When morphology meets regular polysemy

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Abstract

This study investigates the existence of complex morphological patterns that include a regular polysemy extension. Such complex patterns derive ambiguous words whose semantic types are both related and specified. To address this issue, nouns derived from verbs in French are investigated. A sample of 2,953 deverbal nouns ending with 46 suffixes are collected and systematically analyzed with respect to semantic properties and lexical ambiguity. Thirty-eight complex patterns are identified. The formation of ambiguous nouns whose meanings fit into a regular polysemy pattern appears as a discriminative property of some suffixes. Different kinds of patterns are further distinguished, depending on whether secondary meanings in complex patterns can be directly related to a base verb or not. In accordance with the literature on the polysemy of nominalizations, the semantic categories of EVENT and RESULT are prominent in morphological patterns, but other semantic types such as AGENT, INSTITUTION and COGNITIVE OBJECT are importantly represented as well. In addition, metonymy is the main semantic figure observed in complex patterns. Overall, the article sheds new light on the relationship between word formation and lexical polysemy by describing the possibility of direct association between them.

Keywords: polysemy, derivation, affix, nominalization, French

Résumé

Cette étude cherche à établir l'existence de patrons morphologiques complexes comprenant une extension polysémique régulière, permettant de former des noms ambigus dont les types sémantiques sont à la fois liés et spécifiés. Pour traiter de cette question, 2953 noms déverbaux du français, construits avec 46 suffixes différents, sont collectés et analysés sémantiquement. Au total, 38 patrons complexes sont identifiés. La formation de noms ambigus dont les sens s'inscrivent dans un schéma de polysémie régulière apparaît comme une propriété distinctive de certains suffixes. Différents types de patrons complexes sont en outre distingués, selon que les sens secondaires des noms dérivés peuvent être ou non

directement liés au verbe de base. En accord avec la littérature existante sur la polysémie des nominalisations, les catégories sémantiques ÉVÉNEMENT et RÉSULTAT apparaissent comme essentielles dans les schémas morphologiques. Cependant, d'autres types tels que AGENT, INSTITUTION et OBJET COGNITIF sont également répandus. La métonymie est, par ailleurs, la principale figure sémantique observée au sein des patrons complexes. Dans l'ensemble, l'article apporte un éclairage nouveau sur les relations entre polysémie lexicale et construction morphologique en décrivant la possibilité d'association directe entre celles-ci.

Mots-clefs : polysémie, dérivation, affixe, nominalisation, français

1. Introduction[*]

The derivation from verb to noun is known to be associated with a wide variety of output meanings in many languages. In the literature on nominalizations, this variety of meanings has been studied following two lines of research. On the one hand, morphologists have investigated the different semantic types produced by verb-to-noun derivation and the multiplicity of meanings associated with deverbal suffixes – a property that is sometimes referred to as the "polysemy" of suffixes (see e.g., Müller, 2011 for *-er* in German; Fradin, 2016 for *-age* and *-ment* in French; Lieber, 2016 for 18 suffixes in English). On the other hand, semanticists have studied the polysemy of nominalizations and the regular associations observed between their various meanings (see e.g., Pustejovsky, 1995 for English; Ježek, 2008 for Italian; Barque *et al.*, 2014 for French). These two lines of research are rarely combined, although the relationship between the polysemy of deverbal suffixes and the polysemy of deverbal nouns appears to be complex and calls for further investigation. The polysemy of affixes does not necessarily imply that of derived words. As shown by Varvara *et al.* (2022), deverbal suffixes can be highly variable with respect to how their possible output meanings are distributed among derivatives and generate lexical ambiguity. [1] Nevertheless, the

[1] We use the term *ambiguity* to refer to the property of having several meanings that are mutually exclusive. For example, the ambiguous noun *diner* can denote either a person or a building, but a single occurrence of this noun cannot denote both meanings at the same time. Ambiguity encompasses polysemy, i.e., when meanings are related semantically, and homonymy, i.e., when they are not.

combination of semantic types in polysemous nominalizations may depend to some extent on suffix properties and should be analyzed as such.

A few studies have investigated the relationship between nominalizing suffixes and the ambiguity of deverbal nouns. For example, Melloni (2006) has described the EVENT/RESULT polysemy in Italian as a property of nominalizations ending in *-mento, -zione, -tura*; Ferret and Villoing (2015) have examined the capacity of the French suffix *-age* to form polysemous nouns with 'event' and 'instrument' interpretations; Schulte (2015) has investigated the semantic types of *-age* and *-ery* derivatives in English and their frequency of co-realization in polysemous nominalizations. However, these studies are limited to some suffixes, making it difficult to identify distinctive suffix properties and to get an overview of how polysemous combinations are distributed in the derivational system. The structure of polysemy could also be further explored by examining whether the ambiguity of nominalizations results from multiple derivations or from a metonymic or metaphorical extension, and whether associated semantic types can be independently realized for a given suffix. It could be the case that morphological patterns include a polysemy pattern, if it appears that some combinations of meanings in polysemous nominalizations are exclusively observed for some suffixes, and if certain meanings associated with a suffix are only instantiated in polysemous nominalizations. In French for example, the formation of polysemous deverbal nouns in *-ion* that denote both an event and a collective agent could result from a complex derivational pattern, as illustrated in (1).

(1)   V + *-ion* → N 'event'/'collective agent'
        a. *rédiger* 'write' + *-ion* → *rédaction* 'writing'/'editorial board'
        b. *se rebeller* 'rebel' + *-ion* → *rébellion* 'rebellion'/'rebels'
        c. *immigrer* 'immigrate' + *-ion* → *immigration* 'immigration'/'immigrants'

The 'collective agent' meaning with *-ion* appears to be only realized in ambiguous nouns that also have the 'event' meaning, and the ambiguity between 'event' and 'collective agent' does not seem to be observed in nominalizations ending with other eventive suffixes such as *-age, -ade, -aison* or *-ure*. Accordingly, it could be considered that the formation of nouns with the 'event'/'collective agent' polysemy is a property of *-ion*, and that *-ion* is distinctively associated with a complex morphological pattern that includes the 'event' → 'collective agent' sense extension. Generally speaking, the formation of ambiguous deverbal nouns whose meanings fit into a regular polysemy pattern could be a subsidiary property of suffixes.

In this paper, we investigate whether nominalizing suffixes in French are associated with complex derivational patterns that integrate a regular polysemy extension, i.e., patterns that

produce polysemous nouns with both related and specified semantic types. We explore the system of French deverbal suffixes to identify associations of semantic types in polysemous nominalizations that are suffix-dependent, and analyze the relationship between associated semantic types (as based on multiple derivation or lexical figure). Given that semantic functions of suffixes can only be observed through their realization in derivation, we collect and analyze a large number of nominalizations representative of the diversity of deverbal suffixes, which allows us to study how regular sense alternations can be related to the morphological properties of deverbal nouns.

The article is organized as follows. In Section 2, we review some theoretical elements concerning polysemy and regular sense alternations in deverbal nouns. Section 3 outlines our data collection method and the semantic analysis that was performed on the collected nouns. Results are presented and discussed in Section 4.

2. Morphological derivation and regular polysemy

In this section, we discuss the possible combination of morphological and regular polysemy patterns to produce ambiguous deverbal nouns. In Section 2.1., we present the different configurations of ambiguity that can be instantiated by deverbal nouns, with respect to both morphological and semantic structure. Section 2.2. reports on regular associations of semantic types that have been described in the literature for verb-to-noun derivation. In Section 2.3., we introduce the criteria used to identify complex patterns that include a regular polysemy extension.

