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Direkt Profil: A System for Evaluating Texts of Second Language Learners of French Based on Developmental Sequences

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Abstract

Direkt Profil is an automatic analyzer of texts written in French as a second language. Its objective is to produce an evaluation of the developmental stage of students under the form of a grammatical learner profile. Direkt Profil carries out a sentence analysis based on developmental sequences, i.e. local morphosyntactic phenomena linked to a development in the acquisition of French.

The paper presents the corpus that we use to develop the system and briefly, the developmental sequences. Then, it describes the annotation that we have defined, the parser, and the user interface. We conclude by the results obtained so far: on the test corpus the systems obtains a recall of 83% and a precision of 83%.

1 Introduction

With few exceptions, systems for evaluating language proficiency and for Computer-Assisted Language Learning (CALL) do not use Natural Language Processing (NLP) techniques. Typically, existing commercial and non-commercial programs apply some sort of pattern-matching techniques to analyze texts. These techniques not only reduce the quality and the nature of the feedback but also limit the range of possible CALL applications.

In this paper, we present a system that implements an automatic analysis of texts freely written by learners. Research on Second Language Acquisition (SLA) has shown that writing your own text in a communicative and meaningful situation with a feedback and/or an evaluation of its quality and its form constitutes an excellent exercise to develop second language skills.

The aim of the program, called Direkt Profil, is to evaluate the linguistic level of the learners’ texts in the shape of a learner profile. To analyze sentences, the program relies on previous research on second language development in French that itemized a number of specific constructions corresponding to developmental sequences.

2 The CEFLE Lund Corpus

For the development and the evaluation of the system, we used the CEFLE corpus (Corpus Écrit de Français Langue Étrangère de Lund “Lund Written Corpus of French as a Foreign Language”). This corpus currently contains approximately 100,000 words (Ågren, 2005). The texts are narratives of varied length and levels. We elicited them by asking 85 Swedish high-school students and 22 young French to write stories evoked by a sequence of images. Figure 1 shows pictures corresponding to one of them: Le voyage en Italie “The journey to Italy”. The goal of the system being to analyze French as a foreign language, we used the texts of the French native speakers as control group.

The following narrative is an example from a be-
ginner learner:

Elles sont deux femmes. Elles sont a
italie au une vacanse. Mais L'Auto est
très petite. Elles va a Italie. Au l'hôtel elles demande une chambre. Un homme a
le clo. Le chambre est grande avec deux
tes. Il fait chaud. C'est noir. Cette
du femmes est a une restaurang. Dans
une bar cet deux hommes. Ils amour les
femmes. Ils parlons dans la bar. Ils ont
tres bien. Le homme et la femme particip-
ait a un sightseeing dans la Rome. Ils
achetons une robe. La robe est verte. La
femme et l'homme reste au un bange. Ils
c'est amour. La femme et l'homme est
au une ristorante. es hommes va avec les
femmes. L'auto est petite.

This text contains a certain number of typical
constructions for French as a foreign language:
parataxis, very simple word order, absence of ob-
ject pronouns, basic verb forms, agreement errors,
spelling mistakes. Research on the acquisition of
French as a foreign language has shown that these
constructions (and others) appear in a certain sys-
tematic fashion according to the proficiency level of
the learners. With Direkt Profil, we aim at detecting
automatically these structures and gathering them
so that they represent a grammatical learner profile.
This learner profile can ultimately be used to assess
learners' written production in French.

3 Direkt Profil and Previous Work

Direkt Profil is an analyzer of texts written in French
as a foreign language. It is based on the linguistic
constructions that are specific to developmental se-
quenences. We created an annotation scheme to mark
up these constructions and we used it to describe
them systematically and detect them automatically.
The analyzer parses the text of a learner, annotates
the constructions, and counts the number of occur-
rences of each phenomenon. The result is a text pro-
file based on these criteria and, possibly, an indica-
tion of the level of the text. A graphical user inter-
face (GUI) shows the results to the user and visual-
izes by different colors the detected structures. It is
important to stress that Direkt Profil is not a gram-
mar checker.

