

Semantic Roles in Multilingual Terminological Descriptions: Application to French and Korean Contexts

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Abstract

This article presents a project that aims at enriching a domain specific lexical database with a module in which contexts are annotated. The lexical database which contains French terms that belong to the domains of computing and the Internet is currently being extended to other languages, namely English and Korean. The annotation model (based on that used in FrameNet, Ruppenhofer et al. 2002) first takes into account the semantic roles of participants (e.g., AGENT, PATIENT, INSTRUMENT) which are assumed to be language-independent. The second part of the annotation describes the syntactic behavior of participants and thus also takes into account linguistic specificities. In this part, phrases are annotated according to their function and their type. We also encode prepositions used in French and cases and particles used in Korean. This annotation allows us to inventory syntactic information along with semantic roles. As a result, we can verify that the annotation model in French also applies to other different languages, even very different ones, such as Korean.

1. Introduction

A specialized lexical database – which contains terms related to the fields of computing and the Internet – is currently being extended to other languages, namely English and Korean (a Spanish version is also planned in the near future). The original database, called *DiCoInfo*. *Dictionnaire fondamental de l'informatique et de l'internet* (the French version is available at <http://olst.ling.umontreal.ca/dicoinfo/>) provides detailed information on the lexico-semantic properties of terms and contains five main sections: headword (along with grammatical information), actantial (i.e., argument) structure with lists of linguistically realized terms, lexico-semantically related terms for each headword, contexts and definitions. The English and Korean counterparts also contain rich linguistic information, but definitions have not been included yet.

The extension of our descriptions to other languages raises the question of ensuring that similarities between senses are represented using the same apparatus while taking into account linguistic specificities. To this end, we developed a method for annotating contexts in which terms appear that describes the semantic roles of participants, but also their syntactic behavior. We also designed an XML structure that is flexible enough to

accommodate annotations in different languages. We are currently testing this method and the XML structure on French and Korean, two typologically different languages. This paper presents our method and its relevance in multilingual terminology descriptions that aim at describing the linguistic properties of terms.

This paper is structured as follows. Section 2 describes the general hypotheses underlying the project. Section 3 explains the basic principles on which our annotation model relies and the XML structure used for carrying out the annotations. The methodology devised to annotate French and Korean contexts is detailed in Section 4. Finally, Section 5 makes observations on differences between French and Korean that were encountered during the annotation process and some adaptations that were made to the XML structure.

2. Why semantic roles in a specialized lexical database?

Semantic roles are designed to capture the semantic relationships between a predicate and its actants (i.e., arguments). The specification of actants in terms of roles is an efficient and elegant way to use the same labels to refer to similar relationships shared by an actant and a

predicate as shown in (1) and (2) (cf. Baker et al. 1998; Fillmore 1968; FrameNet 2008; VerbNet 2008).

- (1a) PATIENT (e.g., *a computer, a server*) starts
- (1b) AGENT (e.g., *a user*) starts PATIENT (e.g., *a computer, a server*)
- (2a) INSTRUMENT (*a printer*) prints PATIENT (e.g., *a file, data*)
- (2b) AGENT (e.g., *a user*) prints PATIENT (e.g., *a file, data*) with INSTRUMENT (*a printer*)
- (2c) printing of PATIENT (e.g., *a file, data*) with INSTRUMENT (*a printer*) by AGENT (e.g., *a user*)
- (2d) printer used by AGENT (e.g., *a user*) to act on PATIENT (e.g., *a file, data*)

Semantic roles also appear to be an efficient apparatus to capture semantic similarities between languages regardless of surface phenomena which can set them apart.¹ For instance, *print*, 인쇄하다 and *imprimer* (3) have the same actantial structures, even if syntactic phenomena can differ.

- (3a) print 1b
AGENT prints PATIENT with INSTRUMENT
- (3b) 인쇄하다 1b
AGENT-이 PATIENT-을 INSTRUMENT-로
인쇄하다
- (3c) imprimer 1b
AGENT imprime PATIENT avec INSTRUMENT

As can be seen in example (3), terms in all three languages have the same number of actants and these all have the same semantic roles. Terms differ here according to the preposition used as far as English and French are concerned (*with* and *avec*). In Korean, word order changes drastically and a case particle is added to the linguistic units that express a given actant: -이 for the AGENT, -을 for the PATIENT, and finally -로 for the INSTRUMENT.

