Regular polysemy and novel word-sense identification

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Abstract

This study examines speakers' intuitions about novel word senses created through regular polysemy patterns. We investigate the effect of scalar regularity and lexical figure (metaphor vs. metonymy) on the identification of novel word senses, based on a detection experiment. It is shown that the more regular a polysemy pattern is, the less salient are the novel senses it produces, and that metaphorical patterns derive more salient novel senses than metonymic patterns. These results provide insights into the processing of novel word senses and support a non-homogeneous mental representation of regular polysemous words.

Keywords: novel word sense, neological intuition, regular polysemy, metonymy, metaphor

Introduction

Neologisms are often thought of as novel linguistic forms in a given language, either created through morphology or borrowed from another language. However they can also consist of new meanings assigned to already existing forms, as in the case of the noun *unicorn* used to denote highly valued startup companies. Such novel word senses are called 'semantic neologisms' (Bastuji, 1974; Smyk-Bhattacharjee, 2009; Renouf, 2013; a.o). They result from semantic extension by means of polysemy, usually through metaphor or metonymy. Semantic neologisms can rely on idiosyncratic sense associations, but also follow patterns of polysemy, thus integrating lexical networks of regular form-meaning associations.

In this paper, we are interested in the neological salience of semantic neologisms. By neological salience, we mean the extent to which a word or word sense appears as novel to speakers. Neological salience, a property of words or word senses, can be investigated through neological intuition, defined as speakers' ability to identify a word or a word sense as novel. A previous study (Lombard et al., 2021) has shown that at least two linguistic factors influence neological intuition: formal novelty, depending on whether neologisms are morphological or semantic neologisms (e.g., *untattoo* vs. *unicorn* in the sense described above), and lexical regularity, depending on whether neologisms are created through regular processes or not (e.g., *untattoo* is regularly derived morphologically whereas *workcation,* blended from *work* and *vacation*, is not). Moreover, it seems that regular neologisms are heterogeneous with respect to neological salience, which raises questions as to whether some properties of polysemy patterns could motivate these disparities.

Our goal here is to experimentally investigate the effects of two essential properties of polysemy patterns, i.e., scalar regularity and lexical figure, on the salience of novel word senses in French. More precisely, we address the question of whether the degree of regularity of polysemy patterns and the distinction between metaphor and metonymy influence the neological salience of semantic neologisms. Our main hypotheses are that (i) the more regular a polysemy pattern is, the less salient are the novel senses it produces, and the less neological intuition it generates, and (ii) metaphorical patterns produce more salient novel senses, and therefore generate more neological intuition, than metonymic patterns.

To test these hypotheses, we conducted a lexical identification experiment using semantic neologisms created through various polysemy patterns. Many psycholinguistic experiments have been carried out with materials consisting of existing ambiguous words of different types, but rarely with novel word senses. The study of neological intuition may provide information about the semantic processing of neologisms, as well as indirect insights into the treatment of regular polysemy and the representations of ambiguous words in the mental lexicon.

We first consider the mental representation of ambiguous words and its relationship to regular polysemy. We outline the practical problems involved in assessing the degree of regularity of a given sense alternation and explain our methodology for selecting the polysemy patterns used in the experiment. Then we present a preliminary study designed to

test experimental materials, and the methodology and results of the experiment we conducted. The paper concludes with a discussion of the results and their implications.

Background

Ambiguous words in the mental lexicon

Many psycholinguistic studies have investigated the mental representation or processing of ambiguous words, considering different aspects of word sense multiplicity (for an overview, see Eddington & Tokowicz, 2015; Falkum & Vicente, 2015). One of these aspects is semantic relatedness, which distinguishes homonyms from polysemous words, characterized respectively by unrelated and related meanings[1]. Authors generally agree that homonyms have separate representations in the mental lexicon (Duffy et al., 1988; Frazier & Rayner, 1990; Klepousniotou 2002; Pylkkänen et al., 2006), but consensus is lower for polysemous words. The idea that polysemous words involve a single representation is often shared, but authors diverge as to whether senses are listed as subparts of this representation (Pylkkänen et al., 2006; Brown, 2008; Brocher et al., 2018) or are contextual specifications of the same underspecified core meaning (Frisson & Pickering, 1999; Klepousniotou, 2002; Frisson, 2009). More recent studies provide evidence for differentiated treatments according to the type of polysemy involved. Considering that polysemous words do not form a homogeneous class, two aspects of related sense multiplicity have been further investigated: (i) the lexical figure (metaphor or metonymy) that grounds semantic extensions and (ii) the regularity or irregularity of the relation between senses.

