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# Building a computational lexicon of verbal syntactic constructions in French

Nuria Gala<sup>1</sup>

André Valli<sup>2</sup>

DELIC - Université de Provence

29 av. Robert Schuman, F-13100, Aix en Provence, France

e-mail : <sup>1</sup>nuria.gala@up.univ-aix.fr <sup>2</sup>andre.valli@up.univ-aix.fr

## Abstract

We describe a computational lexicon which encodes verbal syntactic constructions in French. The aim of the project is to encode into a standard formalism the valency lexicon for French initiated in the eighties by M. Salkoff and A. Valli and continued since then. The whole computational lexicon will include about six thousand verbal entries with a list of the arguments of each verb, the restrictions associated with the arguments and examples found in real corpora. Such a lexicon may be a useful resource for the linguistic community as well as for natural language processing applications.

## 1 Introduction

Lexical databases are considered indispensable in language studies and in natural language engineering. However, creating wide-coverage and accurate computational lexicons is labour-intensive and time-consuming. Furthermore, specialized lexicons, such as syntactic lexicons, require specific information which is sometimes omitted or outdated in the main existing dictionaries. For these reasons, this particular kind of resource is not generally available, especially for languages other than English.

There are few examples of such syntactic databases for French. One of them, PROTON (Eynde and Mertens, 2001), is a valency lexicon at the University of Leuven. This database lists the syntactic properties of the arguments of nearly four thousand verbs. All the information has been extracted from the *Petit Robert* dictionary. Another example is the one available at the ATILF in Nancy (Jackey, 2005) where subcategorization information is

being extracted from the dictionary *Trésor de la Langue Française informatisé*. The major drawback in these approaches is the use of a general dictionary as a main resource : the syntactic information obtained is rather limited.

Other approaches for creating syntactic databases extract subcategorization from textual corpora (Manning, 1993) (Briscoe and Carroll, 1997). However, the results obtained show that more filtering is needed for the selection of argument preferences.

This paper presents our ongoing project for the construction of a computational lexicon for French verbal complementation. Section 2 presents the linguistic aspects of the lexicon while section 3 gives details on the encoding of the various kinds of information within each verbal entry. In conclusion, section 4 presents a discussion of future improvements of the project.

## 2 Linguistic features of the lexicon

The computational syntactic lexicon we present here is based on a lexicographic approach adopted in the eighties (Valli, 1980) and continued since then (Salkoff and Valli, 2005). It can be considered hybrid in the sense that the building of the lexicon is based on two kinds of resources : primary resources (textual corpora) and secondary resources (French lexical databases). The linguistic information encoded in the lexicon consists of a list of all possible patterns for a given verbal entry together with a set of associated restrictions.

### 2.1 Resources

The first source of syntactic information is to be found in the lexicon-grammar tables of the laboratory LADL (university of Paris VII). These tables, created by M. Gross and his collaborators (Gross, 1975) (Salkoff et al., 1976), contain a detailed list of verbal complementation. Although the list is incomplete, it has

proven to be a valuable starting point for examining French verbs.

Another set of sources for extracting verbal constructions consist of the major French dictionaries, all of them available in computer-readable format : the TLFi (*Trésor de la Langue Française*), the PR (*Petit Robert*) and the GR (*Grand Robert*). Again, despite the precision of their entries, these resources turn out to be incomplete with regard to verbal arguments (e.g. many of the prepositional complements are lacking). Besides, the information is presented in terms of the semantic use of verbs, and this contributes to dissipate the grammatical information due to the polysemic nature of most verbs.

Finally, the lexicon is being completed by using information captured from the French pages in the Web. A number of experiences (i.e. (Volk, 2001), (Aït-Mokhtar and Gala, 2003)), have already proved the advantages of using the Web for NLP tasks such as prepositional attachment disambiguation. Indeed, the Web is a mine of language data of unprecedented richness, much better than other smaller or controlled data sources, despite the many criticisms about the quality of the data.

## 2.2 Organization of the linguistic knowledge

The robustness and accuracy of natural language systems strongly depend on a precise formalization of the linguistic knowledge. That is the reason why we have tried in this lexicon of verbal complementation to make use of two kinds of linguistic knowledge, one from the tables of the LADL, the other inspired from the string grammar of French (Salkoff, 1973) (Salkoff, 1979).

