Definition patterns for predicative terms in specialized lexical resources

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Abstract

The research presented in this paper is part of a larger project on the semi-automatic generation of definitions of semantically-related terms in specialized resources. The work reported here involves the formulation of instructions to generate the definitions of sets of morphologically-related predicative terms, based on the definition of one of the members of the set. In many cases, it is assumed that the definition of a predicative term can be inferred by combining the definition of a related lexical unit with the information provided by the semantic relation (i.e. lexical function) that links them. In other words, terminographers only need to know the definition of *pollute* and the semantic relation that links it to other morphologically-related terms (*polluter*, *polluting*, *pollutant*, etc.) in order to create the definitions of the set. The results show that rules can be used to generate a preliminary set of definitions (based on specific lexical functions). They also show that more complex rules would need to be devised for other morphological pairs.

Keywords: terminological definition, predicative term, lexical function

1. Introduction

Definitions are the privileged medium for providing users with a representation of the meaning of a lexical unit (LU). Even if many resources contain very rich semantic and/or conceptual information, definitions are still extremely useful and help users to fully grasp the meaning of LUs or concepts. For instance, a recent survey showed that ontologists consider that definitions are a very important element to gain a clear understanding of the terms in an ontology (Seppälä & Ruttenberg 2013: 19). Although terminological definitions have already been extensively studied in the literature (De Bessé 1990; Sager & Ndi-Kimbi 1995; Lorente 2001; Faber 2002, Seppäla 2012, *inter alia*), the focus has been on terms denoting entities (e.g., *computer*, *Earth*, *habitat*). Predicative terms (e.g., *download, pollute*, *warm*) have been largely ignored.

The research described in this paper is part of a larger project that targets the semi-automatic formulation of definitions of semantically-related terms in specialized resources. The work reported here creates a set of instructions that are able to generate the definitions of sets of morphologically-related predicative terms from the definition of one of the members of a given set. It is assumed that in many cases the definition of a predicative term can be generated by combining the definition of another related LU with the information provided by the semantic relation that links them. In other words, the definition of *pollute* and the semantic relation that links it to other morphologically-related terms (*polluter*, *polluting*, *pollutant*, etc.) would suffice to generate the definition of the latter. The long-term objective of this research is to automate definitions with only the minimal revision of the terminographer. This paper presents the results of an analysis of a preliminary set of specialized terms in order to assess the extent to which this type of generation is possible. The paper has the following structure. Section 2 gives a short description of the terminological resources from which the data were extracted. Section 3 provides general rules for writing terminological definitions. Section 4 lists the instructions for the generation of definitions and discusses the problems encountered. Section 5 presents the conclusions derived from this research and mentions the areas to be covered in future work.

2. DiCoInfo and DiCoEnviro

This work was undertaken within the framework of two terminological databases: DiCoEnviro[1] (environmental terminology) and DiCoInfo[2] (computer and Internet terminology). The compilation of these databases follows chiefly the theoretical and methodological principles of Explanatory Combinatorial Lexicology (ECL) (Mel'ćuk

[1] http://olst.ling.umontreal.ca/dicoenviro

[2] http://olst.ling.umontreal.ca/dicoinfo

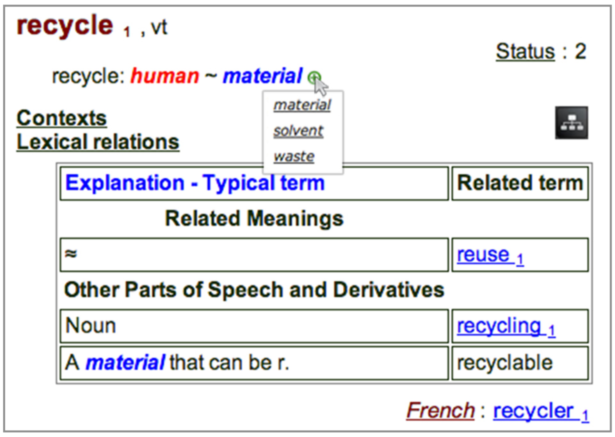

Figure 1: Entry for *recycle$_1$* in DicoEnviro

et al., 1995). Their entries provide rich lexico-semantic information for nouns, verbs, adjectives and adverbs (Figure 1): actantial (i.e. argument) structure, linguistic realizations of actants (i.e. arguments), contexts, and lexical relationships.