The majority of the tools in the field can be de-
scribed as writing assistants. They identify and
sometimes correct spelling mistakes and grammat-
ical errors. The line of programs leading to PLNLP
(Jensen et al., 1993) and NLPWin (Heidorn, 2000)
is one of the most notable achievements. The gram-
matical checker of PLNLP carries out a complete
parse. It uses binary phrase-structure rules and takes
into account some dependency relations. PLNLP is
targeted primarily, but not exclusively, to users writ-
ing in their mother tongue. It was created for En-
lish and then applied to other languages, including
French.

Other systems such as FreeText (Granger et al.,
2001) and Granska (Bigert et al., 2005) are rele-
vant to the CALL domain. FreeText is specifically
designed to teach language and adopts an interactive
approach. It uses phrase-structure rules for French.
In case of parsing failure, it uses relaxed constraints
to diagnose an error (agreement errors, for exam-
ple). Granska, unlike FreeText, carries out a par-
tial parsing. The authors justify this type of analysis
by a robustness, which they consider superior and
which makes it possible to accept more easily incor-
correct sentences.

4 An Analysis Based on Developmental
Sequences

The current systems differ with regard to the type
of analysis they carry out: complete or partial. The
complete analysis of sentences and the correction of
errors are difficult to apply to texts of learners with
(very) low linguistic level since the number of un-
known words and incorrect sentences are often ex-
tremely high.

We used a test corpus of 6,842 words to evalu-
ate their counts. In the texts produced by learners
at the lowest stage of development, Stage 1, nearly
100% of the sentences contained a grammatical er-
ror (98.9% were incorrect\(^1\)) and 24.7% of the words
were unknown.\(^2\) At this stage of development, any
complete analysis of the sentences seems very diffi-
cult to us. On the other hand, in the control group the

\(^1\)An “incorrect sentence” was defined as a sentence contain-
ing at least one spelling, syntactic, morphological, or semantic
error.

\(^2\)An “unknown word” is a token that does not appear in the
lexicon employed by the system (ABU CNAM, see below)
corresponding figures are 32.7% for incorrect sentences and 10.6% for unknown words. More importantly, this analysis shows that using a quantification of “unknown words” and “incorrect sentences” only is insufficient to define the linguistic level of learners’ texts. Learners at Stage 3 have in fact fewer incorrect sentences than learners from Stage 4 (70.5% vs. 80.2%). Moreover, the percentage of unknown words in the control group (the natives) is slightly higher than that of learners from the Stage 4 (10.6% vs. 10.4%). Thus, the simple count of errors is also insufficient to distinguish more advanced learners from natives. To identify properly and to define learners of various linguistic levels, we need more detailed analyses and more fine-grained measures. This is exactly the purpose of the developmental sequences and learner profiles implemented in Direkt Profil.

5 Developmental Sequences in French

Direkt Profil carries out an analysis of local phenomena related to a development in the acquisition of French. These phenomena are described under the form of developmental sequences. The sequences are the result of empirical observations stemming from large learner corpora of spoken language (Bartning and Schlyter, 2004). They show that certain grammatical constructions are acquired and can be produced in spontaneous spoken language in a fixed order. Clahsen and al. (1983) as well as Pienemann and Johnston, (1987) determined developmental sequences for German and spoken English. For spoken French, Schlyter (2003) and Bartning and Schlyter (2004) proposed 6 stages of development and developmental sequences covering more than 20 local phenomena. These morphosyntactic phenomena are described under the form of local structures inside the verbal or nominal domain. Table 1 shows a subset of these phenomena. It is a matter of current debate in field of SLA to what extent these developmental sequences are independent of the mother tongue.