2.1. Patterns of ambiguity

As noted in the literature (Booij, 1986; Panther & Thornburg, 2002; Melloni, 2011; Ferret & Villoing, 2015; among others), the ambiguity of deverbal nouns can be variously motivated and find its source in different morphological and/or semantic patterns. While lexical ambiguity may result from figurative extension as in the simplex lexicon, it may also originate in multiple derivational processes. Figure 1 presents the different morphosemantic patterns in which ambiguous nominalizations can be formed. Note that we focus here on synchronic analysis and on lexical mechanisms that are independent of word history.
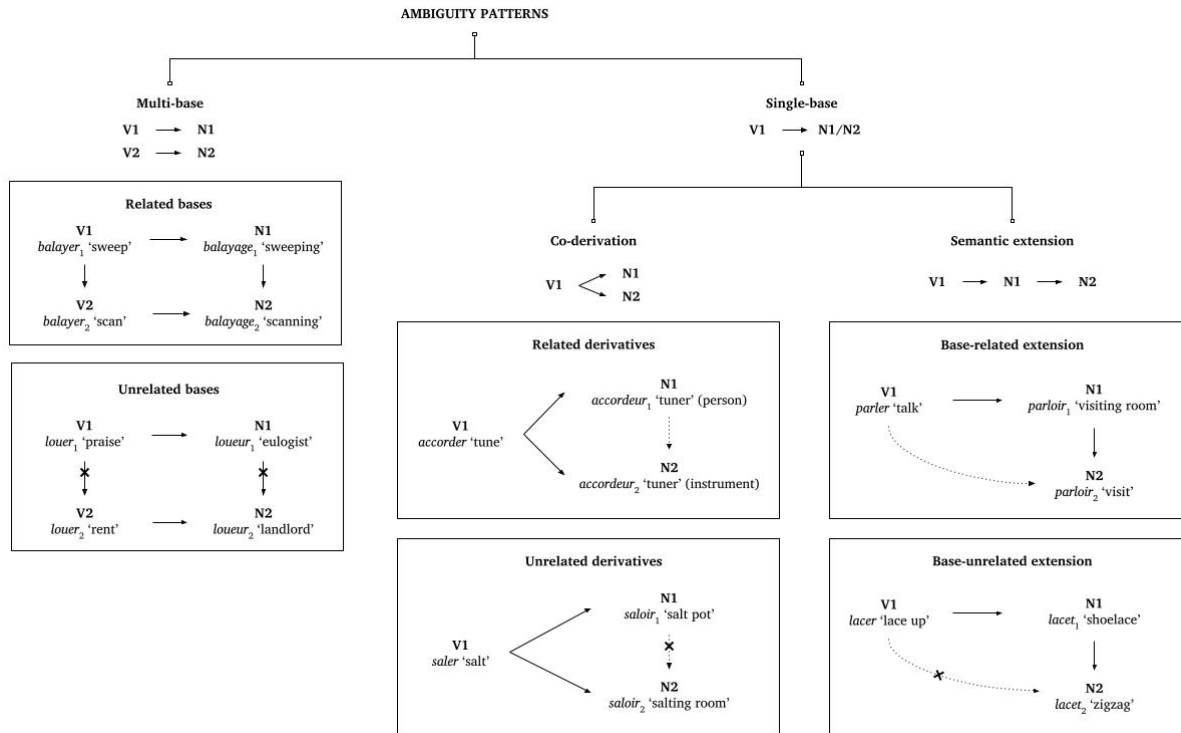
Figure 1. Ambiguity patterns in deverbal nouns

In multi-base derivation, two meanings of the base verb lead independently to two meanings of the derived noun.[2] V1 and V2 may be unrelated semantically, i.e., homonymous (e.g., $louer_1$ 'praise' → $loueur_1$ 'eulogist' and $louer_2$ 'rent' → $loueur_2$ 'landlord'), but they may also be linked metonymically or metaphorically, i.e., polysemous. The verb $balayer_2$ 'scan', for example, can be analyzed as a metaphor of $balayer_1$ 'sweep'. The figure between V1 and V2 may also be identified between N1 and N2, especially if the nouns denote the same type of events as the base verbs (e.g., $balayage_1$ 'sweeping' and $balayage_2$ 'scanning').

In single-base derivation, by contrast, ambiguous nominalizations are derived from the same meaning of the base verb. Two sub-patterns can be distinguished here: co-derivation and semantic extension. In co-derivation, two meanings are independently derived from the same base verb meaning (V1 → N1 and V1 → N2), whereas in semantic extension, ambiguity is built up step by step. A noun is first created by derivation and then undergoes semantic extension through metaphor or metonymy (V1 → N1 and N1 → N2). It can be difficult to

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[2] As is well known, verbal ambiguity is not always easy to identify, and consequently the distinction between V1 and V2 can at times be delicate. Moreover, depending on the semantic theory adopted, verbal meanings can be considered as more or less invariant (see e.g., Paillard, 2001). Here we assume that a change in lexical aspect or semantic role assignment is sufficient to consider multiple verbal meanings.

distinguish between co-derivation and semantic extension when N2 appears to be semantically linked to both N1 and V1. Such is the case in French of deverbal nouns in *-eur* that denote both an agent and an instrument (e.g., *accorder* 'tune' → *accordeur* 'tuner'), or deverbal nouns in *-oir* that denote both a location and an event (e.g., *parler* 'talk' → *parloir* 'visiting room'/'visit'). However, there is an important difference between N2s depending on whether their semantic type can or cannot be derived independently of any N1. Co-derivation can be assumed for a given suffix *-x* if the semantic type of N2 can be produced independently, i.e., in monosemous words suffixed with *-x*. Conversely, semantic extension can be assumed for N2s ending in *-x* if their semantic type cannot be derived independently through suffixation in *-x*. Accordingly, a deverbal noun ending in *-eur* that denotes both an agent and an instrument will be analyzed as a case of co-derivation, given that *-eur* can form both monosemous agent nouns (e.g., *déménager* 'move' → *déménageur* 'mover') and monosemous instrument nouns (e.g., *réfrigérer* 'refrigerate' → *réfrigérateur* 'fridge'). On the other hand, a deverbal noun ending in *-oir* that denotes both a location and an event will be analyzed as a case of semantic extension, given that *-oir* can form monosemous location nouns (*se promener* 'walk' → *promenoir* 'walkway') but not monosemous event nouns.

   Two scenarios can be further distinguished for co-derivation and semantic extension, depending on whether a semantic link can be established or not between N1 and N2, and V1 and N2, respectively. As far as co-derivation is concerned, N1 and N2 can sometimes be analyzed as metaphorically or metonymically related. In the example given above, $accordeur_2$ 'tuner' (instrument) can be interpreted as a metonymy of $accordeur_1$ 'tuner' (person), as it denotes the instrument with which an agent performs the action of tuning.[3] By contrast, the semantic link between $saloir_1$ 'salt pot' and $saloir_2$ 'salting room' – which can be analyzed as co-derived based on the fact that *-oir* forms monosemous instrument and location nouns (e.g., *raser* 'shave' → *rasoir* 'razor' and *promener* 'walk' → *promenoir* 'walkway') – seems more tenuous. When it comes to semantic extension, N2s can be semantically related to base verbs, as in the case of $parloir_2$, which denotes prison visits during which inmates talk to their visitors. However, N2s may also lack a semantic link with the base verb: $lacet_2$ 'zigzag', for example, is

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[3] The relationship between instrumental and agentive meanings has also been analyzed as a metaphor. As noted by Booij (2005, p. 221), "[t]he shift from PERSON to INSTRUMENT is an example of domain shift that one often finds in natural languages. This chain can be seen as a metaphorical one: the notion AGENT is transferred to the domain of inanimate material things that are conceived of as agents that perform a particular task."

metaphorically derived from *lacet*₁ 'shoelace' but has no semantic relationship with the verb *lacer* 'lace up'.