Very few of these entries currently contain definitions, and p n il no , he ri ing of he e definitions has only been subject to very basic rules. In Section 3, we formulate an initial set of definition rules based on the lexico-semantic information already provided in the entries (actantial structure and lexical relationships). Actantial structures state the number of obligatory participants, i.e. those that are necessary to understand the meaning of terms. Figure 1 shows an example with two participants: an AGENT, instantiated by *human*, and a PATIENT, instantiated by *material*.[3]

Lexical relationships between terms are encoded with lexical functions (LFs) (Mel'čuk et al., 1995) that capture the syntactic and semantic properties of lexical relationships. It should be highlighted that such relationships can be paradigmatic or syntagmatic (i.e. collocational). This paper focuses on a reduced set of paradigmatic relationships. For instance, the relationship between *degrade* and *degraded* is represented by the LF A_2 (the adjective that applies to the second actant). This LF is also applicable to other term pairs: *compile* → *compiled*; *partition* → *partitioned*. LFs are not visible in the online version of the databases. However, a simplified explanation designed to capture their expressiveness is provided. For instance, A_2 is translated as "That is or that has been + *verb*".[4]

3. Definitional methodology in DiCoInfo and DiCoEnviro

In order to create a methodology for definition writing in DiCoInfo and DiCoEnviro, we adapted the ECL definitional rules (Mel'čuk et al., 1995: 72-111) to the terminological nature of the two resources as well as to some of their special characteristics.

3.1 Actantial Structure Rule

If the LU to be defined is predicative (or if it is a quasi-predicate), all the actants must be reflected in the definition. Examples (1-3) show definitions for a verb, noun, and adjective in DiCoInfo and DiCoEnviro.

(1)
impact$_2$ (v): CAUSE (change$_{1a.1}$) ~ PATIENT (biodiversity$_1$, resource$_1$)
Definition: CAUSE (change$_{1a.1}$) has an important effect on PATIENT (biodiversity$_1$, resource$_1$).

(2)
clipboard$_1$ (n): ~ used by AGENT (user$_1$) to act on PATIENT (data$_1$)
Definition: temporary memory$_1$ area used by AGENT (user$_1$) to store$_{1b}$ PATIENT (data$_1$) briefly for pasting$_1$ PATIENT (data$_1$) in a file$_1$.

(3)
hot$_1$ (adj): ~ [PATIENT (water$_1$)]
Definition: [PATIENT (water$_1$)] that is at high temperature$_1$.

As can be observed in the examples, the definitions of verbs and nouns follow the Aristotelian structure of genus and differentiae. In other words, a verb is defined in terms of a more general verb plus differentiating characteristics, and a noun is also defined in terms of another more general noun plus differentiating characteristics. However, adjectives and adverbs are not defined using the same pattern since these definitions are introduced by a relative pronoun.

3.2 Decomposition Rule

This rule states that a definition must be a decomposition of the meaning expressed in semantically simpler LUs. An LU is considered to be semantically simpler than another LU if the latter can be defined in terms of the former but not vice versa (Mel'čuk et al., 1995: 79-83).

[3] In DiCoInfo and DiCoEnviro, actants in are represented by a combination of semantic roles and the typical terms that instantiate them. Currently, typical terms are displayed in a color that represents their semantic roles. Users can place the pointer over the typical terms to obtain the name of the semantic role and place it on a green plus icon to visualize other possible realizations for that actant. Since ECL (the

implement semantic roles (actants are represented with the variables X, Y, and Z), a system was created to assign them to the actants of predicative terms in the databases. This methodology is described in L'Homme (2012). The set of labels for semantic roles is designed especially for DiCoEnviro and DiCoInfo although some roles can be more frequently used in one database than the other (e.g. CAUSE is more frequent in DiCoEnviro).

[4] Figure 1 shows that LFs are replaced in the online version of DiCoEnviro by a natural language explanation: "A material that can be r.". These explanations mirror the LFs that are encoded by terminologists in the entry.

However, in order to apply this rule to a terminological resource, a distinction must be made between those LUs that are terms that are recorded or could be recorded in the resource, and other kinds of LUs.

With the exception of those LUs that instantiate actants, no term can appear in the definition of another term if the former needs the latter in its definition. Furthermore, the use of terms that are morphologically related to the definiendum is not permitted. This is to prevent users from consulting other entries to understand the meaning of the term.

Definitions inevitably contain LUs that are not encoded in the resource and will never be since they do not correspond to terms. In these cases, the terminographer is required to use only the LUs contained in the *Longman Communication 3000*[5] (Longman Dictionaries, 2007) and morphologically-related words. This ensures that any speaker of English will be able to understand the definition without needing to consult a general-language dictionary.[6]

3.3 Standardization Rule

All the LUs in a definition that appear in the resource need to be linked and disambiguated by their sense number. Moreover, the use of pronouns to substitute actants in the definition should be avoided.

To ensure uniformity, each meaning to be represented in a definition should always be expressed in the same way. For instance, the expressions in example (4) are all synonymous, and therefore, terminographers must always use "activity in which AGENT…" whenever they want to represent this meaning in the definitions.