Thus the description of verbal entries in our lexicon is not a simple collection of information extracted from different sources. The argument slot in a verbal entry refers to a list of possible patterns with their associated restrictions. This list, which is described in the string grammar of French, offers an accurate grammatical description of all the possible verbal arguments of French.

All the patterns have been systematically verified and exemplified with the aid of the resources mentioned above (lexical databases, dictionaries, corpora).

Figure 1 illustrates the first five syntactic

patterns in the list :

```
N Pattern
0 0
1 SN
2 [SN//SA//D//Vpp]
3 D
4 J CV
5 P SN
(...)
```

FIG. 1 – Syntactic patterns (object structures).

The first construction is for intransitive verbs (zero argument as in "*Les routes convergent*"<sup>1</sup>). The second pattern concerns a noun phrase (i.e. "*Il justifie ses propos*"<sup>2</sup>). The third one describes objects of the verb "être" (to be) : "*Pierre est malade// lui-même//content//ici//à l'école//parti*"<sup>3</sup>. Pattern number three stands for an adverbial argument as in "*Pierre agit mal*"<sup>4</sup>. Pattern number four describes a finite verbal construction introduced by a linking conjunction or pronoun : "*Il comprend comment faire//lequel choisir*"<sup>5</sup>. The last example shows a widespread pattern presenting a noun phrase introduced by a preposition ("*Pierre parle à Marie*"<sup>6</sup>).

So far, about ninety different syntactic patterns have been described (cf. Appendix 1 for more examples).

The detailed information encoded in each verbal entry, which is particularly relevant for NLP systems, can be classified into two kinds : firstly, the type and the number of the valency arguments, and secondly, the general and/or particular restrictions associated with each argument.

### 2.2.1 Valency elements

The description of prepositional objects involves a delicate issue : it is necessary to differentiate verbal arguments from modifiers that

<sup>1</sup>The roads meet.

<sup>2</sup>He justifies his intentions.

<sup>3</sup>Pierre is sick//himself//glad//here//at school//gone.

<sup>4</sup>Pierre behaves badly.

<sup>5</sup>He understands how to do it//which one to choose.

<sup>6</sup>Pierre talks to Mary.

can occupy the same position. Thus, identifying arguments is less difficult when the sequence is required (*"Le Gouvernement compte sur un miracle"*<sup>7</sup>, *"Il faut s'attacher aux aspects principaux de cette constitution"*<sup>8</sup>): the sentence *"Le Gouvernement compte sur"* is incorrect and the verb *"s'attacher"* in *"Il faut s'attacher"* does not have the same meaning.

However, whenever the presence of the element is not required a classical problem of grammatical ambiguity arises. Different approaches ((Gross, 1975), (Eynde and Mertens, 2001), (Mel'cuk and Iordanskaya, 2005 to appear)) propose using pronominal indicators ("lui", "y", "en") to decide whether the pattern is an argument or not. These pronouns allow us to identify sequences such as P SN (a preposition followed by a noun phrase) as arguments whenever this is the case.

To give an example : in the construction *"Il parle de développement durable"*<sup>9</sup> the prepositional phrase *"de développement durable"* can be replaced by the pronoun "en" (*"Il en parle"*). This replacement gives evidence of the argument status of this prepositional phrase for the verb "parler" (*to speak*).

In other cases, distinguishing between arguments and modifiers gives rise to a theoretical problem that admits empirical solutions in the case of prepositional sequences : the distinction between object and modifier can only be considered in terms of different levels of dependency upon the verb.

Thus, we adopt the proposal in Salkoff's string grammar of French of an additional criterion for identifying the specific arguments of the verb : noun phrase objects may be subject to a number of selectional restrictions which turn out to be stronger for arguments than for modifiers.

To give an example, we consider argument of the verb "distinguer" (*to distinguish*) the pattern SN P SN for the following prepositions : "à" (*"on le distingue à une cicatrice au pied"*), "de" (*"on distingue le vin des autres boissons"*), "en" (*"on les distingue en deux classes"*), "par" (*"la France se distingue par ses mathématiciens"*), "pour" (*"le comité vient de le distinguer pour la découverte d'une*

*molécule"*), "d'avec" (*"il sait distinguer le vrai d'avec le faux"*), "entre" (*"saurais-tu distinguer entre les effets et les causes"*), "par rapport" (*"distinguer le harcèlement par rapport à d'autres problématiques"*).