The horizontal axis indicates the temporal development for a particular phenomenon: The developmental sequence. The vertical axis indicates the set of grammatical phenomena gathered in such way that they make up a “profile” or a stage of acquisition. To illustrate better how this works, we will compare the C (finite verb forms in finite contexts) and G (object pronouns) phenomena.
At Stage 1, the finite and infinitive forms coexist in finite contexts. As the main verb of the sentence, we find in the learners’ production je parle (transcription of /je parle/ analyzed as a “finite form”) as well as *je parler or *je parlé. The current estimation is that in Stage 1, there are between 50 and 75% of finite forms in finite contexts. At Stage 4, the percentage of finite forms has increased to 90–98%. For this morphological phenomenon, the developmental sequence describes a successive “morphologization”.

The G phenomenon concerns the developmental sequence of object pronouns. The first object pronouns are placed in a postverbal position according to the scheme Subject-Verb-Object (SVO), e.g. *je vois le/la/lui (instead of je le/la vois). At Stage 3, learners can produce phrases according to the SVO scheme (Pronoun-Auxiliary-Object-Verb): Je veux voir (correct) but also *j’ai vu (incorrect). At Stage 5, we observe je l’ai vu. For this syntactic phenomenon, the developmental sequence describes a change in the linear organization of the constituents.

6 Annotation

The concept of group, either noun group or verb group, correct or not, represents the essential grammatical support of our annotation. The majority of syntactic annotation standards for French takes such groups into account in one way or another. Gendner et al. (2004) is an example that reconciles a great number of annotations. These standards are however insufficient to mark up all the constructions in Table 1.

We defined a text annotation specific to Direkt Profil based on the inventory of the linguistic phenomena described by Bartning and Schlyter (2004) (Table 1). We represented these phenomena by decision trees whose final nodes correspond to a category of analysis.

The annotation uses the XML format and annotates the texts using 4 layers. Only the 3rd layer is really grammatical:

- The first layer corresponds to the segmentation of the text in words.
- The second layer annotates prefabricated expressions or sentences (e.g. je m’appelle).

These structures correspond to linguistic expressions learned “by heart” in a holistic fashion. It has been shown that they have a great importance in the first years of learning French.

- The third layer corresponds to a chunk annotation of the text, restricted to the phenomena to identify. This layer marks up simultaneously each word with its part-of-speech and the verb and noun groups to which they belong. The verb group incorporates subject clitic pronouns. The XML element span marks the groups and features an attribute to indicate their class in the table. The tag element annotates the words with attributes to indicate the lemma, the part-of-speech, and the grammatical features. The verb group in the sentence Ils parlons dans la bar extracted from the learner text above is annotated as:

  <span class="pl_t1_c5131"><tag pos="pro:nom:pl:p3:mas">Ils</tag>
  <tag pos="verb:imp:pl:pl1">parlons</tag></span> dans la bar. The class denoted pl_t1_c5131 corresponds to a “finite lexical verb, no agreement”.

- The fourth layer counts structures typical of an acquisition stage. It uses the counter XML element, <counter id="counter.2" counter_name="passe_compose" rule_id="participe_4b" value="1"/>.

7 Implementation

The running version of Direkt Profil is restricted to the analysis of the verb groups and clitic pronouns. For each category in Table 1, the program identifies the corresponding constructions in a text and counts them.