2.2. Regular polysemy in verb-to-noun derivation

The relationship between the different meanings of ambiguous nominalizations calls for further examination, especially when they result from semantic extension as presented in Figure 1. While the semantic relationship may be idiosyncratic (e.g., *lacet* 'shoelace'/'zigzag'), it may also be regular if various nominalizations with similar semantic types instantiate it. Such is the case, for example, of the alternation between the 'event' and 'collective agent' meanings in *rédaction* 'writing'/'editorial board', *rébellion* 'rebellion'/'rebels' and *immigration* 'immigration'/'immigrants' in (1). Regular polysemy is defined in the seminal study of Apresjan (1974, p. 16) as follows:

> [p]olysemy of the word A with the meanings a_i and a_j is called regular if, in the given language, there exists at least one other word B with the meanings b_i and b_j, which are semantically distinguished from each other in exactly the same way as a_i and a_j and if a_i and b_i, a_j and b_j are nonsynonymous.

Typical examples of regular polysemy are nouns that denote both animals and their meat (e.g., *chicken, lamb* in English) or nouns that denote containers and their content (e.g., *glass, spoon* in English). Interestingly, Apresjan (1974, pp. 16-17) already alludes to the close links between morphology and regular polysemy: "In addition to metonymical transfers several other processes give rise to regular polysemy. Among them are semantic analogy [...], compression of phrases [...], and various word-formation processes [...]." If ambiguous deverbal nouns do follow regular polysemy patterns, then one may ask whether these patterns are dependent on the morphological construction of the polysemous nouns or are realized independently of derivational processes (e.g., as in the simplex lexicon). In the former case, polysemous deverbal nouns would fit into complex patterns that include both a derivational pattern and a regular polysemy pattern, or to put it differently, into morphological patterns that derive polysemous words with specified semantic types.

Many regular sense alternations involving deverbal nouns have been described in the last decades. The most discussed pattern in the literature on nominalizations is undoubtedly the EVENT/RESULT one (2a) (see e.g., Anscombre, 1986; Grimshaw, 1990; Pustejovsky, 1995; Jacquey, 2006; Bisetto & Melloni, 2007; Melloni, 2011; Lieber, 2016; Alexiadou, 2019). However, the label "result" covers different scenarios depending on the authors and the theoretical stance they take. Whereas in the generative tradition, it is used as a cover term for

deverbal nominals that do not exhibit argument structure, morphological approaches generally reserve it for nouns that semantically denote a result (or product) with respect to the eventuality denoted by the base verb. Given the privileged relationship that deverbal nouns have with the action domain, it comes as no surprise that other alternations involving an event-related meaning are also observed, including EVENT/STATE (2b), EVENT/COGNITIVE OBJECT (2c), EVENT/INSTRUMENT (2d), EVENT/LOCATION (2e), as well as EVENT/AGENT (2f) (Godard & Jayez, 1996; Osswald, 2005; Jacquey, 2006; Ježek, 2008; Huyghe & Jugnet, 2010; Melloni, 2011; Barque *et al.*, 2014; Ferret & Villoing, 2015; Fradin, 2016; a.o.). Not all cases, however, imply an eventuality. Other authors have also investigated AGENT/INSTRUMENT (2g) and STATE/STIMULUS (2h) as semantic alternations possibly instantiated by deverbal nouns (Booij, 1986; Huyghe & Tribout, 2015; Barque *et al.*, 2012).

(2) a. EVENT/RESULT: *construction* 'building', *gribouillage* 'scribbling'/'scribble'
   b. EVENT/STATE: *humiliation* 'humiliation'/'shame', *satisfaction* 'satisfaction'
   c. EVENT/COGNITIVE OBJECT: *description* 'description', *révélation* 'revelation'
   d. EVENT/INSTRUMENT: *éclairage* 'lighting'/'light', *équipement* 'equipping'/'equipment'
   e. EVENT/LOCATION: *passage* 'passing'/'pathway', *croisement* 'passing'/'junction'
   f. EVENT/AGENT: *rébellion* 'rebellion'/'rebels', *rédaction* 'writing'/'editorial board'
   g. AGENT/INSTRUMENT: *accordeur* 'tuner', *découpeuse* 'jigsaw operator'/'circular saw'
   h. STATE/STIMULUS: *appréhension* 'apprehension', *obsession* 'obsession'

Very few studies have discussed how regular sense alternations such as those in (2) are related to the derivational nature of nominalizations, and in particular whether they are observed in multi-base derivation, single-base co-derivation, or result from semantic extension. It may be asked (i) whether the different word senses are directly related or not, and (ii) in case they are directly related, whether the relationship depends or not on the morphological structure of the nouns. The potential implication of derivational processes should be considered insofar as not all nominalizing suffixes are associated with the same semantic categories of input and output. A sense alternation that is exhibited by deverbal nouns ending with a given suffix and that fits into a regular polysemy pattern may be conditioned by the word formation process itself. In what follows, we will explore the possibility that semantic extensions in single-base ambiguity patterns are dependent on morphological specifications and, accordingly, that some derivational patterns include a regular polysemy pattern.

2.3. Identifying complex patterns

We set five criteria to test the existence of complex morphological patterns that include a regular sense extension and to possibly identify the suffixes and alternations at stake. These criteria apply differently to bisemous nouns and to nouns with more than two meanings. A prerequisite is that all five conditions should be observed in single-base ambiguity patterns (see Figure 1). Multi-base patterns are not to be considered when evaluating the existence of complex morphological patterns, since these are by definition related to the same verbal entry. The criteria presented in this section therefore apply only to polysemous nouns that can be directly or indirectly associated with one verbal meaning.

In the case of bisemous nouns, the existence of complex derivational patterns can be assumed based on the joint fulfillment of three conditions, hereafter designated as **C1**, **C2**, and **C3**.

> [**C1**]   There are at least two polysemous nouns ending with the suffix -*x* that have type A and type B meanings.

This criterion is used to ensure regularity by dismissing cases of idiosyncratic ambiguity. The polysemy of nouns such as *lacet* 'shoelace'/'zigzag', which is based on ad hoc metaphorical extension, is not considered a possible part of a complex pattern.

> [**C2**]   When realized by the suffix -*x*, type B meaning is only instantiated by polysemous nouns.

This second criterion allows us to identify cases of semantic extension as opposed to co-derivation. Here, we exclude cases in which the semantic type B is realized independently for nouns ending in -*x*, considering that the existence of monosemous nouns with type B meaning shows the existence of an independent derivational pattern – and consequently, that ambiguous nouns with type B meanings are co-derived (see Section 2.1). For example, the agentive and instrumental meanings of nouns such as *arroseuse* 'person who waters'/'street washing truck' and *veilleuse* 'lookout'/'night light' are not considered the result of a lexical polysemy pattern, given that these two semantic types can also be realized by monosemous nouns ending in -*euse* (e.g., the agent noun *nageuse* 'swimmer' and the instrument noun *centrifugeuse* 'juice extractor').[4]

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[4] For a detailed discussion of the agent-instrument polysemy in derivation, see Booij (1986), Watmough (1995), Bauer (2000), Luján (2010), Luschützky and Rainer (2011), among others. The ability of some suffixes to form agent and instrument nouns is often considered the result of a "semantic extension" from agent to instrument. However, it is important to distinguish here between semantic extension at

[**C3**]   If other suffixes than -*x* form nouns with type A meaning, not all of them derive polysemous
       nouns with type A and type B meanings.

The third criterion ensures that all deverbal suffixes that are used to derive nouns with the
first meaning do not necessarily form polysemous nouns exhibiting both the first and the
second semantic types, and accordingly, that it is a distinctive property of -*x* to form
ambiguous nouns with a combination of A and B meanings. This condition allows us to
identify cases of semantic extension that are dependent on morphological patterns, as opposed
to free associations between polysemy patterns (possibly attested in the simplex lexicon) and
morphological patterns. By applying to suffixes selectively, some polysemy patterns prove to
be embedded in morphological patterns.

Two more conditions, **C4** and **C5**, are added for nouns with more than two meanings.

[**C4**]   If all the nouns formed with -x that instantiate type C and type B meanings also instantiate
       type A and type B meanings, but not reciprocally, then only the association between A and B
       is considered part of a complex pattern for -*x*.