(4)
activity in which AGENT… (preferred option)
activity consisting of AGENT…
activity during which AGENT…
activity performed by AGENT consisting of…

This procedure involves systematic ongoing work to identify synonymous expressions being currently used in the definitions, which could be standardized. Indeed, in many cases, the choice of one expression instead of another is arbitrary. A closed inventory of permitted expressions and the use of the *Longman Communication 3000* can be regarded as a sort of incipient controlled language for definitions.

In addition, the standardization of definitions in DiCoInfo and DiCoEnviro could be achieved with the use of definitional patterns based on LFs for the creation of the definitions of morphologically-related terms. As shall be seen in Section 4, this implies that the definitions of all adjectives related to a verb with the LF A_1 share the same structure and that their semantic content is based on the content of their respective starter verbs.

3.4 Mutual Substitutability Rule

A suitable definition is one that can replace the LU that it represents in any context. This rule is one of the most traditional in definition writing. Substitution is used to check whether definitional components are necessary and sufficient.

In the framework of DiCoInfo and DiCoEnviro, substitution is verified using all the typical terms of the actants of the definiendum as well as the annotated contexts of the entry.

4. Definition patterns for recurrent lexical relationships

As previously mentioned, paradigmatic LFs allow the systematic encoding of semantic relations between morphologically-related LUs.[7] Figure 2 shows how the semantic relations between terms morphologically related to the verb *pollute* are represented by means of LFs.

This paper presents a preliminary study to test whether it is possible to generate the definition of a predicative LU using the definition of an LU to which it is morphologically related, and the LF that links the two terms.

Since our model requires the definition of an LU to be used as a starting point, this study has been limited to those cases where this LU is a verb. When there is more than one verb in the family, the one with fewer actants is chosen. In the example of Figure 2, *pollute*$_{1a}$ would be chosen over *pollute*$_{1b}$ and *depollute*$_{1}$.

Since the scope of this preliminary analysis has been limited to those lexical families where a verb is the starting point, only those LFs encoded in DiCoInfo and DiCoEnviro with a verb as the first element were

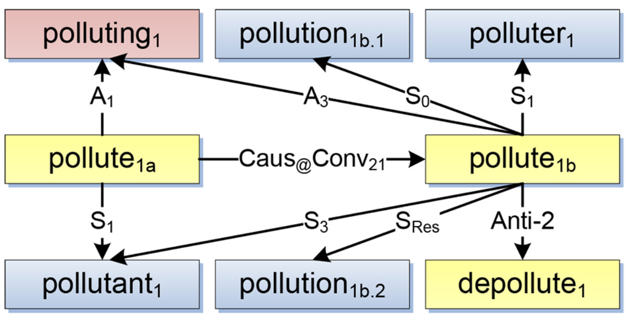

Figure 2: *Pollute* and its morphologically-related terms linked by means of LFs

[5] The *Longman Communication 3000* is a list that contains the 3,000 most common English LUs. The definitions in Longman dictionaries are written using only the words in the *Longman Defining Vocabulary* (Longman Dictionaries, 2008), which contains about 1,000 LUs less.

[6] Other lists would naturally be necessary to implement this principle in the versions of DiCoEnviro and DiCoInfo in other languages.

[7] Paradigmatic LFs can also relate LUs that are not morphologically related. However, the focus in this paper is only on morphologically-related terms.

considered. Then, the LFs for which there were less than three examples in the resources were discarded. The list of LFs studied was the following:

verb → verb	verb → noun	verb → adj.
Caus$_@$ *warm$_{1a}$* → *warm$_{1b}$*	S$_0$ *predict* → *prediction*	A$_1$ *pollute* → *polluting*
De_nouveau *compile* → *recompile*	S$_1$ *program* → *programmer*	A$_2$ *compile* → *compiled*
Caus$_@$Conv$_{21}$ *print$_{1a}$* → *print$_{1b}$*	S$_{Res}$ *pollute* → *pollution*	Able$_1$ *predict* → *predictive*
Anti-2 *compile* → *decompile*	S$_{Instr}$ *incinerate* → *incinerator*	Able$_2$ *configure* → *configurable*

Table 1: List of LFs considered in this study

The next step was to find a definitional pattern for each LU that allowed the generation of definitions without the introduction of non-predictable elements. The following sections show the resulting instructions and explain how they were developed.

4.1 From verb to verb: Caus$_@$, De_nouveau, Caus$_@$Conv$_{21}$, and Anti-2

In the case of De_nouveau (Table 2), Caus$_@$ (Table 3), and Caus$_@$Conv$_{21}$ (Table 4), rules applicable to all the examples found in DiCoInfo and DiCoEnviro were established by an iterative process. As will be explained, it was not possible to create a rule for Anti-2.