All these examples (obtained from the GR and TLFi dictionaries, from the lexicon-grammar tables and from the Web) show that the class of nouns accepted after such prepositions is rather restricted.

However, prepositional phrases headed by the prepositions "dans" and "parmi" following the verb "distinguer" should be excluded as arguments because they do not imply particular restrictions for the noun (any class of nouns would be acceptable). The prepositional phrases in the sequence SN P SN headed by these prepositions are thus to be considered modifiers (and not arguments); as such, they are compatible with a large number of verbs.

### 2.2.2 Restrictions

We define a restriction as a particular information limiting either the subclasses of the categories appearing in a verbal construction, or the context in which that construction may appear. Two kinds of restrictions are to be distinguished depending on whether they concern the verb itself or the argument.

a) Some verbs accept an object only under certain conditions. This kind of restriction applies to pronominal and impersonal forms :

*"Pierre se choque de ce que Marie soit si peu morale"*

*\*"Pierre choque de ce que Marie soit si peu morale"*

*"Pierre semble malade"*

*"Il semble que Marie soit partie"*

*\*"Pierre semble que Marie soit partie"*

b) A pattern for an argument is only possible under particular conditions. For instance, the verb "devenir" (*to become*), even if it is semantically similar to the verb "être" (*to be*), does not accept the same kind of arguments :

*"Pierre est beau//un homme//à la rue//là-bas"*

*"Pierre devient beau//un homme//\*à la rue//\*là-bas"*

<sup>7</sup>The Government expects a miracle.

<sup>8</sup>It is necessary to concentrate on the principal aspects of this constitution.

<sup>9</sup>He talks about durable development.

Another example is that of verbs accepting the same syntactic construction but not the same kind of forms within the pattern. That is the case of "accepter" (*to accept*) and "traiter" (*to deal*) which accept the construction SN J SN but the nature of the linking element is different :

"Pierre accepte Paul comme//pour ami"  
 "Pierre traite Paul comme//d'//\*pour ami"

A similar example concerning the restrictions on the nature of the noun phrase is to be found in Appendix 2 showing various arguments for the verb "justifier" *to justify*. We see that frames number 9 and 10 present the same pattern (SN P[à//de//pour] Vinf) but frame number 9 selects a "non human" subject while there is no restriction for the subject in frame number 10.

### 3 Structure of verbal entries

The set of lexical data is encoded in XML-based format and is based on the guidelines proposed within the Lexical Markup Framework (ISO TC 37/SC 4). Each entry is represented by a *lexical entry node* containing a *form* and a *frameset*. A *form* encodes the lemma of a verb and may have other information about pronunciation, orthographical variants, etc. The *frameset* stands for the list of syntactic constructions associated with a form.

#### 3.1 Description of the frames

We define a *frame* as a given syntactic pattern of a lexical entry. Each frame is identified by a number within the verb as well as by a number corresponding to an object structure within the list shown in Figure 1. An object structure is thus a pattern representing the morphosyntactic components of the construction. The following is an example, SN P SN in "Il a justifié son aptitude physique par un certificat médical homologué"<sup>10</sup>.

In some cases, the pattern may give information about the internal syntactic functions for certain syntactic categories, for instance when a noun phrase is also the subject of the infinitive verb (SNsbj P Vinf SN) in "Il élève ses

<sup>10</sup>He has justified his physical aptitude by an approved medical certificate.

enfants à respecter autrui"<sup>11</sup>.

Each frame is composed of three elements, the first one referring to the verb itself, the second one containing the list of syntactic slots, the last one showing an example of the verb with the given pattern, taken from textual corpora.

Figure 2 gives a simplified example for one of the patterns of the verb "élever" (*to raise, erect*).

```
<LEXICALENTRY>
<FORM> élever </FORM>
<FRAMESET>
(...)
<FRAME> id="10" struct="5">
<SELF syntfeature="pron"/>
<LISTOFSLOTS>
<SLOT syntgroup="P" type="au-dessus de"/>
<SLOT syntgroup="SN"/>
</LISTOFSLOTS>
<EX> Le Tribunal Pénal International pour
le Rwanda doit s'élever au-dessus de la
politique. </EX>
</FRAME>
(...)
</FRAMESET>
</LEXICALENTRY>
```

FIG. 2 – A pattern of the verb "élever".

