comparison system does not contain an actual semantic component, it has some shortcomings. Open questions can be answered in many ways, and our system has its limits. Let us consider the question in (7a)—illustrated by a picture. The teacher enters (7b) as a model, and the learner answers (7c).

- (7) a. *De quelle couleur est le chien?*
Of which color is the dog?
- b. *Le chien est blanc et noir.*
The dog is white and black.
- c. *Le caniche est noir et blanc.*
The poodle is black and white.



Let us assume that learners know the word for this breed of dog and that the picture in fact represents this breed. The system will detect a meaning error since *chien* differs from *caniche*. It could be improved by the use of semantic dictionaries containing, for example, hyponyms, hypernyms, and synonyms. However, this solution also has limitations because learners could also use a wrong breed of dog to describe the picture (hyponym) or use the hypernym word *animal* ‘animal’ because they do not remember the word *chien* ‘dog.’

Overall, this new technique seems to be interesting and sound enough to be implemented and used in a CALL program; it improves the quality of the feedback. Teachers can easily enter new, smarter exercises since automatic error diagnosis offers more precise feedback.

4.3 System Interface

Good feedback is crucial in a CALL application, since learners are often left to themselves and cannot rely upon teachers and tutors to help them. In this subsection, we discuss the output of our system and the way we use it to provide feedback.

4.3.1 XML Output

Our system provides an XML document for each parse. This formalism is well known worldwide, is extensible, and can be easily adapted to specific purposes. Let us consider the output in Figure 3, an extract of the output for “*le chats a dormi*” (the-SG cats has slept), which contains an agreement error:

Figure 3
Extract of Output for “*le chats a dormi*”

```
<PROJ cat="DP" attachedAs="spec" colorGramm="sujet" tree="GN">
  <HEAD cat="D" tool="yes" gender="masc" number="sin" lexeme="le"
    ortho="le" colorGrammLex="Det">
    <ERROR index="Aa01" manypart="yes" category="NBR">le</ERROR>
  </HEAD>
  <PROJ cat="NP" attachedAs="comp" tree="hidden">
    <HEAD cat="N" tool="no" gender="masc" number="plu" lexeme="chat"
      ortho="chats" colorGrammLex="Nom">
      <PARTERROR antecedent="Aa01">chats</PARTERROR>
    </HEAD>
  </PROJ>
</PROJ>
```

The PROJ tags mark the syntactic projections and contain syntactic information: the top projection has the grammatical function of subject (attribute *colorGramm*) and will be analyzed as a nominal phrase (attribute *tree*). The HEAD tags mark the projections heads and contain information about the words (gender, number, tense, lexical category, and lexeme).¹⁰ Errors are marked with



ERROR tags, and possibly with PARTERROR tags if the error covers several words. Here, we have a number error (marked by the attribute *category*) between *le* 'the' and *chats* 'cats.' Both tags are co-indexed because several errors can be detected in a single sentence.

4.3.2 Intelligent Feedback

Of course, the XML output can not be used as such. An XML output can be parsed by many tools and languages available on the web. In Figures 4 and 5 below, we show two different interpretations of the output illustrated in Figure 3 above, namely a color grammar and the error diagnosis system.

Figure 4 shows a color grammar. Syntactic functions are shown by colored underscores, and the lexical categories are marked by different font colors. If the mouse cursor moves over a word, all the lexical information for that word is displayed. In this example, the verb tense is described as *passé composé*, and its two elements are shown separately. Since this sentence contains an error, a warning is displayed and learners can directly access the error diagnosis by clicking on a hypertext link. They can also access the conjugation tool for each verb of the sentence provided in the system by means of a link.

Figure 4
Color Grammar

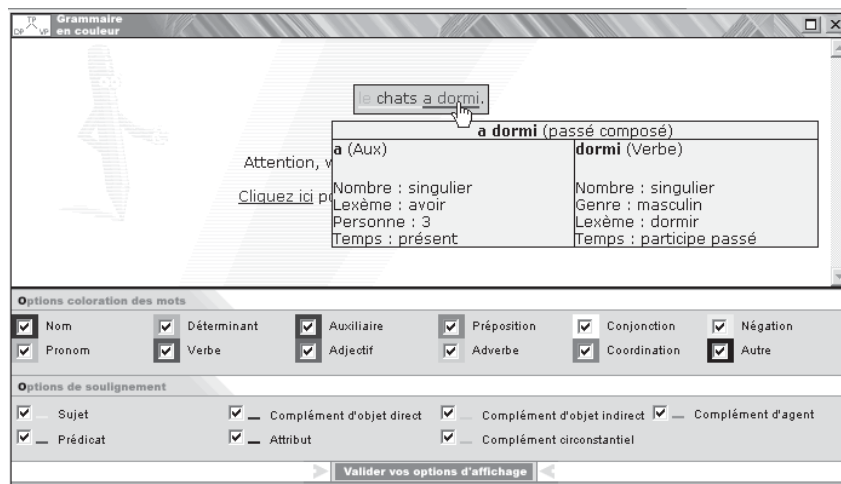


Figure 5 shows how the error diagnosis is displayed. If learners move the mouse over the word *Erreur* 'error,' the two parts of the error are highlighted in green. If they move the mouse over the words of the sentence, the same lexical information as in the color grammar is displayed. If the system does not find any mistakes, a message signals users that no error has been detected¹¹.