De_nouveau
Cases in DiCoInfo and DiCoEnviro: 7
LU1: verb
LU2: verb
Semantic change: LU2 expresses that the action of LU1 is repeated.
Syntactic change: None.

Instructions

1. Add *once again* at the end of LU1 definition.

Examples

upload$_1$: AGENT (user$_1$) ~ PATIENT (application$_1$, file$_1$) from SOURCE (computer$_1$) to DESTINATION (computer$_1$, network$_1$)
Definition: AGENT (user$_1$) transfers PATIENT (application$_1$, file$_1$) from local$_1$ SOURCE (computer$_1$) to remote$_2$ DESTINATION (computer$_1$, network$_1$) so that DESTINATION (computer$_1$, network$_1$) keeps a copy$_{3.2}$ of PATIENT (application$_1$, file$_1$).
re-upload$_1$: AGENT (user$_1$) ~ PATIENT (application$_1$, file$_1$) from SOURCE (computer$_1$) to DESTINATION (computer$_1$, network$_1$)
Definition: AGENT (user$_1$) transfers PATIENT (application$_1$, file$_1$) from local$_1$ SOURCE (computer$_1$) to remote$_2$ DESTINATION (computer$_1$, network$_1$) so that DESTINATION (computer$_1$, network$_1$) keeps a copy$_{3.2}$ of PATIENT (application$_1$, file$_1$) once again.
write$_1$: AGENT (drive$_1$, program$_1$, processor$_1$) ~ PATIENT (data$_1$) to DESTINATION (memory$_1$, storage_device$_1$)
Definition: AGENT (drive$_1$, program$_1$, processor$_1$) records PATIENT (data$_1$) in or on DESTINATION (memory$_1$, storage_device$_1$).
rewrite$_1$: AGENT (drive$_1$, program$_1$, processor$_1$) ~ PATIENT (data$_1$) to DESTINATION (memory$_1$, storage_device$_1$)
Definition: AGENT (drive$_1$, program$_1$, processor$_1$) records PATIENT (data$_1$) in or on DESTINATION (memory$_1$, storage_device$_1$) once again.

Table 2: Generation rule for De_nouveau

Caus$_@$
Cases in DiCoInfo and DiCoEnviro: 23
LU1: verb
LU2: verb
Semantic change: An external participant (LU2's first actant) causes the action expressed by LU1 to happen.
Syntactic change: From intransitive verb to transitive verb. LU1's first actant becomes LU2's second actant.

Instructions

1. Change LU1 definition into a subordinate clause of the main clause whose subject is the instantiation of LU2's first actant and whose verb is *cause*.

Examples

melt$_{1a}$: PATIENT (ice$_1$) ~
Definition: PATIENT (ice$_1$) changes$_{1a}$ from solid$_1$ to liquid$_1$ state.
melt$_{1b}$: CAUSE (temperature$_1$) ~ PATIENT (ice$_1$)
Definition: CAUSE (temperature$_1$) causes PATIENT (ice$_1$) to change$_{1a}$ from solid$_1$ to liquid$_1$ state.

run$_{1a}$: PATIENT (program$_2$) ~ on ENVIRONMENT1 (computer$_1$) or under ENVIRONMENT2 (operating_system$_1$)
Definition: PATIENT (program$_2$) operates on ENVIRONMENT1 (computer$_1$) or under ENVIRONMENT2 (operating_system$_1$)
run$_{1b}$: AGENT (user$_1$) ~ PATIENT (program$_2$) on ENVIRONMENT1 (computer$_1$) or under ENVIRONMENT2 (operating_system$_1$)
Definition: AGENT (user$_1$) causes PATIENT (program$_2$) to operate on ENVIRONMENT1 (computer$_1$) or under ENVIRONMENT2 (operating_system$_1$)

Table 3: Generation rule for Caus$_@$

Caus$_@$Conv$_{21}$
Cases in DiCoInfo and DiCoEnviro: 7
LU1: verb
LU2: verb
Semantic change: An external participant (LU2's first actant) causes the action expressed by LU1 to happen.
Syntactic change: LU1's first actant becomes LU2's third actant.

Instructions

1. Change LU1 definition into a subordinate clause of

the main clause whose subject is the instantiation of LU2's first actant and whose verb is *use*.

Examples

print.1a: INSTRUMENT (printer$_1$) ~ PATIENT (data$_1$)
Definition: INSTRUMENT (printer$_1$) copies PATIENT (data$_1$) on paper.
print.1b: AGENT (user$_1$) ~ PATIENT (data$_1$) with INSTRUMENT (printer$_1$)
Definition: AGENT (user$_1$) uses INSTRUMENT (printer$_1$) to copy PATIENT (data$_1$) on paper.

predict$_{1a}$: METHOD (model$_1$) ~ PATIENT (change$_{1a.1}$)
Definition: METHOD (model$_1$) estimates PATIENT (change$_{1a.1}$) to be likely to happen in the future.
predict$_{1b}$: AGENT (expert$_1$) ~ PATIENT (change$_{1a.1}$) with METHOD (model$_1$)
Definition: AGENT (expert$_1$) uses METHOD (model$_1$) to estimate PATIENT (change$_{1a.1}$) to be likely to happen in the future.