The analyzer uses manually written rules and a lexicon of inflected terms. The variety of the constructions contained in the corpus is large and in order not to multiply the number of rules, we chose a constraint reinforcement approach. Conceptually, the analyzer seeks classes of phrase structures in which all the features are removed. It gradually identifies the structures while varying the feature
<table>
<thead>
<tr>
<th>Ph.</th>
<th>Stages</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>% of sentences containing a verb (in a conversation)</td>
<td>20–40%</td>
<td>30–40%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>75%</td>
</tr>
<tr>
<td>B.</td>
<td>% of lexical verbs showing +/-finite opposition (types)</td>
<td>No opp.:</td>
<td>10–20%</td>
<td>About 50%</td>
<td>Most in op-</td>
<td>All in op-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>% of types in opposition</td>
<td>% in finite forms 1–3sg</td>
<td></td>
<td></td>
<td>position</td>
<td>position</td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>% of finite forms of lexical verbs in obligatory contexts (occurrences)</td>
<td>Finite forms 50%–75%</td>
<td>Finite forms 70–80%</td>
<td>Finite forms: 80–90%</td>
<td>Finite forms: 90–98%</td>
<td>Finite forms: 100%</td>
<td>+</td>
</tr>
<tr>
<td>D.</td>
<td>1st, 2nd, 3rd pers. sing. (copula/aux) est, a, va</td>
<td>No opp.</td>
<td>Opposition</td>
<td>Isolated errors *je va, *je a</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>1st pers. plural S-V agreement notre V-ons (occurrences)</td>
<td>–</td>
<td>70–80%</td>
<td>80–95%</td>
<td>Errors in complex constructions</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>E.</td>
<td>% of 1st pers. plural S-V agreement</td>
<td>–</td>
<td>–</td>
<td>Isolated cases of agreement</td>
<td>50% of cases with agreement</td>
<td>Some problems remain</td>
<td>+</td>
</tr>
<tr>
<td>F.</td>
<td>3rd pers. plural S-V agreement with viennent, veulent, prenent</td>
<td>–</td>
<td>–</td>
<td>Isolated cases of agreement</td>
<td>50% of cases with agreement</td>
<td>Some problems remain</td>
<td>+</td>
</tr>
<tr>
<td>G.</td>
<td>Object pronouns (placement)</td>
<td>–</td>
<td>SVO</td>
<td>S(v)oV</td>
<td>SovV appears</td>
<td>Productive</td>
<td>+ (y, en)</td>
</tr>
<tr>
<td>H.</td>
<td>% of gender agreement Article-Noun (occurrences)</td>
<td>55–75%</td>
<td>60–80%</td>
<td>65–85%</td>
<td>70–90%</td>
<td>75–95%</td>
<td>90–100%</td>
</tr>
</tbody>
</table>

Table 1: Developmental sequences adapted from Schlyter (2003); Bartning and Schlyter (2004).

Legend: – = no occurrences; + = acquired at a native-like level; aux = auxiliary; pers. = person; S-V = Subject-Verb
values. The recognition of the group boundaries is done by a set of closed-class words and heuristics inside the rules. It thus follows an old but robust strategy used in particular by Vergne (1999), *inter alia*, for French.

*Direkt Profil* applies a cascade of three sets of rules to produce the four annotation layers. The first unit segments the text in words. An intermediate unit identifies the prefabricated expressions. The third unit annotates simultaneously the parts-of-speech and the groups. Finally, the engine creates a group of results and connects them to a profile. It should be noted that the engine neither annotates all the words, nor all segments. It considers only those which are relevant for the determination of the stage. The engine applies the rules from left to right then from right to left to solve certain problems of agreement.

The rules represent partial structures and are divided into a condition part and an action part. The condition part contains the search parameters. It can be a lemma, a regular expression, or a class of inflection. The engine goes through the text and applies the rules using a decision tree. It tests the condition part to identify the sequences of contiguous words. Each rule produces a positive (“match”) or negative (“no match”) result. The rules are applied according to the result of the condition part and annotate the text, count the number of occurrences of the phenomenon, and connect to another rule. By traversing the nodes of the tree, the engine memorizes the rules it has passed as well as the results of the condition parts of these rules. When arriving at a final node, the engine applies the action parts of all the rules.

The engine finds the words in a dictionary of inflected terms. It does not correct the spelling mistakes except for the accents and certain stems. Learners frequently build erroneous past participles inferring a wrong generalization of stems. An example is the word *prendu* (taken) formed on the stem *prendre* and of the suffix *-u*.

We used a lexicon available from the Association des Bibliophiles Universel’s* web site (http://abu.cnam.fr/) that we corrected and transposed into XML. We also enriched it with verb stems.

8 Interface

*Direkt Profil* merges the annotation levels in a result object. This object represents the original text, the annotation, the trace of the rule application, and the counters. The result object, which can be saved, is then transformed by the program to be presented to the user. The display uses the XHTML 1.1 specifications which can be read by any Web browser. *Direkt Profil* has a client-server architecture where the server carries out the annotation of a text and the client collects the text with an input form and interacts with the user.

