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Building a lexical database to investigate the semantics of French deverbal nouns

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1 Introduction

Because of their grammatical complexity, formal variety and semantic diversity, deverbal nouns have challenged linguistic theory for more than half a century. Since Lees (1960) and Chomsky (1970), many studies have been devoted to the syntactic aspects of nominalization, especially with respect to argument realization (Grimshaw, 1990; Siloni, 1997; Alexiadou, 2001; Borer, 2003; Koptjevskaja-Tamm, 2003; Sleeman and Brito, 2010; Alexiadou et al., 2013; a.o.). Research about the morphosemantic properties of deverbal nouns has developed more recently (Booij, 1986; Gaeta, 2000; Namer and Villoing, 2008; Kawaletz and Plag, 2015; Fradin, 2016; Andreou and Petitjean, 2017; Wauquier et al., 2018; Varvara et al., 2021; a.o.), still leaving many questions unanswered. Extensive analyses of the semantic properties of deverbal nouns require large lexical resources that provide in-depth systemized information, possibly offering an overall picture of their organization in the lexicon. In this paper, I present the design of a database of French deverbal nouns created to answer research questions about derivational semantics, cross-categorial semantic preservation, and affix functionality. I introduce these issues in Section 2, and in Section 3 outline the methodology used to build and annotate a sample of French deverbal nouns. Section 4 provides an example of theoretical exploitation of the data through the examination of the aspectual properties of nouns ending in *-age*, *-ion* and *-ment*.

2 Morphosemantic issues

General issues about the semantics of derivation have been discussed by morphologists in the last decades (Corbin, 1987; Szymanek, 1988; Temple, 1995; Lieber, 2004; Rainer, 2014; Schulte, 2015; Plag et al., 2018; a.o.). Three major topics concerning the semantics of deverbal nouns are presented in this section.

2.1 Semantic diversity

It is well known that deverbal nouns can denote either eventualities or entities, in relation to the base verb meaning, but their semantic diversity needs to be further described. Detailed classifications of deverbal nouns have been proposed in the literature (see e.g. Fradin, 2012 for French nouns, and Lieber, 2016 for English nouns), but with questionable variations and lexical coverage. To ensure a broad application, the semantic analysis of deverbal nouns should be based on a general classification of nouns. It also requires a clear distinction between derivational semantics (i.e. the semantic operations associated to morphological processes) and lexical semantics (i.e. the semantics of conventionalized words in the lexicon). Derivational semantics is often underspecified with respect to lexical semantics, and it may be difficult to precisely determine the semantic outcome of morphological processes. Given that lexicalization idiosyncratically influences the meaning of lexemes, it is uncertain which semantic features of a given complex word result from derivation. For instance, French deverbal nouns *dortoir* 'dormitory' and *tuerie* 'slaughter' include a collective feature that is absent from the meaning of their base verbs—a plurality constraint applies to participants denoted by the external argument of *dormir* 'sleep' and the internal argument of *tuer* 'kill'. Whether the collective feature is implied by derivational semantics or not can only be determined through generalized observations of deverbal nouns suffixed with *-oir* and *-erie*.

2.2 Cross-categorial properties

The transfer of semantic properties through derivational processes raises a number of questions. It can be asked to what extent deverbal nouns inherit the semantic properties of base verbs, which properties are (not) preserved, and why. When deverbal nouns denote entities, the nominalization of verbal arguments can be discussed. For instance, *attaquant* 'attacker' nominalizes the agentive argument of *attaquer* 'attack', whereas *buvette* 'refreshment bar' as a locative nominalization does not correspond to any syntactic or semantic argument of *boire* 'drink'. When deverbal nouns denote eventualities, the preservation of lexical aspect and semantic role assignment can be investigated. It appears that the cross-categorial transfer of semantic properties is not always transparent (Haas et al., 2008; Balvet et al., 2011; Huyghe, 2015a), and it can be asked how frequently cases of non-preservation are observed. Generally speaking, cross-categorial features may depend on lexical class. For instance, the aspectual distinction between occurrential and non-occurrential actions in the nominal domain (e.g. *réunion* 'meeting' vs. *jardinage* 'gardening') does not have any equivalent in the verbal domain (Huyghe, 2011). Such discrepancies attest to differences in the semantic structure of verbs and nouns, which can affect the nature of cross-categorial semantic properties.

2.3 Affix polyfunctionality and rivalry

Many suffixes in French can form deverbal nouns, and their relation with nominal semantics calls for investigation. The general correspondence between affix selection and the meaning of deverbal nouns is known to be a many-to-many relation. For example, French deverbal nouns ending in *-ment* can denote events (*avortement* 'abortion'), states (*énervement* 'irritation'), agents (*gouvernement* 'governement'), instruments (*déguisement* 'costume'), locations (*logement* 'accommodation'), etc., whereas the instrument type can be denoted by nouns ending in *-ail* (*éventail* 'fan'), *-et* (*jouet* 'toy'), *-eur* (*aspirateur* 'vacuum cleaner'), *-oir* (*hachoir* 'mincer'), *-ure* (*couverture* 'blanket'), etc. These many-to-many relations need to be further explored.