The role of lexical figure has been examined in experimental studies comparing the processing of metonymic and metaphorical polysemous words, finding that the former are processed faster than the latter. Metaphor and metonymy are based on distinct semantic relations (analogy vs. referential contiguity) that imply differences of relatedness and similarity between literal and figurative meanings. These differences have led to the hypothesis that metaphorical meanings are stored separately from their source meaning, while metonymic meanings share a core representation with their source meaning[2] (Klepousniotou & Baum, 2007; Klepousniotou et al., 2008; Klepousniotou et al., 2012; Lopukhina et al., 2018; Yurchenko et al., 2020).

The influence of regular polysemy on the processing of ambiguous words has received less attention than that of lexical figure. According to Apresjan (1974), regular polysemy occurs when at least two polysemous words have identical types of related meanings. Regular polysemy is based on semantic patterns that directionally associate two semantic types as

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[1] In this paper, we indifferently use the terms *sense* and *meaning* to refer to the various senses of polysemous words.

[2] Schumacher (2014) suggests, however, the existence of distinct cognitive treatments and representations depending on the type of metonymic transfer (e.g., CONTAINER-FOR-CONTENT vs. CONTENT-FOR-CONTAINER).

source and target meanings (e.g., ANIMAL → FOOD as in *chicken*, *lamb* and *rabbit*). Several aspects of regular polysemy have been discussed, including the variable productivity of polysemy patterns (Nunberg & Zaenen, 1992; Copestake & Briscoe, 1995; Nunberg, 1995; Pustejovsky, 1995; Dölling, 2020; a.o.), but the scalar dimension of regular polysemy has rarely been investigated in depth. A few experimental studies have addressed whether word senses resulting from irregular (i.e., idiosyncratic and unpredictable) semantic extensions are processed differently from word senses produced through regular patterns (Rabagliati & Snedeker, 2013; Brocher et al., 2018). Experimental data plead in favor of core representations for regularly produced polysemous words, and of separate lexical representations for the others, whether these include irregular polysemous words (e.g., *wire* 'electric cable'/'secret recording device') or words with meanings resulting from weakly regular extensions (e.g., MATERIAL → OBJECT as in *glass* and *iron*).

On the basis of online processing measures, two continuums have therefore been postulated in the literature. On one continuum, metaphor falls between homonymy and metonymy; on another continuum, irregular polysemy falls between homonymy and regular polysemy. If these continuums are assumed to represent the same dimension of variation, direct correspondence may be inferred between metaphor and irregularity on the one hand and between metonymy and regularity on the other hand, as suggested by Apresjan (1974). Yet, it appears that both irregular and regular polysemous words can be produced by both metaphor and metonymy. The different combinations of figure and regularity in polysemy should therefore be examined to achieve a better understanding of their respective influence on mental representations.

Processing novel word senses

Most studies of online processing of lexical ambiguity are based on attested polysemous words, i.e., words with multiple lexicalized senses. However, a few experimental studies have also examined novel word senses. Since these are not stored in the lexicon, they should provide insight into the process of meaning extension itself. Three aspects have been specifically addressed: polysemy vs. homonymy, the familiarity (or regularity) of meaning extensions, and the role of context. Studies have shown that novel meanings are more easily processed when they are related by polysemy to an existing word meaning than when there is no relation, that is, when the novel meaning is homonymous (Rodd et al., 2012; Maciejewski et al., 2020). Novel word senses fitting into polysemy patterns have also been compared to attested senses derived from the same patterns and to novel senses produced through unfamiliar patterns. It appears that regular novel senses are processed as easily as attested ones, as long as the context explicitly guides their interpretation (Frisson & Pickering, 2007), and that these senses can be processed effortlessly from their first mention, unlike irregular novel senses (Murphy, 2006). However, only cases of systematic metonymy have been examined in these studies, and the effects of lexical figure and scalar regularity on the processing of novel meanings require further investigation.