This criterion is used to exclude potential cases of "false" patterns, which would be
subordinate to existing patterns but could be identified as independent complex patterns
based on **C1**-**C3**. For example, if two potential patterns EVENT/RESULT and
PROPERTY/RESULT are found for a given suffix, but that each time the association
PROPERTY/RESULT is observed, the association EVENT/RESULT is also present, and not
reciprocally, then the formation of PROPERTY/RESULT nouns is probably not a complex
derivational pattern in itself.

[**C5**]   If all the nouns formed with -*x* that instantiate type C and type B meanings also instantiate
       type A and type B meanings, and reciprocally, then the associations between A and B and
       between C and B are considered parts of complex patterns for -*x* and it is assumed that A-B
       and C-B are systematically associated for -*x*.

The last criterion is used to allow for complex patterns that would associate more than two
meanings, i.e., derivational patterns that productively form polysemous nouns with three or

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the lexical level and semantic extension at the affixal level. The fact that some affixes extend their
semantic functionality based on conceptual associations (e.g., contiguity or analogy) does not imply
that their derivatives will be polysemous and instantiate multiple semantic types. Words derived with
polyfunctional affixes may be monosemous derivatives, only with different semantic types. Conversely,
the existence of polysemous derivatives does not necessarily indicate that the affix used is itself
polyfunctional. The meaning of a derived word can be extended in the lexicon independently of its
morphological structure.

more specified meanings (e.g., EVENT/INSTRUMENT/RESULT for a given suffix). As noted by Lieber (2018), some polysemous derivatives may indeed be amenable to more than one pattern at a time. In French, for example, *maquillage* 'makeup' denotes an event (3a), an instrument (3b), as well as a concrete result (3c), therefore corresponding to both the EVENT/INSTRUMENT (2d) and EVENT/RESULT (2a) alternations mentioned in the previous section. The hypothesis that *-age* is associated with a complex pattern producing a combination of three different meanings should not be a priori dismissed.

(3)   a. Un questionnaire santé sera aussi rempli pour s'assurer de pouvoir effectuer le *maquillage* permanent sans complication. (Web)
'A health questionnaire will also be filled out to ensure that the permanent *makeup* can be performed without complication'
b. Elle m'a acheté du *maquillage* et des vêtements à la mode. (Web)
'She bought me *makeup* and fashionable clothes'
c. Visuellement, c'est bluffant, le casting est dingue, les costumes et les *maquillages* sont magnifiques et l'histoire est très bien écrite. (Web)
'Visually, it's amazing, the cast is great, the costumes and *makeup* are beautiful and the story is very well written'

In the following sections, we present the method followed to identify complex derivational patterns in French and the results observed for nominalizations and deverbal suffixes.

3. Method

As mentioned in the introduction, the semantic properties of derivational patterns can only be observed through their lexical realization. In this section, we describe how we collected (Section 3.1.) and analyzed (Section 3.2.) a large sample of deverbal nouns formed with a wide variety of suffixes in order to determine the existence of complex morphological patterns.

3.1. Data collection

Forty-six suffixes allowing for verb-to-noun derivation in French were considered for this study (4). Given that morphological patterns of gender-varying forms are not necessarily semantically equivalent, homographic suffixes were distinguished for deverbal suffixes that form both masculine and feminine nouns (e.g., *-aire*), and potentially allomorphic suffixes were treated separately if they differed in gender (e.g., *-eur/-eure/-eresse/-euse/-rice*). Allomorphs were analyzed together in the absence of gender variation (e.g., *-ance/-ence*).

(4)   *-ade, -age, -ail, -aille, -ain, -aire* (feminine), *-aire* (masculine), *-aison, -ance/-ence, -ant, -ante,*
        -ard, -arde, -ase, -asse, -eau, -elle, -er/-ier, -ère/-ière, -eresse, -erie, -et, -ette, -eur (feminine),
        -eur (masculine), *-eure, -euse, -in, -ine, -ing, -ion, -is, -ise, -isme, -iste* (feminine),
        -iste (masculine), *-ment, -oir/-oire* (masculine), *-oire* (feminine), *-on, -onne, -ose, -ot, -ote/-otte,*
        -rice, -ure

Regarding the choice of a method for collecting derivatives, the ideal option would obviously be to study all French deverbal nouns, which is unfortunately unfeasible. The possibility of random sampling was also ruled out, insofar as rare cases of regular polysemy might not have been identified[5] and our goal was to list as exhaustively as possible the semantic functions associated with a given suffix. We thus collected all deverbal nouns mentioned in two kinds of resources seeking to provide a comprehensive overview of affix versatility: (i) dictionary entries dedicated to the selected suffixes in lexicographic resources, viz. *Le Trésor de la Langue Française informatisé* (CNRS – Université de Lorraine, n.d.), *Petit dictionnaire des suffixes du français* (Le Petit Robert, n.d.) and *Le Robert méthodique* (Rey-Debove, 1985); and (ii) general studies aiming at a complete description of the derivational system in French (Dubois, 1962; Thiele, 1987; Apothéloz, 2002). Nouns recommended as synonyms and/or appearing in specialized studies were also added to the database to ensure that we would obtain the greatest semantic diversity possible.

In total, 3,091 nouns were collected, with very variable quotas depending on the suffixes ($M = 67.20$, $SD = 90.26$). While *-eur* (masculine form) ($n = 428$), *-ment* ($n = 329$) and *-ion* ($n = 253$) are associated with the largest numbers of derivatives in the sample, *-ase, -ose* and *-ail* are poorly represented, with only 3, 4 and 6 nouns, respectively.

3.2. Semantic analysis

To establish patterns of regular polysemy, one needs to describe the different semantic types involved. Many semantic classifications of deverbal nouns have been proposed over the years (see e.g., Ježek, 2008; Fradin, 2012; Lieber, 2016). However, the description of the nature of the referent (e.g., event, state, artefact) and the description of the relation with the eventuality[6] denoted by the base verb (e.g., transposition, result, instrument) are often conflated. To obtain a homogeneous description of nominalizations, we therefore

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[5] As a reminder, according to Apresjan (1974), two examples are indeed sufficient for a pattern to exist.

[6] We use the term *eventuality* to refer to situations of the world with temporal properties (Bach, 1981). These situations can be static (*agacement* 'annoyance', *tolérance* 'tolerance') or dynamic (*patinage* 'skating', *réunion* 'meeting').

systematically reanalyzed all collected nouns using a standardized, bipartite typology composed of *ontological* types and *relational* types. As illustrated below, ontological (Artefact, Animate, State) and relational (RESULT, INSTRUMENT, LOCATION) semantic components are not one-to-one related (5-6). Accordingly, they can be used to refine the analysis of some previously studied alternations, including EVENT/RESULT (7-8). We present the complete lists of ontological and relational types in the next two subsections, before describing our annotation procedure in Section 3.2.3.[7]

(5) a. *bâtir* 'build' → *bâtiment* 'building' [Artefact-RESULT]

b. *créer* 'create' → *créature* 'creature' [Animate-RESULT]

c. *énerver* 'irritate' → *énervement* 'irritation' [State-RESULT]

(6) a. *bâtir* 'build' → *bâtiment* 'building' [Artefact-RESULT]

b. *raser* 'shave' → *rasoir* 'razor' [Artefact-INSTRUMENT]

c. *garer* 'park' → *garage* 'garage' [Artefact-LOCATION]

(7) a. *coller$_1$* 'glue' → *collage$_1$* 'gluing' [Event-TRANSPOSITION]

b. *coller$_1$* 'glue' → *collage$_2$* 'collage' [Artefact-RESULT]

(8) a. *instituer$_1$* 'institute' → *institution$_1$* 'establishment' [Event-TRANSPOSITION]

b. *instituer$_1$* 'institute' → *institution$_2$* 'institute' [Institution-RESULT]

3.2.1. Ontological types

The ontological typology is composed of 14 simple semantic types (see Table 1 for the complete list), which are distinguished on the basis of distributional tests used for the semantic classification of nouns in French (Godard & Jayez, 1996; Flaux & Van de Velde, 2000; Huyghe, 2015; Haas *et al.*, 2022).