On the one hand, detailed information should be provided about the possible semantic outputs of each suffix and their frequency. When a suffix is associated with distinct outputs, it should be determined whether these are primary or secondary outputs, because of the possible existence of polysemous nouns derived through metonymy (Ferret and Villoing, 2015). For instance, *-ion* in French seems to form collective agent nouns (*rébellion* 'rebellion', *rédaction* 'editorial board', *administration* 'administration'), but only for nouns which also have an event meaning, so that the existence of a deverbal pattern in *-ion* directly deriving agent nouns is uncertain. In the case of metonymic derivations, the formation of ambiguous nouns could still be seen as an indirect property of the suffix, if a given metonymic extension was only attested for some suffixes. The existence of complex derivational types could thus be hypothesized.

On the other hand, differences of semantic functionality between nominalizing suffixes should be examined to accurately evaluate their rivalry. The extent of suffix rivalry can vary according to (i) the existence of differences between similar semantic functions, (ii) the number of functions shared between polyfunctional suffixes, (iii) the actualization frequency of shared functions. First, it can be questioned whether suffixes with a similar function involve strictly identical constraints on lexical inputs and outputs, or tolerate some variation. Second, rivalry between polyfunctional affixes is usually partial and the number of functions involved in each case of rivalry should be investigated. Third, when suffixes compete for a given function, it can be asked if that function is equally frequently actualized for the different suffixes, both in terms of absolute frequency and of relative frequency (i.e. with respect to the other functions of the suffix). For example, *-ion* (*habitation* 'house') and *-erie* (*distillerie* 'distillery') apparently compete to derive locative nouns, but their degree of rivalry may be low if it appears that *-ion* as opposed to *-erie* rarely forms locative deverbal nouns.

3 Creation of a database

To answer theoretical questions about the semantic aspects of deverbal derivation, extensive data with detailed annotation are needed. Since the existing lexical databases for French do not provide the required

fine-grained semantic information, we intend to describe the semantic properties of a large sample of French deverbal nouns. This section presents the methodology used to build and analyze that sample.

3.1 Data sampling

The sample of deverbal nouns is based on candidates extracted from the FRCOW16A corpus, which is a large French web corpus containing 10.8 billion tokens (Schäfer, 2015; Schäfer and Bildhauer, 2012). Using a large web corpus allows for the inclusion in the sample of non-lexicalized words (nonce words and neologisms). The extracted candidates are verb-noun pairs (tagged with TreeTagger), in which the noun is formally related to the verb, possibly through regular allomorphy, in an apparently suffixed or converted form. Forty suffixes and 4 forms of conversion are considered in the extraction. Candidates are then manually filtered so that there is a semantic relation between at least one meaning of the verb and one meaning of the noun. Cases of double analyzability, in which a noun could be derived from a verb or from another word, are included provided that a deverbal morphological pattern is instantiated by at least two monosemous nouns. For instance, the existence of *causette* 'chat' and *ronflette* 'nap', univocally analyzable as derived from *causer* 'chat' and *ronfler* 'snore', attests to deverbal derivation of event nouns in *-ette*, and therefore ensures the analyzability of *grimpette* 'climb' (which could also be derived from the noun *grimpe* 'climbing') as possibly derived from the verb *grimper* 'climb'. Note that nouns in a relation of conversion with a verb but that do not include any verbal exponent are selected only if they denote eventualities. The sampling of the verb-noun pairs is performed in two stages. First, lists of words corresponding to weakly productive deverbal processes (e.g. suffixation in *-ade*, *-ail*, *-ard*, *-is*, *-ette*, conversion from verb stems in *-at*) are exhaustively filtered to optimize the possibility of quantitative generalization. Random selection across frequency ranges is done for the remaining types (e.g. suffixation in *-age*, *-eur*, *-ion*, *-ment*, *-ure*, conversion from participial verb forms), to finally obtain a sample of 4,000 verb-noun pairs.

3.2 Semantic description

Sampled verb-noun pairs are described with respect to nominal semantic type, verbal and nominal aspectual properties, and verbal and nominal capacity of assigning semantic roles. In order to account for the polysemy of nominalizations, the different meanings of each verb and noun are carefully distinguished and systematically paired. The semantic description is based on controlled manual annotation and explicit definitions of the annotated criteria. The general principles and linguistic tests used to analyze the semantic properties of both verbs and nouns are detailed in Salvadori et al. (2021a).