Table 4: Generation rule for Caus$_@$Conv$_{21}$

The specification of the rules for De_Nouveau and Caus@ was unproblematic. However, Caus$_@$Conv$_{21}$ was more difficult. The rule in Table 4 works for all the cases currently contained in DiCoInfo and DiCoEnviro, but further research (with a larger set of examples) will be required to determine whether the rule should be adapted depending on the nature of the first actant of LU1.
For Anti-2, which is an LF that relates an LU to its reversive antonym (e.g. *zip* → *unzip*, *stabilize* → *destabilize*), rule generation was impossible because the process of undoing something (*unzip*, *destabilize*) is not always the same as performing the original action (*zip*, *stabilize*) in reverse.

4.2 From verb to noun: S$_0$, S$_1$, S$_{Res}$, and S$_{Instr}$

The creation of rules for S$_0$ involved analyzing how such LUs are usually defined in other lexical resources in order to identify regular patterns. S$_0$ is the LF that relates an LU to the noun that expresses the same meaning (e.g. *absorb* → *absorption*, *develop* → *development*, *access (v)* → *access (n)*).

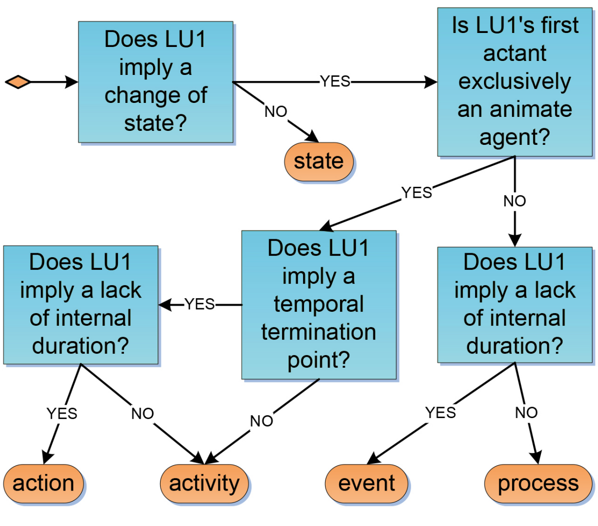

Figure 3: Choice of genus for S$_0$ definitions

The difficulty in generating an S$_0$ definition from its starter verb is the choice of genus. An analysis of the genera used in definitions of deverbal nouns in various lexical resources showed that the most common are *process*, *action*, *activity*, *act*, *state*, *fact*, and *event*. In order to find a way of predicting the right genus, we analyzed the choice of genus, based on the four features used in Van Valin's adaptation (2005) of Vendler's verb classification (1967): [± static] (does the verb imply a change of state?), [±telic] (does the verb imply a temporal termination point?), [±dynamic] (does the verb involve action?), and [±punctual] (does the verb imply internal duration?). The analysis indicated that the choice of genus is largely dependent on these distinctions.
In order to choose the right genus and follow the standardization rule, a schema was developed based on the analysis (Figure 3). However, we discarded the notion of dynamicity and substituted it with the more restricted notion of animate agentivity (Is the first actant of the verb exclusively an animate agent?). The resulting instructions for S$_0$ are shown in Table 5.

S$_0$
Cases in DiCoInfo and DiCoEnviro: 193
LU1: verb
LU2: noun
Semantic change: None
Syntactic change: From verb to noun.

Instructions

1. Change LU1 definition into a prepositional relative clause (preposition: *in*) whose head is the genus of LU2 definition. To choose the genus, refer to Figure 3[8]. In case of doubt on the application of Figure 3, refer to the tests in Van Valin (2005: 35-42).

Examples[9]

click$_1$: AGENT (user$_1$) ~ on PATIENT (icon$_1$) with INSTRUMENT (mouse$_1$)
Definition: AGENT (user$_1$) selects$_2$ PATIENT (icon$_1$) by pressing and releasing a button of INSTRUMENT (mouse$_1$).
click$_{1.1}$: ~ on PATIENT (icon$_1$) with INSTRUMENT (mouse$_1$) by AGENT (user$_1$)
Definition: action in which AGENT (user$_1$) selects$_2$ PATIENT (icon$_1$) by pressing and releasing a button of INSTRUMENT (mouse$_1$).

migrate$_1$: AGENT (species$_1$) ~ from SOURCE (region$_1$) to DESTINATION (region$_1$)

[8] Terminographers need to make use of Figure 3 because DicoInfo and DicoEnviro still not systematically include aspectual information for verbs. Nonetheless, some of this information can be stored in the form of LFs.
[9] No example of an S$_0$ definition whose genus is *state* is offered because there are currently no applicable cases in DiCoInfo or DiCoEnviro.