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[7] More information is provided in the annotation guide that was used for this work and which is available at the following link: https://github.com/semantics-deverbal-nouns/annotation-guide

Simple ontological type	Example
Animate	*collaboratrice* 'colleague'
Artefact	*bouilloire* 'kettle'
Cognitive	*juron* 'swear word'
Disease	*pelade* 'autoimmune alopecia'
Domain	*jardinage* 'gardening'
Event	*accouchement* 'labor'
Financial	*redevance* 'license-fee'
Institution	*association* 'association'
Natural	*nageoire* 'fin'
Phenomenon	*senteur* 'scent'
Property	*persévérance* 'perseverance'
Quantity	*métrage* 'length'
State	*agacement* 'annoyance'
Time	*échéance* 'due date'

Complex ontological type	Example
Artefact*Institution	*restaurant* 'restaurant'
Artefact*Cognitive	*circulaire* 'memorandum'
Cognitive*Event	*témoignage* 'testimony'
Event*Financial	*paiement* 'payment'
Event*Natural	*inflammation* 'inflammation'
Event*Phenomenon	*crissement* 'squealing'
Event*State	*emprisonnement* 'imprisonment'

Table 1. Ontological types

For example, *éclosion* 'hatching' and *réparation* 'repair' in (9) are considered to be Event, because they can be used as the subject of the verbs *se produire* 'occur' or *avoir lieu* 'take place', or as the object of the verb *effectuer* 'perform', *procéder à* 'proceed' or *accomplir* 'carry out'. The different tests are applied to one noun meaning at a time following a decision tree presented in detail in Haas *et al.* (2022).

(9)   a. L'*éclosion* des œufs a eu lieu ce matin.
         'The *hatching* of the eggs took place this morning'
         b. Elle a procédé à une *réparation* difficile.
         'She performed a difficult *repair*'

Seven complex types composed of 2 simple types are also included in the typology to take into account nouns with a hybrid semantic structure, which are often called "dot types" or

nouns with "facets"[8] (Pustejovsky, 1995; Cruse, 1995; Godard & Jayez, 1996; Kleiber, 1999; Asher, 2011; Murphy, 2021; a.o.) (see Table 1). Unlike true polysemes, these nouns allow for co-predication, i.e., a grammatical construction in which predicates of distinct semantic types can jointly apply to one argument without any zeugma effect. The noun *discussion* 'discussion', for example, is assigned the Cognitive*Event complex ontological type because it can combine with predicates typical of both Event (*avoir lieu* 'take place') and Cognitive content (*porter sur* 'focus on'), without the two meanings being mutually exclusive:

(10) La discussion qui a eu lieu hier à huis clos portait également sur les modalités de suivi, dans la perspective d'une action commune future. (Web)
`The discussion that took place yesterday behind closed doors also focused on the modalities of follow-up, with a view to future joint action'

As illustrated below, the typology also offers the possibility to indicate whether the noun is collective, i.e., has a plural reference when used in the singular, using the additional label Coll (Flaux, 1999; Lammert, 2006; de Vries, 2019; a.o.):

(11) a. *assister* 'attend' → *assistance* 'audience'   [Animate·Coll]
     b. *naître* 'be born' → *naissain* 'spawn'   [Natural·Coll]
     c. *tuer* 'kill' → *tuerie* 'massacre'   [Event·Coll]

3.2.2. Relational types

The relational typology comprises 18 types, which correspond to roles of participants in eventualities and are akin to semantic roles possibly assigned to verb arguments (see Table 2 for the complete list). Adapted from existing works on semantic roles, in particular *VerbNet* (Kipper Schuler, 2005) and *LIRICS* (Petukhova & Bunt, 2008), they are identified with the help of definitions.

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[8] Following Pustejovsky (1995), nouns with "facets" are often called "inherent polysemes". However, according to Dölling (2020, p. 24), the use of the label "polysemy" to refer to such cases should be reconsidered, in accordance with the fact that they display "only one meaning, which [...] is related to distinct aspects of the objects denoted by the respective noun". We adopt this point of view in this article.

Relational type	Definition	Example
AGENT	Entity that brings about an event intentionally	*forger* 'forge' → *forgeron* 'blacksmith'
BENEFICIARY	Entity that receives or is dispossessed of something, or that is advantaged or disadvantaged by an event or a state	*hériter* 'inherit' → *héritier* 'heir'
CAUSE	Entity that initiates an eventuality (not necessarily intentionally), or is the reason why an eventuality occurs	*agglutiner* 'agglutinate' → *agglutinine* 'agglutinin'
DESTINATION	Endpoint in a change of location	*cracher* 'spit' → *crachoir* 'spittoon'
EXPERIENCER	Entity that is in or enters a particular state in relation to a psychological, perceptive or physiological stimulation	*adorer* 'admire' → *adorateur* 'admirer'
EXTENT	Extensive value related to an event, or measurable magnitude of a change of state or location	*contenir* 'contain' → *contenance* 'capacity'
INSTRUMENT	Entity that is manipulated in order to perform an action	*arroser* 'water' → *arrosoir* 'watering can'
LOCATION	Entity that serves as a landmark to locate another entity or an event	*fumer* 'smoke' → *fumoir* 'smoking room'
MANNER	The way an action is performed, or the intensity of a state	*prononcer* 'pronounce' → *prononciation* 'pronunciation'
PATH	Trajectory followed during a change of location	*dévier* 'divert' → *déviation* 'detour'
PATIENT	Entity that undergoes a (potential) change of structure	*mourir* 'die' → *mourant* 'dying person'
PIVOT	Entity that is attributed a property, or is in a non-stimulated condition	*composer* 'make up' → *composante* 'component'
RESULT	Entity that is created through an event	*hacher* 'mince' → *hachis* 'ground meat'
SOURCE	Starting point in a change of location	*goutter* 'drip' → *gouttière* 'gutter'
STIMULUS	Entity that causes a psychological, perceptive or physiological state	*emmerder* 'bother' → *emmerdement* 'bother'
THEME	Entity that is in a certain location or changes location	*charger* 'load' → *chargement* 'load'
TOPIC	Entity that is a subject of thought, discussion or cognitive activity	*deviner* 'guess' → *devinette* 'riddle'
TRANSPOSITION	Eventuality denoted by the base word	*atterrir* 'land' → *atterrissage* 'landing'

Table 2. Relational types

In order to be able to account for situations where the noun roughly denotes the same type of eventuality as the base verb, a TRANSPOSITION type (e.g., ten Hacken, 2015) is included in the typology in addition to roles commonly found in the literature. This allows us to distinguish between a verb-noun pair such as *licencier* 'dismiss' → *licenciement* 'dismissal', where the verb and the noun denote the same kind of event, and a pair like *agacer* 'annoy' → *agacement* 'annoyance', where the noun refers to a result with respect to the verb.

The relational typology was also designed to capture lexicalized metaphorical (12b) and metonymic (13b) meanings which are derived from another meaning of a given noun but cannot be directly connected to a base verb. The relational type of these particular cases is always composed of (i) the relational type attributed to the meaning from which they derive (that is used as an indication to identify the source meaning) and (ii) a label UNRELATED (as it pertains to the verb).

(12) a. *lacer* 'lace up' → *lacet*$_1$ 'shoelace'   [INSTRUMENT]
      b. *lacet*$_1$ 'shoelace' → *lacet*$_2$ 'zigzag'   [(INSTRUMENT·)UNRELATED]
(13) a. *planter* 'plant' → *planteur*$_1$ 'planter'   [AGENT]
      b. *planteur*$_1$ 'planter' → *planteur*$_2$ 'Planter's punch'   [(AGENT·)UNRELATED]

3.2.3. Procedure

The evaluation of the collected nouns was performed by a single annotator, and problematic cases were settled by a second annotator. The method followed in this article had already been used in a previous study involving both annotators and the agreement scores were

substantial[9] (Huyghe *et al.*, to appear). In order to consistently describe cases of ambiguity, different meanings were systematically postulated for any change of base verb[10] (14), ontological type (15) or relational type (16). For each nominal meaning, we informed its base verb, its ontological type, as well as its relational type. Meanings listed as archaisms in *Le Petit Robert* (Éditions Le Robert, n.d.) or the *TLFi* (CNRS – Université de Lorraine, n.d.) were indexed as such in the database. In total, 5,212 meanings were found for the 3,091 collected nouns (see Section 4.1.).