Figure 2 shows a screenshot of *Direkt Profil*’s GUI displaying the analysis of the learner text above. The interface indicates to the user by different colors all the structures that the analyzer detected.

9 Results and Evaluation

We evaluated *Direkt Profil* with a subset of the CEFLE corpus. We chose 20 texts randomly distributed on 4 learner stages. We also used 5 texts coming from the control group. In this version, we did not test the correction of the misspelled words: accent and stems. Table 2 shows some statistics on the size of the texts and Table 3 shows the results in the form of recall and precision.

The results show that *Direkt Profil* detects well the desired phenomena. It reveals also interesting differences according to the levels of the texts. The results show that *Direkt Profil* analyzes better the learner texts than the texts from the native French adolescents (control group). Without knowing exactly why, we note that it suggests that the adopted strategy, which aims at analyzing texts in French as a foreign language, seems promising.

10 Conclusion and Future Work

We presented a system carrying out a machine analysis of texts based on developmental sequences. The goal is to produce a learner profile. We built a parser and developed a set of rules to annotate the texts. *Direkt Profil* is integrated in a client-server architecture and has an interface allowing the interaction with the user.

The results show that it is possible to describe the vast majority of the local structures defined by the
Figure 2: The graphical user interface.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of analyzed texts</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Word count</td>
<td>740</td>
<td>1233</td>
<td>1571</td>
<td>1672</td>
<td>1626</td>
<td>6842</td>
</tr>
<tr>
<td>Sentence count</td>
<td>85</td>
<td>155</td>
<td>166</td>
<td>126</td>
<td>107</td>
<td>639</td>
</tr>
<tr>
<td>Average text length (in words)</td>
<td>148</td>
<td>247</td>
<td>314</td>
<td>334</td>
<td>325</td>
<td>274</td>
</tr>
<tr>
<td>Average length of sentences (in words)</td>
<td>8.7</td>
<td>7.9</td>
<td>9.5</td>
<td>13.3</td>
<td>15.2</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Table 2: Test corpus.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference structures</td>
<td>23</td>
<td>97</td>
<td>101</td>
<td>119</td>
<td>85</td>
<td>425</td>
</tr>
<tr>
<td>Detected structures</td>
<td>27</td>
<td>98</td>
<td>100</td>
<td>112</td>
<td>92</td>
<td>429</td>
</tr>
<tr>
<td>Correctly detected structures</td>
<td>15</td>
<td>81</td>
<td>89</td>
<td>96</td>
<td>73</td>
<td>354</td>
</tr>
<tr>
<td>Non detected structures</td>
<td>5</td>
<td>16</td>
<td>12</td>
<td>20</td>
<td>11</td>
<td>064</td>
</tr>
<tr>
<td>Overdetected structures</td>
<td>10</td>
<td>17</td>
<td>11</td>
<td>17</td>
<td>19</td>
<td>074</td>
</tr>
<tr>
<td>Recall</td>
<td>65%</td>
<td>84%</td>
<td>88%</td>
<td>81%</td>
<td>86%</td>
<td>83%</td>
</tr>
<tr>
<td>Precision</td>
<td>56%</td>
<td>83%</td>
<td>89%</td>
<td>86%</td>
<td>79%</td>
<td>83%</td>
</tr>
<tr>
<td>F-measure</td>
<td>0.6</td>
<td>0.83</td>
<td>0.89</td>
<td>0.83</td>
<td>0.82</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table 3: Results.
developmental sequences under the form of rules. Direkt Profil can then detect them and automatically analyze them. We can thus check the validity of the acquisition criteria.

In the future, we intend to test Direkt Profil in teaching contexts to analyze and specify, in an automatic way, the grammatical level of a learner. The program could be used by teachers to assess student texts as well as by the students themselves as a self-assessment and as a part of their learning process.

A preliminary version of Direkt Profil is available on line from this address http://www.rom.lu.se:8080/profil

References