3. A model for describing semantic roles

We developed a method (based on that used in FrameNet, Ruppenhofer et al. 2006) which consists in annotating the linguistic realizations of terms together with their participants (these include, but are not limited to, actants).² This annotation is performed on a number

of sentences extracted from corpora. In addition to giving information on linguistic realizations of terms and their environment in real contexts, these annotations provide empirical evidence that support the terminologists' intuitions while writing entries in the lexical database.

The annotation model first describes the semantic roles of participants which are assumed to be language-independent. The second part of the annotation takes into account linguistic specificities and describes the syntactic behavior of participants. In this part, phrases and clauses are annotated according to their function and their type. We also encode all relevant information related to syntactic realizations (i.e., prepositions used in French and cases and particles used in Korean).

3.1 XML annotation structure

The annotation is performed in an XML structure in which language independent abstract categories have been defined in order to accommodate the specificities of different languages. The annotation model has been designed with a view to serve the specific purposes of this project. Thus, no effort has been devoted up to now to adhere to annotations standards used to encode terminological data. The aim in our project is to annotate a significant number of contexts that will then be used to train a machine learning algorithm.

XML tags allow us to integrate the semantic role annotations within the contexts themselves. Appropriate tools can then be used to display them in different forms such as HTML pages (an example of annotated French contexts and the HTML page generated from these is reproduced in Appendix A). But the most important advantage of using XML is the fact that the annotations of the contexts can be validated against a schema (a grammar-like formalism illustrated in Appendix B) that defines the allowable tags and their embedding at each step of annotations.

The most important components of our annotation for the purpose of this article is the "participant" with a "type" ("Act" or "Circ") and a "role" (e.g., "Agent", "Patient", "Instrument", "Manner" ...).³ A "participant" contains a "syntactic function" with its name ("Subject", "Object", "Complement", "Modifier" ...) and – for languages in which this attribute applies – case ("Agentive", "Accusative", "Genitive" ...). A "syntactic function" contains more specific linguistic information such as "syntactic type" that will be presented further in the paper.

With these definitions, a schema aware XML Editor such as oXygen or XMLSpy) can be used to drive the

¹ Interestingly, FrameNet is also being extended to other non-Indo-European languages; e.g., Japanese (Kyoko et al. 2004; 2006) and Chinese (You et al. 2007).

² In addition to the several projects using the FrameNet framework to annotate lexical units in different languages, some extensions have been or are being developed to apply FrameNet-like descriptions to specialized languages, namely the Kicktionary

(<http://www.kicktionary.de/>; Schmidt, forthcoming) and BioFrameNet (Dolbey et al. 2006).

³ For the purpose of this article, the names of tags and attributes have been translated. They are given in French in the original version of the schema.

annotations in real-time showing at each step a menu of allowable choices at a certain point.

4. Methodology

The annotation of contexts itself is performed by terminologists and consists in four steps: 1) selection of terms; 2) definition of relevant semantic roles corresponding to realizations in contexts; 3) description of syntactic information (function and type); 4) use of the annotation model for contexts in different languages (and potentially adaptation to the specificities of these languages). The first three steps are described in the following subsections. The linguistic specificities related to French and Korean are discussed in Section 5.

4.1 Selection of terms

The annotation is carried out for predicative terms, in other words, terms having at least one semantic actant and a corresponding surface realization. Considering that verbs are the main predicates and that participants for this part of speech are most likely to be linguistically realized, we started with verbal terms. For each term, we annotate up to 20 contexts extracted from the corpora used at all stages of the work.

4.2 Definition of semantic roles

In its current state, our annotations already use around 15 semantics roles for actants. Among these, there are typical roles, such as AGENT, PATIENT, INSTRUMENT, DESTINATION.⁴

Figure 1 shows the application of our grammar to a sentence containing the verb *print*, namely *You can print the HowStuffWorks Big List of Computer Memory Terms*. The portion of the schema concerned with this example appears between lines 21 and 30 in Appendix B.

```
<participant type="Act" role="Agent">
... You ...
</participant>
can
<lexie-att>print</lexie-att>
<participant type="Act" role="Patient">
... the HowStuffWorks Big List of Computer Memory Terms
...
</participant>
```

Figure 1: XML annotation of arguments

We also consider circumstants⁵ in our annotations, and need a much larger set of semantic roles. Also, new roles must be defined, such as MANNER, PURPOSE, TIME. In this case, the type attribute will contain the value "Circ". Again, the portion of the schema

⁴ Note that some roles used in our database differ from frame elements in FrameNet (2008). We try to define very general roles that can apply to long lists of terms and not only to units that appear in a specific frame.