In addition to research on the processing of novel word senses, other studies have used offline measures to explore the extent to which novel word senses are actually perceived as novel by speakers. Gardin, Lefèvre, Marcellesi, and Mortureux (1974) conducted a pioneering study showing that neologisms in general could not be defined with reference to largely shared intuitions, and that metalinguistic judgements about lexical novelty were highly variable depending on both linguistic and extralinguistic factors. Sablayrolles (2003) and Ben Hariz Ouenniche (2009) further examined the linguistic aspects of neological intuition, highlighting the influence of different types of neologisms. However, these studies suffer from a small number of participants and the lack of quantitative generalization. Adopting a more controlled experimental design, Lombard, Huyghe and Gygax (2021) have shown that lexical regularity influences neological intuition, and that irregular neologisms are more salient as novel items than regular ones. Significant differences were also observed among regular neologisms, calling for further investigation. The present study aims to explore these differences, by focusing on the diversity of regular semantic neologisms and by examining the influence of scalar regularity and lexical figure on their salience as novel lexical items. Based on the idea that low regularity and metaphor imply less semantic relatedness and less proximity between word senses than high regularity and metonymy, we hypothesize that (i) the less regular a polysemy pattern is, the more salient are the novel word senses it produces, and (ii) metaphorical patterns produce more salient neologisms than metonymic patterns.

Measuring the regularity of polysemy patterns

Our study is based on the examination of novel word senses in French that fit into polysemy patterns of variable regularity. There is no measure proposed in the literature to precisely evaluate the regularity of a polysemy pattern, but regularity rates could conceivably be calculated from four variables: the number of words attested with a given source meaning, the number of words attested with both the source and target meanings, the frequency of these words, and the frequency of their meanings. Different computations of regularity can be envisaged, depending on whether frequency information is taken into account or not.

The basic calculation of the regularity of a polysemy pattern might be based on the ratio of polysemous words derived from this pattern (*n*) to all attested word types in the source meaning class (*N*), as formulated in [1].

$$\text{R1} = \frac{n}{N} \qquad\qquad [1]$$

Frequency is another important parameter for the calculation of regularity, as it reflects the importance of polysemy patterns in speech. Formula [2] is an alternative to [1] based on tokens instead of types so that word frequency (*f*) is taken into consideration. Frequencies are log-transformed to minimize differences in absolute frequency between words.

$$\text{R2} = \frac{\sum_{i=1}^{n} \log(f_i)}{\sum_{j=1}^{N} \log(f_j)} \qquad\qquad [2]$$

Finally, word sense frequencies may also play a role in the assessment of regular polysemy. It can be assumed that polysemy patterns are more regular when source and target meanings (f_{s1} and f_{s2} respectively) are balanced in frequency than when they are unbalanced. Accordingly, regularity measures could be weighted by the ratio between source and target meaning frequencies, as proposed in [3]. In this third formula, the equation [2] is multiplied by the square root of the sense balancing rate of attested polysemous words. The square root is used to give less importance to the weighting than to the basic word frequency ratio.

$$\text{R3} = \frac{\sum_{i=1}^{n} \log(f_i)}{\sum_{j=1}^{N} \log(f_j)} \times \sqrt{\frac{1}{n} \sum_{i=1}^{n} \frac{\min(f_{s1i}, f_{s2i})}{\max(f_{s1i}, f_{s2i})}} \qquad [3]$$

Note that the three measures in [1]-[3] return regularity scores ranging from 0 (irregularity) to 1 (systematicity), therefore allowing comparison between different patterns in a given language or cross-linguistically.

Other measures of regularity than those proposed above could be considered, a constant being the necessity to evaluate the proportion of words that do instantiate a given polysemy pattern among all the words that could in theory (i.e., words with the source meaning). A major difficulty is to assign values to the variables used in regularity measures, because of some important practical issues. The extraction of pairs of word senses from semantic lexicons to identify polysemy patterns encounters several limitations (Peters & Kilgarriff, 2000). Exploring corpora to determine sense frequencies is also uncertain. Word sense disambiguation systems do not achieve sufficient performance to provide reliable word sense frequencies, despite recent advances provided by neural architectures (Bevilacqua & Navigli, 2020). Norming studies conducted to estimate the sense distribution of ambiguous words (Brocher et al., 2018) are ruled out for a whole lexicon overview. Furthermore, the limits of the lexicon are not clear. It can be asked for instance whether technical polysemous words should be taken into account in the evaluation of a pattern regularity. These methodological issues lead us in the present study to rely on expert judgements to assess degrees of regular polysemy, as explained in the next section.