Definition: AGENT (species$_1$) travels from SOURCE (region$_1$) to DESTINATION (region$_1$) seasonally$_1$.
migration$_1$: ~ of AGENT (species$_1$) from SOURCE (region$_1$) to DESTINATION (region$_1$)
Definition: activity in which AGENT (species$_1$) travels from SOURCE (region$_1$) to DESTINATION (region$_1$) seasonally$_1$.

adapt$_1$: PATIENT (ecosystem$_1$, species$_1$) ~ to CAUSE (change$_{1a.1}$)
Definition: PATIENT (ecosystem$_1$, species$_1$) changes$_{1a}$ according to CAUSE (change$_{1a.1}$).
adaptation$_1$: ~ of PATIENT (ecosystem$_1$, species$_1$) to CAUSE (change$_{1a.1}$)
Definition: process in which PATIENT (ecosystem$_1$, species$_1$) changes$_{1a}$ according to CAUSE (change$_{1a.1}$).

crash$_{1a}$: PATIENT (computer$_1$, program$_2$) ~
Definition: PATIENT (computer$_1$, program$_2$) stops responding.
crash$_{1a.1}$: PATIENT (computer$_1$, program$_2$) ~
Definition: event in which PATIENT (computer$_1$, program$_2$) stops responding.

Table 5: Generation rule for S$_0$

Finally, the LFs S$_1$, S$_{Res}$, and S$_{Instr}$ did not allow a complete definition generation in all cases. In the case of S$_1$, which links an LU with the typical noun given to the first actant (e.g. *develop* → *developer*, *pollute* → *polluter*), the problem lies in the fact that the genus of the definition of the noun cannot be entirely predicted from that of the verb. The same problem arises with S$_{Res}$, and S$_{Instr}$, which relate an LU with the typical noun that designates its result (e.g. *format(v)* → *format(n)*, *damage(v)* → *damage(n)*), and its instrument (eg. *incinerate* → *incinerator*, *debug* → *debugger*), respectively. At this stage of the research, the instructions for S$_1$, S$_{Res}$, and S$_{Instr}$ can only partially generate the definition, which the terminographers must then complete.

4.3 From verb to adjective: A$_1$, Able$_1$, A$_2$, and Able$_2$

The creation of rules for A$_1$ (Table 6), and Able$_1$ (Table 7) were fairly simple given that the A$_1$ and Able$_1$ definitions are very similar to the definitions of their starter verbs, and no change in the order of actants is required.

A$_1$
Cases in DiCoInfo and DiCoEnviro: 3
LU1: verb
LU2: adjective
Semantic change: LU2 expresses the typical attribute for LU1's first actant.
Syntactic change: From verb to adjective.

Instructions
1. Change LU1 definition into a relative clause whose head is the instantiation of LU1's first actant.

Examples
migrate$_1$: AGENT (species$_1$) ~ from SOURCE (region$_1$) to DESTINATION (region$_1$)
Definition: AGENT (species$_1$) travels from SOURCE (region$_1$) to DESTINATION (region$_1$) seasonally$_1$.
migrating$_1$: ~ [AGENT (species$_1$)]
Definition: [AGENT (species$_1$)] that travels from SOURCE (region$_1$) to DESTINATION (region$_1$) seasonally$_1$.

reside$_1$: PATIENT (data$_1$, program$_2$) ~ in LOCATION1 (memory$_1$) or on LOCATION2 (storage_device$_1$)
Definition: PATIENT (data$_1$, program$_2$) is located in LOCATION1 (memory$_1$) or on LOCATION2 (storage_device$_1$) permanently.
resident$_1$: ~ [PATIENT (data$_1$, program$_2$)]
Definition: [PATIENT (data$_1$, program$_2$)] that is located in LOCATION1 (memory$_1$) or on LOCATION2 (storage_device$_1$) permanently.

Table 6: Generation rule for A$_1$

Able$_1$
Cases in DiCoInfo and DiCoEnviro: 5
LU1: verb
LU2: adjective
Semantic change: LU2 expresses the typical attribute for an LU that can instantiate LU1's first actant.
Syntactic change: From verb to adjective.

Instructions
1. Default A$_1$ instructions.
2. Add modal verb *can* before genus verb.