Figure 5
Error Diagnosis System



Learners can also display a syntactic tree structure of the sentence. These three types of output provide sound feedback that is quite reliable and helpful in providing immediate feedback to learners.

5. EXPECTED ADVANTAGES AND IDEAS FOR FURTHER RESEARCH

A first test of the system was conducted with 23 teachers at an early stage of the project. At that time, only a few agreement errors could be detected by the error diagnosis system, and the color grammar was not at an advanced stage. Teachers were interested in having NLP tools with a good diagnosis, but the prototype was not good enough. The wide coverage of the present version of the error diagnosis system and the quality of the color grammar should dramatically improve these results. Our error detection system will allow teachers to build exercises rapidly and easily, and they will be able to elicit more open-ended responses from learners.

From the point of view of learners, the possibility of obtaining quasi-immediate feedback should be a feature of considerable interest. Learners will not have to wait for a tutor in a classroom, for the paper correction of their assignments, or for a long-distance tutor to respond by mail.

Besides the color grammar and the present output of the error diagnosis system, it should be possible to provide users with more specific feedback on their errors, thanks to the richness of the XML output. Future plans include direct links to specific sections of a reference grammar and to remediation exercises targeting the specific errors. The integration of semantic dictionaries could also improve the error diagnosis system.

A new testing phase is planned for January 2003 with actual learners of French as a foreign language using the complete error diagnosis system integrated into the FreeText software. This testing phase should allow us to gather quantitative data on the recall and precision rates of the error diagnosis system as well as qualitative data concerning the acceptance of the tools by language learners. Learners will have to follow a guided path. All pages accessed and sentences typed in by the users will be stored in a database. Teachers and CALL specialists will also fill out a questionnaire about the technical and pedagogical aspects of the software. Learners will report on their use of the system and express their opinions about the software.

Although the system does not yield a perfect error diagnosis, the results achieved so far are encouraging and seem to be good enough to be used by real users.



NOTES

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² For more information on the FreeText project, see the project's web site (www.latl.unige.ch/freetext).

³ Phonological reinterpretation is capable of detecting other error categories, such as gender or number errors, as long as these errors do not involve a change in the pronunciation. However, since phonological reinterpretation is launched only after constraint relaxation, such errors are picked up by constraint relaxation rather than by phonological reinterpretation.

⁴ Words in bold or place markers () indicate incorrect areas.

⁵ The sentence has been simplified from the FRIDA corpus, but the error is authentic.

⁶ “*mètre*” in its noun reading will be excluded from consideration, while “*mètre*” in its verb reading (indicative present, 3rd person singular) will not lead to any grammatical combination. “*les*” is also a clitic pronoun but is already contained in the constituent list as a one-element constituent since all possible readings for a word are kept in the constituent list and can combine into a larger constituent.

⁷ At this stage, this technique, also known as “semantic” checking, is not activated in the error diagnosis system. It will be issued as a secondary output of the FreeText project.

⁸ The system extracts the same structure from both sentences. However, teachers might want to elicit a given structure, as here, for instance, the structure of the model answer is more difficult to produce and learners tend to avoid using it. Some parameterization could be easily added to tolerate, or not, equivalent constructions, ellipsis, etc.

⁹ Both sentences can be translated as “the sister of the captain who has been killed.” However, in French, the past participle of the passive relative clause must agree with its subject, which is feminine in the model sentence (i.e., the sister has been killed) and masculine in the learner's answer (the captain has been killed).

¹⁰ A lexeme is the base form of a word, the singular form for a noun, the infinitive form for a verb, and so on.

¹¹ A help file detailing which errors are well detected, partially detected, and not detected will be available so that learners and teachers are aware of what the system can offer.

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A detailed black and white line drawing of an ancient Greek agora marketplace. The scene is framed by a decorative border. At the top, there are three structures: a stall labeled 'Schoenhof's', a building labeled 'AUDIO-FORUM', and a classical building labeled 'HRW COLLEGE'. To the right, another building is labeled 'World of Reading'. In the center, a large fire burns in a circular hearth. Numerous figures in classical attire are engaged in various activities: some are talking, some are carrying goods, and some are working at stalls. One stall has a sign that says 'PICS'. At the bottom left, a man is shown working on a statue. The overall atmosphere is one of a busy, open-air market.

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