Selection and evaluation of polysemy patterns

We preselected 12 polysemy patterns, including 6 regular metaphors and 6 regular metonymies, that were then submitted to the evaluation of a panel of experts of the French lexicon. The preselected patterns had to meet the three following conditions: (i) be unequivocally analyzable as metaphorical or metonymic, (ii) be compatible with our experimental design, and (iii) putatively have various degrees of regularity.

As far as figure is concerned, we made sure that the preselected patterns of metaphor and metonymy were clearly based on a relation of analogy and referential contiguity, respectively. For instance, the pattern BODY PART → GARMENT PART, instantiated by nouns such as *genou* 'knee', *coude* 'elbow' and *dos* 'back', was discarded because it is uncertain whether the sense extension is based on metonymy (the garment part being named after the body part that is

dressed) or on metaphor (the garment part being named after the body part with which it compares in terms of partitioning structure).

The selected polysemy patterns also had to produce new meanings that could be used in our experimental design (see next section). For instance, we excluded patterns deriving meanings that are subject to cultural variation (e.g., ANIMAL → MEAT, dependent on food habits), as well as patterns generating target senses that cannot be easily disambiguated in the context of a sentence. For example, ANIMAL → PERSON was excluded because of the infrequent metaphorical use of animal-denoting nouns in non-predicative NPs, and the possible literal interpretation of animal nouns denoting persons in referential NPs.

As indicated above, assessing the degree of regularity of polysemy patterns is the most challenging part of the process. To maximize chances that differences in scalar regularity can be observed, we preselected a set of patterns that seemed to us polarized in terms of regularity, both for metaphor and metonymy. For example, we preselected the two metonymy patterns in (1) and (2), estimating that the one in (1) is much less instantiated and regular in French than the one in (2).

(1)   ARTEFACT → LOCATION
        bureau 'desk'/'office', *bar* 'counter'/'pub', *billard* 'pool table'/'pool hall', …

(2)   FOOD SUBSTANCE → PORTION OF FOOD
        yaourt 'yoghurt'/'pot of yoghurt', *chocolat* 'chocolate'/'piece of chocolate', *bière* 'beer'/'glass of beer', *soupe* 'soup'/'bowl of soup', *glace* 'ice cream'/'scoop of ice cream', *sucre* 'sugar'/'sugar cube', *café* 'coffee'/'cup of coffee', *thé* 'tea'/'cup of tea', *pastis* 'pastis'/'glass of pastis', *nougat* 'nougat'/'piece of nougat', *compote* 'compote'/'jar of compote', *bouillon* 'broth'/'bowl of broth', …

The 12 preselected patterns are presented in Table 1.

Table 1: Preselected polysemy patterns.

Figure	Pattern	Attested polysemes
Metaphor	PERSON → ARTEFACT	*groom* 'groom'/'door closer', *valet* 'servant'/'stand'
	FOOD → PORTION OF STH	*carotte* 'carrot'/'core sample', *noix* 'walnut'/ 'knob'
	NATURAL OBJECT → DISH	*rocher* 'rock'/'rocher', *mousse* 'moss'/'mousse'
	WEATHER EVENT → WAY OF OCCURRING	*déluge* 'flood'/'massive occurrence', *tonnerre* 'thunder'/'loud happening'
	BODY PART → OBJECT PART	*cœur* 'heart'/'inner part', *tête* 'head'/'upper part'
	PHYSICAL PROPERTY → NON-PHYSICAL PROPERTY	*fermeté* 'firmness'/'strictness', *noirceur* 'blackness'/'darkness of mind'
Metonymy	ARTEFACT → LOCATION	*bibliothèque* 'bookcase'/'library', *bureau* 'desk'/'office'
	BODY PART → PERSON	*bouche* 'mouth'/'person to feed', *bras* 'arm'/'worker'
	PROPERTY OF HUMANS → GROUP OF PEOPLE	*jeunesse* 'youth'/young people', *noblesse* 'dignity'/ 'nobles'
	CONCRETE ACTION → RESULTING OBJECT	*construction* 'building'/'edifice', *pêche* 'fishing'/'catches'
	PROPERTY → ACTION	*amabilité* 'kindness'/'kind action', *violence* 'violence'/'violent action'
	FOOD SUBSTANCE → PORTION OF FOOD	*sucre* 'sugar'/'sugar cube', *yaourt* 'yoghurt'/'pot of yoghurt'

To obtain a more accurate evaluation of scalar regularity and to quantify degrees of regularity, we solicited academics who are experts in the study of the French lexicon. Forty-one of them were sent a survey in which the preselected patterns were presented randomly. Each question included a definition and an example of a polysemy pattern and experts were asked to rate the proportion of words with the source meaning that also have the target

meaning, on a scale from 1 (few of them) to 7 (all of them)[3]. Twenty-seven experts completed the survey.