Examples
adapt$_1$: PATIENT (ecosystem$_1$, species$_1$) ~ to CAUSE (change$_{1a.1}$)
Definition: PATIENT (ecosystem$_1$, species$_1$) changes$_{1a}$ according to CAUSE (change$_{1a.1}$).
adaptive$_1$: ~ [PATIENT (ecosystem$_1$, species$_1$)]
Definition: [PATIENT (ecosystem$_1$, species$_1$)] that can change$_{1a}$ according to CAUSE (change$_{1a.1}$).

predict$_{1a}$: METHOD (model$_1$) ~ PATIENT (change$_{1a.1}$)
Definition: METHOD (model$_1$) estimates PATIENT (change$_{1a.1}$) to be likely to happen in the future.
predictive$_1$: ~ [METHOD (model$_1$)]
Definition: [METHOD (model$_1$)] that can estimate PATIENT (change$_{1a.1}$) to be likely to happen in the future.

Table 7: Generation rule for Able$_1$

As for A$_2$ (Table 8), the formulation of instructions required the specification of exceptions largely stemming from two factors. The first factor is related to the fact that LU1's second actant needs to function as the subject of LU2 definition. This involves a change in the order of the constituents of the definition, which has to be performed in accordance with the syntactic properties of the genus verb. The second factor in the creation of exceptions is related to the tense to be used in the genus verb (simple present or present perfect). An analysis based on Van Valin's (2005) verbal features revealed that only telicity was relevant in these cases. These factors do not affect Able$_2$ (Table 9).

A_2
Cases in DiCoInfo and DiCoEnviro: 16
LU1: verb
LU2: adjective
Semantic change: LU2 expresses the typical attribute for an LU that can instantiate LU1's second actant.
Syntactic change: From verb to adjective.

Default Instructions (LU1 does not involve a termination point, and the genus verb does not have LU1's second actant as direct object or as modifier of the direct object in a prepositional phrase headed by *of*)
1. Change LU1 definition into a relative clause whose head is the instantiation LU1's second actant.

Example
threaten$_1$: CAUSE (change$_{1a.1}$) ~ PATIENT (forest$_1$, species$_1$)
Definition: CAUSE (change$_{1a.1}$) is a source of danger$_1$ for PATIENT (forest$_1$, species$_1$)
threatened$_1$: ~ [PATIENT (forest$_1$, species$_1$)]
Definition: [PATIENT (forest$_1$, species$_1$)] for which CAUSE (change$_{1a.1}$) is a source of danger$_1$.

Exception 1 Instructions (LU1 involves a termination point, and the genus verb does not have LU1's second actant as direct object or as modifier of the direct object in a prepositional phrase headed by *of*)
1. Follow default instructions.
2. Change the genus verb into present perfect.

Example
impact$_2$: CAUSE (change$_{1a.1}$) ~ PATIENT (biodiversity$_1$, resource$_1$)
Definition: CAUSE (change$_{1a.1}$) has an important effect on PATIENT (biodiversity$_1$, resource$_1$).
impacted$_1$: ~ [PATIENT (biodiversity$_1$, resource$_1$)]
Definition: [PATIENT (biodiversity$_1$, resource$_1$)] on which CAUSE (change$_{1a.1}$) has had an important effect.

Exception 2 Instructions (LU1 does not involve a termination point, and the genus verb has LU1's second actant as direct object or modifier of the direct object in a prepositional phrase headed by *of*)
1. Follow default instructions, but relative clause must be in passive voice.

Example
protect$_1$: AGENT (human$_1$) ~ PATIENT (change$_{1a}$) from THREAT (threat$_1$)
Definition: AGENT (human$_1$) keeps PATIENT (change$_{1a}$) from being damaged$_2$ by THREAT (threat$_1$).
protected$_1$: ~ [PATIENT (ecosystem$_1$)]
Definition: [PATIENT (ecosystem$_1$)] that is kept by AGENT (human$_1$) from being damaged$_2$ by THREAT (threat$_1$).

Exception 3 Instructions (LU1 involves a termination point, and the genus verb has LU1's second actant as direct object or modifier of the direct object in a prepositional phrase headed by *of*)
1. Follow Exception 1 instructions.
2. Follow Exception 2 instructions.

Example
degrade$_1$: CAUSE (change$_{1a.1}$) or AGENT (pollutant$_1$) ~ PATIENT (ecosystem$_1$)
Definition: CAUSE (change$_{1a.1}$) or AGENT (pollutant$_1$) worsens the condition of PATIENT (ecosystem$_1$).
degraded$_1$: ~ [PATIENT (ecosystem$_1$)]
Definition: [PATIENT (ecosystem$_1$)] whose condition has been worsened by CAUSE (change$_{1a.1}$) or AGENT (pollutant$_1$).

Table 8: Generation rule for A$_2$

Able$_2$
Cases in DiCoInfo and DiCoEnviro: 19
LU1: verb
LU2: adjective
Semantic change: LU2 expresses the typical attribute for an LU that can instantiate LU1's second actant.
Syntactic change: From verb to adjective.