The element referring to the verb (*self*) encodes grammatical restrictions, for instance, a pronominal use as in the example above. The list of slots contain the elements present in the given syntactic construction.

Whenever special restrictions concerning the subject are to be indicated, a specific slot is provided; in all other cases, the slots concern only the valency elements appearing in object positions. Each slot encodes the information associated with a given element by means of feature values.

#### 3.2 Features encoded within the frames

Feature values are used to represent a particular syntactic behavior associated with a slot in the syntactic pattern. They generally encode positive restrictions, that is, information associated with a given slot. However, negative res-

<sup>11</sup>He teaches his children to respect others.

trictions are also possible, for instance when a verb does not accept a particular construction, i.e. a pronominalization :

```
syntfeature="pron" value="-"
```

We distinguish four kinds of restrictions, depending on the kind of information they vehiculate :

- structural
- functional
- lexical
- grammatical

### 3.2.1 Structural information

Structural information describes the morphosyntactic characteristics of the elements of the pattern. It can involve atomic categories and chunks. Atomic categories are prepositions (P), adverbs (D) or linking elements (J). The J category may include particular linking conjunctions and pronouns introducing a clause (*comme*, *comment*, *si*, *qui*, etc.).

As for chunks, we distinguish noun phrases (SN), adjective phrases (SA) and verbal constructions (CV, QueCV, CeQueCV). The latter can be special constructions introduced by "que" or "ce que" (*that*).

All information of this kind is encoded in a lexical entry with the *syntgroup* feature :

```
<SLOT syntgroup="SN">
```

### 3.2.2 Functional information

Functional information identifies the main dependency relations between the elements of a syntactic pattern. These relations are generally established between the arguments and the main verb, but they can also exist within two slots in the same pattern, one of them being a verb.

We distinguish three functional relations : subject (sbj), object (obj) and modifier (mod).

The slot for the subject of the main verb only appears when there is a specific restriction to be mentioned. Otherwise, the list of slots concern object positions (the *obj* value is not marked because it is a default value). However, the same slot can be the object of the main verb and the subject of a verb within the pattern. In this case, the function subject is marked on the slot taken by the noun phrase.

As shown in Figure 3 there is no ambiguity in marking both subjects since different slots are concerned. In the following example, the first subject, which concerns the main verb "justifier" (*to justify*) carries the lexical restriction "non human". The second one, which is part of the object slots, is required by the verbal construction and carries the lexical restriction of being "human").

```
<SLOT funct="sbj" selex="hum" value="-"/>
<SLOT syntgroup="prep" type="pour"/>
<SLOT syntgroup="SN" selex="hum" funct="sbj"/>
<SLOT syntgroup="prep" type="de"/>
<SLOT syntgroup="CV" mode="inf"/>
</LISTOFSLOTS>
<EX> Cela justifie pour le Gouvernement
d'arrêter les essais </EX>
```

FIG. 3 – Encoding subjects.

As for modifiers, the information appears whenever the modifying element has a particular restriction. To give an example, the verb "élever" (*to raise*) subcategorizing a single SN, accepts a prepositional phrase modifier, introduced by the preposition "de" (*of*) with the lexical restriction "measure" ("*La crue a élevé le niveau de cinquante centimètres*"<sup>12</sup>). It is important to encode this information within the pattern, even though the modifier is not, by definition, an argument of the verb. Figure 4 shows such a feature :

```
<SLOT syntgroup="SN"/>
<SLOT syntgroup="P"/>
<SLOT syntgroup="SN" funct="mod"
selex="measure"/>
```

FIG. 4 – Encoding information about modifiers.

### 3.2.3 Lexical information

Lexical information describes lexical selection constraints according to different noun classes. Eight classes have been retained so far : human, abstract, concret, collective, symbol, time, measure, proper name. As mentioned before, these features can also be marked with a

<sup>12</sup>The water level rose 50 cm

negative value, i.e. to describe "non human" nouns :

```
<SLOT syntgroup="SN" selex="human"
value="-">
<SLOT syntgroup="SN" selex="abstr" value="-">
```

### 3.2.4 Grammatical information

Grammatical information makes more precise the morphosyntactic category description. Besides number for nouns, this kind of information concerns principally the verb. There can be restrictions about particular constructions (pronominalizations, impersonal constructions, etc.) or information can be added about the so-called "TAM" features (tense, aspect, mode).