⁵ In FrameNet, these are called *non-core frame elements*.

concerned with this example appears between lines 21 and 30 in Appendix B.

4.3 Syntactic function

All phrases and clauses linked to each predicative unit are first analyzed in terms of their syntactic function (i.e., subject, object, complement, modifier, etc.). Figure 2 shows how syntactic functions are encoded in our sample sentence containing the verb *print*. The portion of the schema that corresponds to information appears between lines 40 and 44 in Appendix B.

```
<participant ...> ...
  <syntactic-function name="Subject">
... You ... </syntactic-function>
</participant>
can
<lexie-att>print</lexie-att>
<participant ...>
  <syntactic-function name="Object">
... the HowStuffWorks Big List of Computer Memory
Terms ...
  </syntactic-function>
</participant>
```

Figure 2: Annotation of syntactic functions

4.3 Syntactic types

Then, phrases and clauses are encoded according to their type (noun phrase, prepositional phrase, clause, etc.).

Figure 3 shows the model used for annotating syntactic types and its application to our sample sentence. The portion of the schema concerned with this example appears between lines 45 and 50 in Appendix B.

```
<participant ...> ...
  <syntactic-type name="NP">
... You ...
  </syntactic-type>
</participant>
can
<lexie-att>print</lexie-att>
<participant ...> ...
  <syntactic-type name="NP">
... the HowStuffWorks Big List of Computer Memory
Terms
... </syntactic-type >
</participant>
```

Figure 3: Annotation of syntactic types

5. Adaptation of the annotation model to different languages

The same annotation method and XML structure are applied to predicative units in different languages, French and Korean.

Lexical units that correspond to terms are chosen in both languages according to the same methodology. A list a specific units is produced using the TermoStat (Drouin 2003) term extractor and then validated by

terminologists applying four different lexico-semantic criteria (Bae & L'Homme 2006). The term extractor produces valid terms that belong to the following parts of speech: noun, verb, adjective, and adverb. As was said above, in this project we first focus on verbal terms.

Since lists of terms are validated independently in each language, we do not necessarily annotate equivalent verbs. Examples of French verbs are: *configurer* (Engl. configure), *accéder* (Engl. access), *partager* (Engl. share), *partitionner* (Engl. partition), *télécharger* (Engl. download). Examples of Korean verbs are: 공격하다 (Engl. attack), 공유하다 (Engl. share), 검색하다 (Engl. search).

However, French and Korean belong to completely different language families: the first is an Indo-European language and the second is an Altaic language. As an agglutinative language, Korean nouns accompany particles and verbs endings. In Korean, particles express cases and this allows words to be ordered freely in sentences, as compared with French or English. This section discusses some cases where differences were observed between the two languages and how our annotations were carried out in accordance with these.

5.1 Syntactic realizations of predicative terms and their participants

Although predicative terms have the same actantial structure in French and Korean, these can behave very differently when syntax is considered.

We will illustrate this with an example. The French verb *partager* and its Korean equivalent 공유하다 (Eng. share) have the same actantial structure (their participants are labelled as AGENT and PATIENT). However, in French, *partager* is transitive; the PATIENT role is expressed in the form of object noun phrases; AGENTS (A and B) can be expressed in different syntactic structures, as shown in (4a). In Korean, 공유하다 is also transitive; the PATIENT is expressed in the form of object noun phrases; AGENTS can be expressed in three different syntactic structures as shown in (4b).

(4a) ... *partager les ressources* (PATIENT) *entre plusieurs utilisateurs* (AGENTS)

Un ordinateur (AGENT-A) *relié à une imprimante* (PATIENT) *pourra donc éventuellement la* (PATIENT) *partager.*

De nombreux professeurs (AGENTS) *s'en servent pour partager entre eux* (AGENTS) *des informations* (PATIENT), *des documents* (PATIENT), *les sujets donnés à leurs élèves respectifs* (PATIENT), *proposer des séquences de travaux pratiques, etc.*

(4b) 수십 개의 서비스가 (AGENTS) 하나의 인증 시스템을 (PATIENT) 공유하다.