(14) a. *manifester*$_1$ 'protest' → *manifestation*$_1$ 'protest' [Event-TRANSPOSITION]
  b. *manifester*$_2$ 'show' → *manifestation*$_2$ 'expression' [Event-TRANSPOSITION]

(15) a. *naviguer*$_1$ 'sail' → *navigateur*$_1$ 'sailor' [Animate-AGENT]
  b. *naviguer*$_1$ 'sail' → *navigateur*$_2$ 'instruments' [Artefact-INSTRUMENT]

(16) a. *emballer*$_1$ 'wrap' → *emballage*$_1$ 'wrapping paper' [Artefact-INSTRUMENT]
  b. *emballer*$_1$ 'wrap' → *emballage*$_2$ 'wrapping' [Artefact-RESULT]

4. Results

This section presents our results regarding the possible existence of complex derivational patterns that include a regular sense extension. We begin by giving general information about the ambiguity of the nouns we examined, before turning to the identification of complex patterns.

4.1. General information

Among the 5,212 meanings that were found during the semantic analysis, 357 were identified as archaisms (e.g., *deviner* 'guess' → *devinaille* 'riddle', *dormir* 'sleep' → *dormeuse* 'chaise longue', *loucher* 'squint' → *louchon* 'person with a squint'). Given that we wish to identify alternations realized by nouns still in use, we excluded them from further analysis. The new database is thus composed of 2,953 nouns, out of which 1,732 are monosemous and 1,221 are ambiguous, for a total of 4,855 meanings. On average, a noun has 1.64 meaning (*SD* =

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[9] Verbs and nouns were annotated in a double-blind process and a third annotator resolved cases of disagreement. The observed inter-annotator agreement over 501 deverbal nouns was 0.83 for ontological types and 0.93 for relational types, corresponding to Cohen's kappa values of 0.77 and 0.78, respectively, and prevalence-adjusted and bias-adjusted kappa (PABAK) values of 0.82 and 0.92, respectively.

[10] Different verbal entries were distinguished based on variation of lexical aspect, argument structure or semantic role assignment.

1.00). If only ambiguous nouns are taken into account, the average rises to 2.56 (*SD* = 0.99). Table 3 shows the ambiguity rate associated with each suffix, which is calculated by dividing the total number of meanings found for a given suffix by the total number of nouns formed with that suffix.

Suffix	Ambiguity rate	Suffix	Ambiguity rate
-ade	1.68	*-eure*	1.18
-age	1.98	*-euse*	1.58
-ail	1.50	*-ier*	1.28
-aille	1.35	*-ière*	1.23
-ain	1.25	*-in*	1.33
-aire fem.	1.08	*-ine*	1.20
-aire masc.	1.11	*-ing*	1.57
-aison	1.77	*-ion*	2.30
-ance	2.13	*-is*	1.34
-ant	1.26	*-ise*	1.80
-ante	1.17	*-isme*	1.09
-ard	1.27	*-iste* fem.	1.00
-arde	1.14	*-iste* masc.	1.00
-ase	1.00	*-ment*	1.89
-asse	1.63	*-oir*	1.35
-eau	1.62	*-oire*	1.35
-elle	1.83	*-on*	1.47
-eresse	1.11	*-onne*	1.00
-erie	1.74	*-ose*	1.00
-et	2.00	*-ot*	1.38
-ette	1.57	*-ote*	1.43
-eur fem.	2.00	*-rice*	1.17
-eur masc.	1.56	*-ure*	2.11

Table 3. Ambiguity rate of derivatives per suffix

Table 4 shows the distribution of ambiguous nouns according to ambiguity patterns. As presented in Section 2.1., we distinguish between single-base ambiguity, where there is only one base verb meaning involved in the formation of ambiguous nouns, and multi-base ambiguity, where more than one verb meaning can be identified.[11]

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[11] Note that some ambiguous nouns can correspond to both patterns. Such is the case of *éplucheur*: *éplucher$_1$* 'peel' → *éplucheur$_1$* 'person who peels'; *éplucher$_1$* 'peel' → *éplucheur$_2$* 'potato peeler'; *éplucher$_2$* 'go through' → *éplucheur$_3$* 'copy editor'.

Ambiguity patterns	Number of nouns	Number of meanings
Single-base	867	2,084
Multi-base	558	1,039

Table 4. Distribution of ambiguous nouns according to ambiguity patterns

Table 5 shows the distribution of the 912 verb-noun pairs that appear in single-base ambiguity according to the number of meanings involved. A noun can be counted more than once if it is linked to two different verbal bases and if each of them is associated with more than one nominal meaning. For example, the noun *parure* is counted twice, since two of its meanings ('adorning', 'set of jewels') can be linked to *parer*$_1$ 'adorn', and two others ('dressing', 'trimming') to *parer*$_2$ 'dress'. The total number of relations observed between meanings in single-base ambiguity is 1,499.

Number of meanings	Number of pairs	Number of relations involved
2	707	707
3	160	480
4	37	222
5	6	60
6	2	30

Table 5. Distribution of verb-noun pairs in single-base ambiguity according to their number of meanings

The number of verb-noun pairs present in cases of single-base ambiguity varies with the suffix. The suffixes associated with the highest percentages are *-ise* (80%), *-eur* fem. (75%), and *-et* (56%), while 9 suffixes (*-ase, -eresse, -eure, -ine, -isme, -iste* masc.*, -iste* fem.*, -onne,* and *-ose*) do not form any ambiguous nouns related to the same verbal meaning.

Regarding the semantic description of derivatives, 150 different complete semantic types, i.e., combining an ontological type and a relational type, are identified in the sample. One hundred forty-four of them appear in single-base ambiguity. The most frequent ones are Event-TRANSPOSITION (e.g., *ajuster* 'adjust' → *ajustage* 'fitting') (*n* = 331 meanings), Artefact-INSTRUMENT (*n* = 308) (e.g., *faner* 'ted' → *faneuse* 'hay tedder'), and Animate-AGENT (e.g., *programmer* 'schedule' → *programmateur* 'scheduler') (*n* = 208), while 50 complete types appear only once.

The frequency of realization of complete types in single-base ambiguity also varies according to the suffix. For example, for *-age*, the most frequent types are Event-TRANSPOSITION (e.g., *nettoyer* 'clean' → *nettoyage* 'cleaning') (40% of the meanings), Artefact-RESULT (e.g., *tatouer* 'tattoo' → *tatouage* 'tattoo') (19%), and Artefact-INSTRUMENT (e.g., *emballer* 'wrap' → *emballage* 'wrapping paper') (8%), while for *-eur* masc., the most frequent types are Artefact-INSTRUMENT (e.g., *trier* 'sort' → *trieur* 'file box') (37%), Animate-AGENT (e.g., *semer* 'sow' →

semeur 'seed sower') (37%), and Natural-CAUSE (e.g., *inhiber* 'inhibit' → *inhibiteur* 'inhibitor') (7%).

Five hundred twenty-three different associations of complete types are identified among cases of single-base ambiguity. While the most frequent associations are Animate-AGENT/Artefact-INSTRUMENT (n = 165 verb-noun pairs), Event-TRANSPOSITION/Artefact-RESULT (n = 73), and Event-TRANSPOSITION/Artefact-INSTRUMENT (n = 40), 341 associations appear only once. Here again, the frequency of semantic associations depends on the suffix. For example, for *-age*, the most frequent associations are Event-TRANSPOSITION/Artefact-RESULT (26% of the verb-noun pairs), Event-TRANSPOSITION/Artefact-INSTRUMENT (10%), and Event-TRANSPOSITION/Artefact·Coll-RESULT (6%), whereas for *-eur* masc., they are Animate-AGENT/Artefact-INSTRUMENT (46%), Artefact-INSTRUMENT/Natural-CAUSE (8%), and Animate-AGENT/Institution-AGENT (7%).