- tense : present, simple past, *passé composé*, *imparfait*, future.
- aspect : perfective, imperfective, instantaneous, static.
- mode : indicative and subjunctive for personal forms; infinitive, present participle and past participle for non personal forms.

We consider that the personal forms of verbs are by default in the indicative mode; the value **s** (subjunctive) is added<sup>13</sup> only when necessary.

Grammatical restrictions may refer to the main verb or to a verb within the pattern. Different examples of such features can be seen in Appendix 2 with some patterns of the lexical entry "justifier" (*to justify*), i.e. frames number 9, 10, 11, 14 and 15.

## 4 Discussion

The initial version of this lexicon of French verbal constructions was supposed to be a resource for the String Grammar for a French parser (Salkoff, 1979). Since a huge effort had already gone into gathering syntactic information, we have considered it useful to improve the already existing computational database by encoding it in a standard formalism. Entries from A to J are thus being reviewed while the work on entries L to Z has been nearly finished so far as the linguistic information is concerned<sup>14</sup>. The encoding of the verbal entries

<sup>13</sup>We use **sbj** for "subjects" and **s** for subjunctive mode, *c.f.* Appendix 1.

<sup>14</sup>We estimate that the three hundred most frequent verbal entries can be made publicly available by the

within the new formalism is thus the next task to set up.

In addition, we are considering the possibility of enriching the lexicon with other kinds of linguistic and statistical information.

As for semantics, it seems rather clear that there is a link between a particular syntactic pattern and a precise meaning of a verb. Therefore, it should be possible to associate a syntactic frame with at least one sense that can be found in a dictionary. To give an example, the *Petit Robert* provides the following meanings for the verb "justifier" :

1. "rendre juste"
2. "couvrir", "décharger", "disculper", "innocenter"
3. "rendre légitime"
4. "expliquer", "motiver"
5. "vérifier"
6. "démontrer", "prouver"
7. "mettre à la longueur requise"

It can be verified that : the first pattern (*c.f.* Appendix 2) corresponds to sense number 4 ("*Justifier une opinion*"); pattern number 9 corresponds to sense number 3 ("*Cela justifie pour le Gouvernement d'arrêter les essais*"); pattern number 16 corresponds to sense number 6 ("*Justifier auprès de son employeur*"); etc.

Furthermore, multilingual information may also be taken up in the project. Indeed, a PhD work is currently in progress on comparing the syntactic frames of about one thousand French and Italian verbs. The aim of such a work, inspired by the Contragram project<sup>15</sup>, is to bring together Italian verb senses with their equivalent French verb senses by comparing their syntactic patterns.

Finally, we plan to add additional information about the frequency of the different patterns in unrestricted corpora. Using the Web as a corpus, we plan to gather statistical information about the real use of a specific syntactic pattern with a given verb. This kind of information has already been able to refine the results of the disambiguation of prepositional phrase attachment (Aït-Mokhtar and Gala,

end of 2006.

<sup>15</sup><http://bank.ugent.be/contragram/cvvd.htm>

2003) and may be useful for other linguistic and NLP tasks.

## 5 Conclusions

This paper reports on an ongoing project which aims to encode a lexicon of French verbal syntactic constructions. Each verbal entry is structured as a list of frames describing the set of possible arguments with their different restrictions and corpus-based examples (found in lexicon-grammar tables, dictionaries and large-scale corpora). The encoding formalism is based on a common standard framework in order to ensure the interchangeability of the data. At this state, and obviously when completed with other linguistic and statistical information, such a lexicon may be of interest for different NLP applications. In particular, for the Papillon project, this kind of information combined with lexical functions may be valuable both for human usage and automated enhancement of verb representation in the lexical database.

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## Appendix 1. List of object constructions.

The list has been simplified : only the syntactic pattern and its identifier are shown.