메인 사이트와 (AGENT-A) 서버 사이트가 (AGENT-B) 인터페이스를 (PATIENT) 공유한다.

인터넷 연결 공유 서비스는 (AGENT) 2000 서버를 라우터로 사용하여 인터넷을 (PATIENT) 공유하고.

5.2 Word order

In French, syntactic roles such as subject and object are decided by the order of phrases. In contrast, in Korean the subject can be positioned anywhere in the sentence. It is sufficient to find the nominal phrase accompanied with a subject particle, but the verbal phrase is always positioned at the end of sentence.

Hence, our annotation structure needs to be flexible enough to take into account the different ordering of words in sentences. In Figure 4, the nominal phrase 시스템 (Engl. system) is an object and 공격하다 (Engl. attack) is a verbal headword. We can annotate the phrases according to their order in the sentence.

```
<participant type="Act" role="Destination">
<syntactic-function name="Object" case="Accusative">
  <syntactic-type name="NP" particle="을">
    <realization > 시스템 </realization>
    을
  </syntactic-type>
</syntactic-function>
</participant>
<lexie-att lemma="공격하다">공격하다가</lexie-att>
<lexie-att lemma="공격하다">공격하다가</lexie-att>다가
```

Figure 4: Position of the headword in the annotation

5.3 Syntactic function in Korean: annotation of cases

In Korean, we also encode case information as an attribute of the syntactic function tag as shown in Figure 4. In Figure 5, the nominal phrase plays subject role and the corresponding case is agentive. For the case feature, we can mark the realized value using case particles (lines 40 to 44 in Appendix B).

```
<syntactic-function name="Subject" case="Agentive"> ...
</syntactic-function>
```

Figure 5: Case information in a syntactic function tag

5.4 Syntactic types

In Korean, adjectival phrases behave like verbal phrases, and prepositional phrases do not exist. We can thus find noun phrases, adverbial phrases⁶ and clauses in our annotations. In the tags, we describe two features: the type of the phrase and the particle that expresses the case. Figure 6 shows how we encode the information (line 48, Appendix B).

```
<syntactic-type name="NP" particle="가"> ...
</syntactic-type>
```

Figure 6: Annotation of phrase type (SN)

⁶ According to the particle classification of Chang (1996:56-61): “particles that mark oblique objects are called adverbial particles, for they function as adverbs, indicating location, direction, goal, source, and the like. (...) The combination of a noun and an adverbial particle forms an adverb phrase.”

5.5 Prepositions in French

In French, when propositional phrases are used, a new attribute is added, namely *preposition*, and we indicate the preposition that appears in the context (e.g., *à, pour, de*). Figure 7 show how this information is taken into account in the annotations (line 47, Appendix B).

```
<lexie-att lemme="appuyer">appuie</lexie-att>
<participant type="Act" role="Patient">
  <fonction-syntaxique nom="Complement">
    <groupe-syntaxique nom="SP" preposition="sur">sur
      <realisation>{Ctrl}-C</realisation>
    </groupe-syntaxique>
  </fonction-syntaxique>
</participant>
```

Figure 7: Adding an attribute for prepositions in French

5.6 List of cases and particles in Korean

While the syntactic function of phrases is chiefly reflected by their order in sentences in French, particles and cases indicate their syntactic function in Korean. Since Korean particles are very rich and developed, the list can be very long. However, in our annotations, particles are relatively limited because the contexts of verbal term entries are extracted from domain specific texts. The main cases and their corresponding particles found in terminological contexts are listed below.

- Agentive case: 이/가 (Rom. -i/-ga)
- Accusative case: 을/를 (Rom. -eul/-reul)
- Dative case: 에/에게 (Rom. -e/-ege)
- Locative case: 에/에서 (Rom. -e/-eseo)
- Allative case: 로/으로 (Rom. -ro/-euro)
- Instrumental case: 로/으로/으로써 (Rom. -ro/-euro/-eurosseo)

We added an attribute particle to our schema to account for this phenomenon (line 48, Appendix B).