Ontological and relational properties are separated to appropriately describe nominal semantic types, and each deverbal noun is doubly classified. Ontological types relate to the nature of the referents, whereas relational types depend on the semantic relation with the base (Huyghe, 2015b). Existing semantic classifications of deverbal nouns often assimilate the two kinds of properties, which may lead to some confusion. As shown in examples (1)-(2), ontological and relational types are at least partially independent.

(1) *bâtir* 'build' → *bâtiment* 'building' [ARTIFACT-RESULT]
aspirer 'vacuum up' → *aspirateur* 'vacuum cleaner' [ARTIFACT-INSTRUMENT]
garer 'park' → *garage* 'garage' [ARTIFACT-LOCATION]

(2) *bâtir* 'build' → *bâtiment* 'building' [ARTIFACT-RESULT]
énerver 'irritate' → *énervement* 'irritation' [STATE-RESULT]
traduire 'translate' → *traduction* 'translation' [COGNITIVE OBJECT-RESULT]

Fourteen ontological simple types are distinguished based on distributional properties (Haas et al., submitted). Some of them combine to form complex types, in which case characteristic predicates of different simple types are contextually compatible (Copestake and Briscoe, 1995; Cruse, 1995; Pustejovsky, 1995; Kleiber, 1999; Asher, 2011; Dölling, 2021; a.o.). Relational types are based on the set of semantic roles used to annotate arguments, complemented with a transpositional type for nouns that

denote the same eventualities as their base verb. Seventeen semantic roles are defined and adapted from the sets of roles used in Verbnet (Kipper-Schuler, 2005) and Lirics (Petukhova and Bunt, 2008).

The lexical aspect of verbs and nouns is decomposed into four basic features (dynamicity, durativity, telicity, and post-phase). These properties are analyzed using linguistic tests mentioned in the literature (Vendler, 1967; Dowty, 1979; Rothstein, 2004; Haas et al., 2008; Filip, 2012; a.o.). Telicity is encoded by default with a delimited internal argument, and annotated as variable for degree achievements (Abusch, 1986; Bertinetto and Squartini, 1995; Hay et al., 1999; Rothstein, 2008; a.o.). Post-phase relates to the possibility of denoting a durative result state (Piñón, 1997, 1999; Apothéloz, 2008; Fradin, 2011; Haas and Jugnet, 2013), as in the case of *partir* 'leave' vs. *arriver* 'arrive' in (3).

(3) *Julie {est partie/?est arrivée} pendant deux jours.*
'Julie {left/arrived} for two days'

An important feature is that ambiguous nouns are assigned one entry per meaning in the database. Lexical ambiguity is identified through the variation of at least one annotated semantic property. Verbal and nominal lexemes are paired based on the principle of closest semantic correspondence: if a verb or a noun is ambiguous, the verbal and nominal lexemes that share the more aspectual and role-assigning properties are paired together.

4 A case study: the preservation of lexical aspect through nominalization

To test the methodology presented in the previous section, we analyzed a sample of 300 French deverbal neologisms ending in *-age*, *-ion* and *-ment*. The annotated sample can be used to investigate theoretical issues such as the preservation of verbal aspect in eventuality-denoting nominalizations (Salvadori et al., 2021b). The results of this investigation are discussed in this section.

4.1 The Aspect Preservation Hypothesis

It is often implicitly assumed that eventuality-denoting nominalizations inherit the lexical aspect of their bases. The idea of a cross-categorial transfer of aspect has been explicitly formulated by Fábregas et al. (2012) as the Aspect Preservation Hypothesis (APH), which stipulates that "the lexical aspect of a verb is preserved under nominalization if the resulting nominal denotes an eventuality". However, extended corpus studies have shown that nominalizations could differ from their bases with respect to lexical aspect (Balvet et al., 2011). For instance, *imagination* 'imagination' contrasts with *imaginer* 'imagine' in that in does not denote a dynamic eventuality. The lexical aspect of the base verb is not inherited, unlike what is the case for pairs such as *inventer-invention* 'invent'-'invention', as can be seen in (4)-(6).

(4) *L'auteur a {imaginé/inventé} une nouvelle forme narrative.* [+DYN]
'The author imagined/invented a new narrative form'

(5) *Cette {invention/*imagination} a eu lieu au 20e siècle.* [+DYN]
'This {invention/imagination} occurred in the 20th century'

(6) *Cet enfant a beaucoup d'{imagination/*invention}.* [–DYN]
'This child has a great {imagination/invention}'

Nevertheless, such aspectual shifts could be caused by lexicalization, and not by derivation, which would not violate the APH. To control for the effects of lexicalization, the semantic properties of neologisms can be scrutinized (Corbin, 1987; Plag, 1999). French neologisms suffixed with *-age*, *-ion*, *-ment* are particularly well suited to explore aspect preservation, for these three suffixes are arguably the most productive ones to form eventuality-denoting nouns in French. *-Age*, *-ion* and *-ment* have received a fair amount of attention in recent years (Martin, 2010; Uth, 2010; Dal et al., 2018; Fradin, 2019; Missud and Villoing, 2020; Wauquier, 2020), but no consensus has yet emerged as to what their distinctive semantic (including aspectual) properties could be.