- 0) 0
- 1) SN
- 2) [SN//SA//D//Vpp]
- 3) D
- 4) J CV
- 5) P SN
- 6) SNSbj Vant
- 7) SNSbj Jcomme Vant
- 8) Vinf
- 9) Pde Vinf
- 10) Pà Vinf
- 11) QueCV
- 12) QueCVs
- 13) SA
- 14) SNSbj Pde Vinf
- 15) SNSbj P[à//pour//jusqu’à] Vinf
- 16) SN P[à//de//pour] Vinf
- 17) P[à//pour] SNSbj Pde Vinf
- 18) P SN P Vinf
- 19) P SNSbj P Vinf



20) P[à//pour//loc] SN Vinf  
 21) Pde SNsbj Pde Vinf  
 22) SN QueCV  
 23) SN QueCVs  
 24) P SN SN  
 25) SN P SN  
 26) SN P[à//de//en] CeQueCV  
 27) P SN QueCV  
 28) P SN QueCVs  
 29) P SN P SN  
 30) SN P CeQueCVs  
 31) P SN P CeQueCV  
 32) P SN P CeQueCVs  
 33) P[à//de] CeQueCVs  
 34) P[à//de] CeQueCV  
 37) [J[comme//P[de//en//pour]] SN  
 39) SNsbj J[comme//pour] [SN//SA]  
 40) J[comme//pour] [SN//SA] SNsbj  
 (...)

## Appendix 2. Verbal entry for "justifier".

The entry has been shortened : seven patterns are shown instead of seventeen.

```
<LEXICALENTRY>
<FORM> justifier </FORM>
<FRAMESET>
<FRAME id="1" struct="1">
<LISTOFSLOTS>
<SLOT syntgroup="SN" selex="abstr"/>
</LISTOFSLOTS>
<EX> Justifier la conduite de quelqu'un </EX>
</FRAME> (...)
<FRAME id="9" struct="16">
<LISTOFSLOTS>
<SLOT funct="sbj" selex="hum" value="-"/>
<SLOT syntgroup="SN" selex="hum" funct="sbj"/>
<SLOT syntgroup="prep" type="à"/>
<SLOT syntgroup="CV" mode="inf"/>
</LISTOFSLOTS>
<EX> La situation justifie le Gouvernement à
changer de politique. </EX>
</FRAME>
<FRAME id="10" struct="16">
<LISTOFSLOTS>
<SLOT syntgroup="SN" selex="hum" funct="sbj"/>
<SLOT syntgroup="prep" type="de"/>
<SLOT syntgroup="CV" mode="inf"
aspect="perf"/>
</LISTOFSLOTS>
<EX> Justifier d'avoir cotisé régulièrement à
```

```
la CNSS </EX>
</FRAME>
<FRAME id="11" struct="33">
<SELF syntfeature="impers"/>
<LISTOFSLOTS>
<SLOT syntgroup="prep" type="de"/>
<SLOT syntgroup="cequephrase" mode="subj"/>
</LISTOFSLOTS>
<EX> Il faut justifier de ce que la marque
vous appartienne ... </EX>
</FRAME> (...)
<FRAME id="14" struct="9">
<LISTOFSLOTS>
<SLOT syntgroup="prep" type="de"/>
<SLOT syntgroup="CV" mode="inf"/>
</LISTOFSLOTS>
<EX> Peut-on justifier de ne pas agir au nom
de l'entreprise? </EX>
<EX> Est-il justifié de prévoir un
financement? </EX>
</FRAME>
<FRAME id="15" struct="20">
<LISTOFSLOTS>
<SLOT funct="sbj" selex="hum"/>
<SLOT syntgroup="prep" type="auprès de"/>
<SLOT syntgroup="SN" selex="hum"/>
<SLOT syntgroup="CV" aspect="perf"/>
</LISTOFSLOTS>
<EX> Il doit justifier auprès de son employeur
avoir effectué un stage d'au moins deux
semestres </EX>
</FRAME>
<FRAME id="16" struct="27">
<LISTOFSLOTS>
<SLOT funct="sbj" selex="hum"/>
<SLOT syntgroup="prep" type="auprès de"/>
<SLOT syntgroup="SN" selex="hum"/>
<SLOT syntgroup="quephrase"/>
</LISTOFSLOTS>
<EX> Justifier auprès de leurs interlocuteurs
qu'ils sont satisfaits </EX>
</FRAME>
</FRAMESET>
</LEXICALENTRY>
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