Particles such as *은, 는, 도, 만, 조차, 까지* are also used in contexts, but these are discourse function particles. Their behavior is different from other particles; they can be added to any other particle, even to verbs (*공격하기도, 접속하기까지*, etc.). Their function is to mark comparison, contrast, focus, limitation, etc.

5.7 Enumeration of terms instantiating an actant

In sentences, actants can be expressed by several terms. The enumerated terms for one actant are annotated by repeating the participant tag.

- (5) 두 대의 컴퓨터가 하나의 모니터 및 마우스와 스피커까지 공유할 수 있다 (Engl. Two computers can share a monitor, a mouse, and even a speaker.)

In sentence (5), we can see that three terms *모니터* (Engl. monitor), *마우스* (Engl. mouse), *스피커* (Engl. speaker) instantiate the PATIENT role. However, in such

as enumeration in Korean, only the last term will carry a particle indicating the accusative case. Since we list participants in enumerations separately, our annotation will mention the particle for each different participant.

In addition, terms in example (5) are used with comitative case particles (which in this example indicate coordination). If comitative cases are seen in enumerations, we do not annotate them.

5.8 Relationships between elements of a phrase

In Korean specialized texts, the chain <noun + generic case particle + noun> is often found. It corresponds to the French pattern <noun + de + noun>.

- (6a) 네트워크 설정 (Engl. configuration network)

- (6b) 시스템 지원 (Engl. system configuration)

In noun phrases such as those in (6), modifiers carry particles expressing genitive cases. These are not taken into account when annotating verbs, since only heads of syntactic groups are analyzed. However, they would be taken into account in the annotation of nouns.

6. Conclusion and future work

As far as semantic roles are concerned, it appears that our annotation model, previously designed for French contexts, can be extended to Korean. Our work on samples, i.e. on verbal headwords *공격하다* (Engl. attack), *공유하다* (Engl. share), *개발하다* (Engl. develop), *검색하다* (Engl. search), *구현하다* (Engl. implement), *나누다* (Engl. partition), *변환하다* (Engl. convert), *삭제하다* (Engl. delete), enabled us to verify that the model can be applied to Korean. Considering that these two languages are very different, we are led to believe that the original semantic annotation model can be used for other languages.

Of course, some adaptations are required to take into account the syntactic characteristics of each language. For instance, the preposition tag is no longer necessary in Korean; on the other hand, we added two features to take into account particles and cases

Regarding these latter specificities, it would be interesting to list specific syntactic phenomena linked to the expression of semantic roles.

In Korean annotations, we could inventory which semantic roles accompany which cases and particles, and confirm the constraints of particle usage in domain-specific texts. Compared with general texts in which style is important, domain-specific texts use a restricted set of particles. However, since this work is only at an early stage, an optimized list of semantic roles and an inventory of Korean cases for each actant and the semantically annotated contexts will be developed continuously.

Similarly, the annotation of French contexts will enable us to list syntactic functions, types and

prepositions that can be linked to specific semantic roles. While being aware that functions, types and prepositions can be ambiguous (i.e., correspond to more than one semantic role), these lists could be useful to recognize roles in French sentences.

Hence, the relationship between the syntactic and the semantic structures will be investigated further. For instance, in Korean, a particle can be embodied in several cases in various contexts, and a case can present several semantic actants. For example, **로** is a particle for marking the indirect complement and that represents the Directional case. In addition, this case can represent the semantic roles corresponding the DESTINATION or DESTINATAIRE. However, this particle can be used to express very different cases: instrumental, transformative, directional, etc. from one contact to another. In addition, these cases should be subcategorized (Cho & Kim 1995).