4.2. Complex patterns

As a reminder, the combination of three basic conditions **C1-C3** was considered sufficient to demonstrate the existence of complex derivational patterns (see Section 2). Two additional conditions **C4-C5** were provided to deal with polysemous nouns that have more than two meanings. In order to meet the first condition **C1**, we extracted from the database all semantic alternations realized at least twice in single-base ambiguity for a given suffix, so that there were at least two polysemous nouns ending with the suffix *-x* that had type A and type B meanings. At this stage, the provisional list contained 324 alternations, for a total of 19 suffixes. The second condition **C2** required to check that, when realized by the suffix *-x*, type B meaning was only instantiated by polysemous nouns. Following the application of this condition to the provisional list, 59 potential alternations were retained, associated with 11 different suffixes. One alternation was removed from the list at this stage because the first semantic type (Artefact-(INSTRUMENT·)UNRELATED) was not attachable to the base verb, and consequently, could not result from derivation. For the third condition **C3**, we made sure that if other suffixes than *-x* formed nouns with type A meaning, not all of them would derive polysemous nouns with type A and type B meanings. No alternation had to be removed from the provisional list based on this third condition.

All remaining alternations were then examined to determine if they matched the additional conditions **C4** and **C5**. They were used to exclude potential cases of "false" patterns and to allow for complex patterns that would associate more than two meanings, respectively. While no alternation corresponded to **C5**, 20 alternations were removed from the list because they

matched **C4**. In the end, 38 alternations were identified for a total of 11 suffixes, therefore confirming our hypothesis of the existence of complex derivational patterns. They are presented in Table 6.

Suffix	First semantic type	Second semantic type	Example	Number of sense alternations	Realization rate (%)
-ade	Event-TRANSPOSITION	Artefact-LOCATION	*promenade* 'walk'/'promenade'	2	5.71
-age	Event-TRANSPOSITION	Artefact-LOCATION	*parcage* 'parking'/'parking lot'	5	2.70
-age	Event-TRANSPOSITION	Artefact-RESULT	*collage* 'gluing'/'collage'	36	19.46
-age	Event-TRANSPOSITION	Artefact-Coll-RESULT	*assemblage* 'assembling'/'assembly'	8	4.32
-age	Event-TRANSPOSITION	Cognitive-TOPIC	*essartage* 'clearing'/'obligation to clear'	3	1.62
-age	Event-TRANSPOSITION	Natural-LOCATION	*virage* 'turn'/'bend'	4	2.16
-age	Event-TRANSPOSITION	Natural-RESULT	*ensilage* 'ensilage'/'silage'	2	1.08
-age	Event-TRANSPOSITION	Property-RESULT	*bronzage* 'sunbathing'/'tan'	3	1.62
-aison	Event*State-TRANSPOSITION	Event*State-Coll-TRANSPOSITION	*feuillaison* 'foliation'/'leafing period'	3	25.00
-ance	Event-TRANSPOSITION	Cognitive-TOPIC	*souvenance* 'remembering'/'memory'	2	5.41
-ance	Event-TRANSPOSITION	Institution-AGENT	*présidence* 'presiding'/'presidency'	9	24.32
-ance	Event-TRANSPOSITION	Natural-SOURCE	*naissance* 'birth'/'base'	3	8.11
-ance	Property-MANNER	Cognitive-TOPIC	*observance* 'observance'/'rule'	2	18.18
-ance	Property-TRANSPOSITION	Cognitive-TOPIC	*connaissance* 'knowledge'/'knowledge'	3	15.79
-ance	State-TRANSPOSITION	Cognitive-TOPIC	*espérance* 'hope'/'hope'	5	26.32
-ette	Artefact-INSTRUMENT	Animate-(INSTRUMENT-)UNRELATED	*lavette* 'dishcloth'/'drip'	2	9.52
-ette	Artefact-INSTRUMENT	Natural-(INSTRUMENT-)UNRELATED	*pincette* 'tweezers'/'leg'	2	9.52
-eur masc.	Animate-AGENT	Artefact-(AGENT-)UNRELATED	*planteur* 'planter'/'Planter's punch'	2	0.55
-eur masc.	Animate-AGENT	Artefact-RESULT	*tailleur* 'tailor'/'suit'	2	0.55
-eur masc.	Animate-AGENT	Institution-AGENT	*éditeur* 'editor'/'publishing house'	12	3.29
-ing	Domain-TRANSPOSITION	Artefact-INSTRUMENT	*jogging* 'jogging'/'tracksuit'	2	14.29
-ion	Cognitive*Event-TRANSPOSITION	Artefact*Cognitive-INSTRUMENT	*attestation* 'confirmation'/'certificate'	4	9.30
-ion	Event-TRANSPOSITION	Animate-Coll-AGENT	*immigration* 'immigration'/'migrants'	4	2.82
-ion	Event-TRANSPOSITION	Artefact-INSTRUMENT	*canalisation* 'channeling'/'pipe'	6	4.23
-ion	Event-TRANSPOSITION	Cognitive-RESULT	*conclusion* 'conclusion'/'conclusion'	10	7.04
-ion	Event-TRANSPOSITION	Institution-AGENT	*organisation* 'organization'/'organization'	10	7.04
-ion	Event-TRANSPOSITION	Natural-Coll-RESULT	*plantation* 'planting'/'plantation'	3	2.11
-ion	Event*State-TRANSPOSITION	Artefact-INSTRUMENT	*fixation* 'fastening'/'binding'	7	4.32
-ion	Event*State-TRANSPOSITION	Artefact*Cognitive-INSTRUMENT	*autorisation* 'permission'/'permit'	2	1.23
-ion	Event*State-TRANSPOSITION	Institution-RESULT	*association* 'association'/'association'	4	2.47
-ion	Event*State-TRANSPOSITION	Natural-Coll-RESULT	*agrégation* 'aggregation'/'aggregation'	4	2.47
-ment	Event-TRANSPOSITION	Artefact-LOCATION	*hébergement* 'accommodation'/'lodgings'	3	2.08
-ment	Event-TRANSPOSITION	Artefact-Coll-INSTRUMENT	*équipement* 'equipping'/'equipment'	3	2.08
-ment	Event-TRANSPOSITION	Institution-AGENT	*gouvernement* 'governing'/'government'	2	1.39
-oire	Natural-INSTRUMENT	Artefact-(INSTRUMENT-)UNRELATED	*mâchoire* 'jawbone'/'jaw'	2	66.67
-ure	Event-TRANSPOSITION	Domain-TRANSPOSITION	*sculpture* 'sculpting'/'sculpture'	10	16.95
-ure	Natural-RESULT	Animate-(RESULT-)UNRELATED	*enflure* 'swelling'/'bastard'	5	7.04
-ure	Natural-RESULT	Artefact-(RESULT-)UNRELATED	*pelure* 'peel'/'coat'	4	5.63

Table 6. List of complex derivational patterns. The realization rate is calculated by dividing, for each suffix, the total number of verb-noun pairs realizing the alternation by the total number of verb-noun pairs realizing the first meaning, before multiplying the quotient by 100

Several elements can be discussed with respect to meanings involved in complex patterns. First, only a few semantic types available for deverbal nouns can be found in regular polysemy combinations produced by complex patterns, since out of the 150 semantic types observed in our data, only 11 feature in complex patterns as primary meaning, and 24 as secondary meaning. Second, these semantic types are unevenly distributed across patterns, both as primary (i.e., N1) and secondary (i.e., N2) meanings. Some semantic types trigger regular polysemy patterns more easily than others. In line with what has already been noted in the literature (see Section 2), the most frequent primary meaning is Event-TRANSPOSITION, which is present in about half of the complex patterns we identified (53%). This proportion even rises to 68% if all the primary semantic types that contain an eventive component are taken into account (i.e., Event-TRANSPOSITION, Cognitive*Event-TRANSPOSITION, Event*State-

TRANSPOSITION). Such a predominance confirms the privileged relationship that deverbal nouns have with the domain of events, as well as the strong metonymic potential of event description, which is based on the relationship between events and participants. Differences can also be observed among secondary meanings. While Cognitive-TOPIC, Institution-AGENT, Artefact-INSTRUMENT and Artefact-LOCATION are present in 5, 4, 3, and 3 complex patterns, respectively, 17 semantic types (e.g., Domain-TRANSPOSITION, Natural-LOCATION) are found in only one complex pattern. The distribution of secondary meanings with respect to relational *vs.* ontological types is quite heterogeneous as well. As far as relational types are concerned, RESULT is the most represented among patterns, with 29% of the secondary meanings listed. The most frequent ontological type is Artefact: it constitutes 25% of the secondary functions in the list.