	-age	*-ion*	*-ment*	Average
Aspect preservation	**74.8**	94.8	84.8	85.5

Table 1: Preservation of aspectual properties between verbs and nouns (%)

4.2 Describing the aspectual properties of deverbal neologisms in *-age*, *-ion* and *-ment*

The analysis is based on 300 French deverbal neologisms in *-age*, *-ion* and *-ment* (100 nouns per suffix) randomly extracted from the FRCOW16A corpus, following the methodology described in the previous section. Candidate words were additionally filtered using the Lefff (Sagot, 2010) and Lexique (New et al., 2004) lexicons as exclusion lists, and an ultimate lexicographic control was made to ensure that candidate words were not lexicalized. The aspectual properties of the sampled verbs and nouns were analyzed with respect to the criteria presented in Section 3.2. Nouns and verbs were annotated in a double-blind process and adjudicated with the help of a third annotator. The semantic annotation was based on the occurrences in FRCOW16A, complemented with examples taken from the web. Inter-annotator agreement scores were calculated for the 10 annotated features using Cohen's kappa and prevalence-adjusted PABAK (Byrt et al., 1993). Overall, the scores show a substantial agreement. Observed agreement scores range from 0.78 (verb post-phase) to 0.98 (verb dynamicity) with an average of 0.86. Kappa scores range from 0.56 (verb dynamicity) to 0.85 (noun dynamicity) with an average of 0.72. PABAK scores range from 0.67 (verb post-phase) to 0.96 (verb dynamicity) with an average of 0.81.

4.3 Results

A total of 501 nominal meanings were identified in the dataset, out of which 449 were eventuality meanings. Thirty-five of these meanings were associated with polysemous nouns and equivocally analyzable as resulting from morphological derivation or metonymy. These were excluded by default, considering that metonymic meanings could bias the results. Finally, aspectual shifts were observed for 60 out of 414 nouns. It appears that the lexical aspect of the verb is often, but not always, preserved in eventuality-denoting neologisms ending in *-age*, *-ion*, *-ment*. The preservation rates per suffix are presented in Table 1.

Discrepancies vary with aspectual properties, as shown in Table 2, and some specific aspectual variations can be observed for each suffix. For instance, *-ment* is associated with dynamic eventualities becoming stative (e.g. *jubiler* 'jubilate' denotes an activity whereas *jubilement* 'jubilance' denotes a state), and *-age* is associated with eventualities dropping post-phase or punctual eventualities becoming durative (e.g. *sortir* 'take out' is punctual and includes a post-phase whereas *sortage* 'taking out' is durative and does not include a post-phase).

Neological and lexicalized nominalizations can be compared with respect to aspectual discrepancies. Based on equivalent aspectual categories, the comparison between our dataset and the lexicalized data from the Nomage resource (Balvet et al., 2011) does not show any significant effect of lexicalization on aspect (non-)preservation ($\chi^2(1, N = 1088) = 0.297, p = .585$). It can be concluded that lexical aspect is not necessarily preserved through nominalization as a derivational process. Aspectual properties are not always inherited from the verbal domain, but can develop in nominal semantic structures. Theoretical models of nominalization should therefore account for possible aspectual shifts between base and derivative.

5 Conclusion

The creation of a database containing detailed semantic information about deverbal nouns could help us better understand the semantic aspects of derivation, the structure of the lexicon, and the nature of lexical categories. Analyses combining qualitative and quantitative approaches can make a substantial contribution to the study of deverbal nouns, and of the relations between form and meaning in the lexicon. They should allow us to evaluate both the extent of lexical idiosyncrasies and the content of complex

	-age	*-ion*	*-ment*	Average
Dynamicity pres.	96.7	98.0	**88.4**	94.4
Durativity pres.	**91.0**	99.3	99.2	96.8
Telicity pres.	**98.4**	100.0	99.2	99.3
Post-phase pres.	**80.3**	96.7	95.5	91.4

Table 2: Preservation of aspectual values per feature between verbs and nouns (%)

lexical regularities. The results obtained and the methodology developed will be exploitable for the comparative study of deverbal nouns in different languages. They may also feed research in related fields, such as computational linguistics, psycholinguistics and philosophy of language, by providing elements for computational semantic analysis, investigations of the mental lexicon, and reflection on the ontology of abstract situations.

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