Instructions
1. Follow default A$_2$ instructions[10]
2. Add modal verb *can* before genus verb.

Examples
parse$_1$: AGENT (program$_1$) ~ PATIENT (string$_1$)
Definition: AGENT (program$_1$) processes$_1$ PATIENT (string$_1$) in order to check if PATIENT (string$_1$) is well-formed according to specific rules.
parsable$_1$: ~ [PATIENT (string$_1$)]
Definition: [PATIENT (string$_1$)] that can be processed$_1$ by AGENT (program$_1$) in order to check if PATIENT (string$_1$) is well-formed according to specific rules.

click$_1$: AGENT (user$_1$) ~ on PATIENT (icon$_1$) with INSTRUMENT (mouse$_1$)
Definition: AGENT (user$_1$) selects$_2$ PATIENT (icon$_1$) by pressing and releasing a button of INSTRUMENT (mouse$_1$).
clickable$_1$: ~ [PATIENT (icon$_1$)]
Definition: [PATIENT (icon$_1$)] that can be selected$_2$ by AGENT (user$_1$) by pressing and releasing a button of INSTRUMENT (mouse$_1$).

Table 9: Generation rule for Able$_2$

4.4. Definition rules to ensure proper generation

In the formulation of the instructions for the generation of definitions, two preliminary rules were established for definition writing in order to ensure proper generation. In subsequent stages of this study, after a larger set of examples have been tested, if they are still found to be necessary, they will be added to the definitional methodology in DiCoInfo and DiCoEnviro.

The first preliminary rule dictates that, wherever possible, the order of the actants in the actantial structure should be maintained as it is in the starter definition. In example (5), the definition provided for *click$_1$* needs to

[10] This does not imply that the same conditions need to be met.

be changed to conform to this rule, because otherwise it would not allow the generation of its Able_2 definition (*clickable$_1$*).

(5)
click$_1$: AGENT (user$_1$) ~ on PATIENT (icon$_1$) with INSTRUMENT(mouse$_1$)
~~*Definition*: AGENT (user$_1$) presses and releases a button of INSTRUMENT (mouse$_1$) in order to select$_1$ PATIENT (icon$_1$).~~
Definition: AGENT (user$_1$) selects$_2$ PATIENT (icon$_1$) by pressing and releasing a button of INSTRUMENT (mouse$_1$).
clickable$_1$: ~ [PATIENT (icon$_1$)]
Definition: PATIENT (icon$_1$) can be selected$_2$ by AGENT (user$_1$) by pressing and releasing a button of INSTRUMENT (mouse$_1$).

The second rule refers to the preference for infinitive clauses over *that*-clauses wherever possible. In example (6), the use of a that-clause would prevent the proper generation of the A_2 definition.

(6)
authenticate$_1$: RECIPIENT (computer$_1$) ~ PATIENT (user$_1$) with INSTRUMENT (password$_1$)
~~*Definition*: RECIPIENT (computer$_1$) recognizes that PATIENT (user$_1$) has permission to perform certain actions based on INSTRUMENT (password$_1$).~~
Definition: RECIPIENT (computer$_1$) recognizes PATIENT (user$_1$) to have permission to perform certain actions based on INSTRUMENT (password$_1$).
authenticated$_1$: ~ [PATIENT (user$_1$)]
Definition: [PATIENT (user$_1$)] that is recognized by RECIPIENT (computer$_1$) to have permission to perform certain actions based on INSTRUMENT (password$_1$).

5. Conclusions

This preliminary study has shown that it is possible to generate the definition of predicative LUs from the definition of a morphologically-related verb provided that the former is related to the latter by means of the LFs De_nouveau, $\mathrm{Caus}_{@}$, $\mathrm{Caus}_{@}\mathrm{Conv}_{21}$, S_0, A_1, A_2, Able_1, or Able_2. Our method assumes that the typical terms that instantiate the actants of morphologically-related predicative units are the same. However, in the course of our analysis, we noticed some minor differences that would need to be analyzed in the future.
The instructions for the generation of definitions presented in this paper allow terminographers to comply with the standardization rule, since the same kind of definition will be written, following the same patterns. Furthermore, in the future, these instructions could constitute the basis for an automatic definition writing system. Such a system would ideally interact with an ontology so that the terminographers' work would be limited to encoding the semantic information in the ontology and performing minimal stylistic corrections of the definitions produced automatically. The use of an ontology would also have the advantage of ensuring a higher level of consistency and would allow a hierarchical organization of genera to avoid circularity.
In addition to validating the preliminary results presented here on a larger set of data, subsequent studies will include other paradigmatic LFs and LUs other than verbs as starting points.

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