Like semantic types, suffixes are not uniformly associated with regular polysemy alternations. Out of the 46 deverbal suffixes we studied, only 11 can be assigned complex morphosemantic patterns – at least based on the sample of nouns we annotated. The number of complex patterns observed for these 11 suffixes is also quite variable. While *-ion*, *-age* and *-ance* are associated with 10, 7 and 6 complex patterns, respectively, *-ade*, *-aison*, *-ing* and *-oire* only have one each. A positive correlation can be observed between the number of patterns and the number of nouns collected for each suffix (Pearson's $r(44) = .60, p < .01$). However, the correlation is not absolute and many suffixes instantiated by important quantities of nouns in our sample are not associated with any complex pattern. Such is the case of *-euse*, *-rice*, *-oir*, and *-erie*, all of which are represented by more than 100 nouns in our sample. It appears that the association with complex morphological patterns is a discriminative property among deverbal suffixes, and not just a function of their realization frequency. Another interesting element that can be pointed out concerns the special relationship that some suffixes seem to have with particular secondary meanings, whatever the primary type to which they are linked. In the case of *-ance*, for example, 4 different primary types can give rise to the secondary meaning of Cognitive-TOPIC, suggesting that *-ance* has a high affinity for this particular meaning, as in *connaissance* 'knowledge' and *espérance* 'hope'. It can also be noted that, although complex patterns including a secondary meaning with a result interpretation are observed for different suffixes, the ontological description associated with results may vary depending on the suffix. In particular, the suffix *-age* can form polysemous nouns that denote artefactual results, whereas *-ion* preferentially forms polysemous nouns that denote cognitive and collective results. Finally, it seems worth mentioning that three alternations (Event-TRANSPOSITION/Artefact-LOCATION, Event-TRANSPOSITION/Institution-AGENT, and Event-TRANSPOSITION/Cognitive-TOPIC) are associated with more than one suffix — but without all

the suffixes that realize the Event-TRANSPOSITION type also realizing the secondary types, in accordance with **C3**. This raises the question of a possible interaction between polysemy and affix rivalry and challenges the approach, often adopted in the literature, of examining in isolation the semantic types associated with competing affixes.

Lastly, the very structure of regular sense alternations can be discussed. Our results show that there are two types of complex patterns, depending on whether the secondary semantic type N2 can be directly related to the base verb or not (see Section 2.1.). The Event-TRANSPOSITION/Artefact-LOCATION pattern available for *-ment* and instantiated by nouns such as *logement* 'housing'/'house' and *hébergement* 'accommodation'/'lodgings', for example, involves a secondary meaning that can be directly analyzed with respect to the base verb: *logement* in its Artefact meaning denotes an entity that can be considered as the location of the verb *loger* 'accommodate'. By contrast, the Natural-RESULT/Animate-(RESULT·)UNRELATED pattern identified for *-ure*, which applies to nouns like *raclure* 'scraping'/'scumbag' and *enflure* 'swelling'/'bastard', includes a secondary meaning that cannot be directly connected to the base verb, but only to the primary meaning of nouns that fit into the pattern. It can be further noted that metaphorical relations between primary and secondary meanings in complex patterns are possible only when the secondary meaning is not directly related to the base verb. In other words, patterns involving secondary meanings that can be analyzed in relation to base verbs are strictly metonymic. As a consequence, if both the possible connection to base verbs and the semantic figure between primary and secondary meanings are taken into account, the following three cases can be distinguished:

(i)   The secondary meaning is derived from the primary meaning by metonymy and both meanings can be directly related to the base verb (e.g., Event-TRANSPOSITION/Artefact-RESULT for *-age*, as in *coller* 'glue' → *collage* 'gluing'/'collage').

(ii)   The secondary meaning is derived from the primary meaning by metonymy and only the latter can be directly related to the base verb (e.g., Animate-AGENT/Artefact-(AGENT·)UNRELATED for *-eur*, as in *planter* 'plant' → *planteur* 'planter'/'Planter's punch').

(iii) The secondary meaning is derived from the primary meaning by metaphor and only the latter can be directly related to the base verb (e.g., Natural-RESULT/Artefact-(RESULT·)UNRELATED for *-ure*, as in *peler* 'peel' → *pelure* 'peel'/'coat').

Although it can be argued that these three cases are not necessarily related to morphology, it should be remembered that the polysemy relations we describe are indeed characteristic of

some particular suffixes, and not of others. Moreover, they could potentially be indicative of fine semantic constraints on the use of the suffix. For example, in the case of *-ure*, we can wonder about the possible preponderance of verbal bases referring to physical processes, which could be related to some of the specific figurative patterns we identified for this suffix.

5. Conclusion

The goal of this study was to investigate the existence of complex derivational patterns that include a regular polysemy pattern. We focused on verb-to-noun derivation in French and collected a sample of 2,953 deverbal nouns ending with 46 different suffixes, aiming to achieve the widest possible semantic coverage. Based on a careful semantic description including relational and ontological information, 1,221 ambiguous nouns were identified, for a total of 4,855 meanings.

Through the analysis of the different configurations of ambiguity observed and their distribution across suffixes, we identified 38 complex morphological patterns that include a regular sense extension. One hundred ninety-five verb-noun pairs (i.e., 21% of all verb-noun pairs in the sample that can be related to one base verb meaning) ending with 11 different suffixes (i.e., 24% of all the suffixes instantiated in the sample) fit into these patterns, whose productivity is highly variable. In addition, the number of semantic types involved in complex patterns is limited (representing only 21% of all the semantic types observed in the sample of deverbal nouns), and strong preferences can be observed for certain ontological and relational types as source or target meanings in the regular polysemy patterns involved. This confirms that the nature of the referents and the relation between bases and derivatives should be distinguished when describing the semantics of deverbal nouns. From a structural point of view, our results reveal that complex patterns can present themselves in two different forms, depending on whether the target meanings can be directly connected to the base verb semantics or not. If this is the case, then the alternation always hinges on a metonymic link between the first and second meanings. If it is not, then the relation can be metonymic or metaphorical. Overall, metonymy remains the semantic figure of choice for sense extension in complex patterns.

We have established that some affixes have the property of forming polysemous words exhibiting a specific meaning alternation, and that this is indeed an affix specificity. It appears that derivational patterns can be complex and encompass a figurative extension, which results in morphologically-driven formation of polysemous words. The study sheds new light on the relations between word formation and polysemy, in that we observe a direct association

between these two types of lexical creation in addition to the structural comparisons sometimes mentioned in the literature (e.g., the fact that regularity and productivity operate in both cases). One can imagine going further and asking whether patterns of regular polysemy embedded in patterns of derivation are conditional on derivation itself. In that perspective, it may be relevant to examine whether some regular polysemy patterns are dependent on morphological processes. Accordingly, investigations comparing the polysemy patterns available for derived and underived words will be necessary to further explore the interdependence between morphological and figurative patterns.

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