Instrumental :

도구/수단/재료 Instrument/Means/Material

Transformative:

변성/분할/선정 Change/Division/Selection

Directional:

경로/방향/지향점 Path/Direction/Destination

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Appendix A: A sample of French annotated contexts and the HTML interface to validate them

```

<vocable identificateur="configurer">
  <lexie numero-acceptation="1">
    <contexte source="CODERREUR" statut="1" annoteur="SK MCLH" mise-a-jour="2008-03-06"> [25 lines]

    <contexte source="BIOSRV" statut="1" annoteur="SK" mise-a-jour="2008-02-23"> [25 lines]

    <contexte source="CEVEIL" statut="1" annoteur="SK" mise-a-jour="2008-02-23">
      <contexte-texte>Ainsi, lorsque l'usager configurerait son nouveau micro-ordinateur, il indiquerait quels sont les paramètres de sa localisation physique
      et de sa culture.</contexte-texte>
      Ainsi, lorsque
      <participant type="Act" role="Agent">
        <fonction-syntaxique nom="Sujet">
          <groupe-syntaxique nom="SN"> l'
            <realisation>usager</realisation>
          </groupe-syntaxique>
        </fonction-syntaxique>
      </participant>
      <lexie-att lemme="configurer">configurerait</lexie-att>
      <participant type="Act" role="Patient">
        <fonction-syntaxique nom="Objet">
          <groupe-syntaxique nom="SN">son nouveau
            <realisation>micro-ordinateur</realisation>
          </groupe-syntaxique>
        </fonction-syntaxique>
      </participant>, il indiquerait quels sont les paramètres de sa localisation physique et de sa culture.
    </contexte>

    <contexte source="CODERREUR" statut="1" annoteur="SK" mise-a-jour="2008-02-23"> [11 lines]
  </lexie>
</vocable>

```

CONFIGURER 1

Si **vous** voulez installer ou **CONFIGURER un logiciel sur le serveur**, contactez votre administrateur réseau. [CODERREUR 1 SK MCLH 2008-03-06]

En **CONFIGURANT correctement la mémoire cache**, **on** peut améliorer considérablement les performances de l'ordinateur. [BIOSRV 1 SK 2008-02-23]

Ainsi, lorsque **l'usager CONFIGURERAIT son nouveau micro-ordinateur**, il indiquerait quels sont les paramètres de sa localisation physique et de sa culture. [CEVEIL 1 SK 2008-02-23]

Pour **CONFIGURER** ou supprimer **la version existante de ce produit** utilisez Ajout Suppression de programmes depuis le Panneau de configuration. [CODERREUR 1 SK 2008-02-23]

CONFIGURER 1		
Actants		
Agent	Sujet (SN) (2) Lien indirect (SN) (1)	on usager vous
Patient	Objet (SN) (4)	logiciel micro-ordinateur mémoire cache version
Autres		
Lieu	Complement (SP -sur) (1)	serveur
Manière	Modificateur (SA _{dv}) (1)	correctement

Appendix B: Schema used for the annotations (The Schema uses the RelaxNG compact notation).

```
1  start = element vocables{element-vocable*}
2
3  element-vocable = element vocable {
4    attribute identifier {text},
5    element-lexie*
6  }
7  element-lexie = element lexie {
8    attribute sense-number {text},
9    element-context*
10 }
11 element-context = element context {
12   attribute source {text},
13   attribute state {xsd:nonNegativeInteger},
14   attribute annotator {list{TypeAnnotator*}},
15   attribute update {xsd:date}?,
16   element-context-text,
17   mixed {(element-lexie-att | element-participant | element-antecedent)*}
18 }
19 element-context-text = element context-text {text}
20
21 element-lexie-att = element lexie-att {
22   attribute auxiliary{Auxiliary}?,
23   attribute lemma {text}?,
24   text
25 }
26 element-participant = element participant {
27   attribute type {TypeParticipant},
28   attribute role {RoleParticipant},
29   element-syntactic-function
30 }
31 element-antecedent = element antecedent {
32   attribute xml:id {xsd:ID},
33   mixed {element-value-antecedent*},
34   text
35 }
36 element-value-antecedent = element value-antecedent{
37   attribute lemma{text}?,
38   text
39 }
40 element-syntactic-function = element syntactic-function {
41   attribute name {NameSyntacticFunction},
42   attribute case {CaseSyntacticFunction}?,
43   element-syntactic-type
44 }
45 element- syntactic-type = element syntactic-type {
46   attribute nom {NameSyntacticType},
47   attribute preposition {text}?,
48   attribute particle {text}?,
49   mixed {element-realization}
50 }
51 element-realization = element realization{
52   attribute lemma {text}?,
53   attribute semantic-label {text}?,
54   attribute ref {xsd:IDREF}?,
55   text
56 }
```