The results are presented in Table 2, where polysemy patterns are ranked in ascending order according to the average regularity scores assigned by the experts. These results confirm the variable regularity of preselected patterns, both for metaphor and metonymy. It can be noted that the regularity scores obtained are relatively similar between the two figures, which might challenge the assumption that metonymy is more regular than metaphor. We will return to this point in the Discussion section.

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[3] Exact instructions in French were: "Le patron de polysémie régulière suivant 'Sens 1: Meuble → Sens 2: Lieu' est attesté en français pour des noms comme *bureau, bar, bibliothèque*. Par exemple, le sens 1 de *bureau* est sélectionné dans la phrase (1) *Il a posé sa tasse sur le bureau*, et le sens 2 dans la phrase (2) *Elle est entrée dans le bureau*. Sur une échelle de 1 (très peu) à 7 (tous), à combien évalueriez-vous la proportion de noms dotés du sens 1 qui ont aussi le sens 2 en français contemporain ?", which can be translated as 'The following polysemy pattern 'Meaning 1: Furniture → Meaning 2: Place' is attested in French for nouns like *bureau* 'desk'/'office', *bar* 'counter'/'pub', *bibliothèque* 'bookcase'/'library'. For example, the source meaning of *bureau* is selected in sentence (1) *Il a posé sa tasse sur le bureau* 'He put his cup on the desk', and the target meaning is selected in sentence (2) *Elle est entrée dans le bureau* 'She entered the office'. On a scale from 1 (few of them) to 7 (all of them), how would you rate the proportion of nouns with meaning 1 that also have meaning 2 in contemporary French?'.

Table 2: Expert rating of polysemy patterns.

Figure	Pattern	Mean score	SD
Metaphor	**P11** FOOD → PORTION OF STH	2.48	1.50
	P12 PERSON → ARTEFACT	2.59	1.72
	P13 NATURAL OBJECT → DISH	2.67	1.33
	P14 WEATHER EVENT → WAY OF OCCURRING	4.41	1.28
	P15 BODY PART → OBJECT PART	4.59	1.58
	P16 PHYSICAL PROPERTY → NON-PHYSICAL PROPERTY	5.52	0.89
	Average	**3.71**	**1.38**
Metonymy	**P21** ARTEFACT → LOCATION	3.00	1.73
	P22 HUMAN PROPERTY → GROUP OF PEOPLE	3.15	1.73
	P23 BODY PART → PERSON	3.56	1.42
	P24 PROPERTY → ACTION	4.33	1.24
	P25 FOOD SUBSTANCE → PORTION OF FOOD	4.63	1.74
	P26 CONCRETE ACTION → RESULTING OBJECT	5.48	1.01
	Average	**4.02**	**1.48**

Preliminary study

The 12 polysemy patterns presented in Table 1 were used to create semantic neologisms to be tested in the neologism detection experiment. We used neologisms specifically created for the experiment, as opposed to attested semantic neologisms, to ensure that they were unknown to participants. A preliminary study was conducted to optimize the selection of these created semantic neologisms. The study was based on speakers' judgements about the plausibility of semantic neologisms that fit into the metaphorical and metonymic patterns selected for the experiment.

Participants

Forty-two volunteer French native speakers of the same age (19-30 years old, Mean 21.1, SD 2.3) took part in the survey. They were recruited in an introductory class of linguistics given at the University of Fribourg (Switzerland).

Materials

For each of the 12 polysemy patterns, we selected 10 words that only had the source meaning, and assigned them the corresponding target meaning. A total of 120 semantic neologisms were thus created. The newly coined meanings had to fulfill four conditions. First, to ensure that the words were not commonly used with the target sense, we checked that this sense was absent from three reference dictionaries (*Le Petit Robert*, *Le Trésor de la Langue Française Informatisé*, *Wiktionnaire*) and not assigned to more than 1% of the tokens of the word in the frTenTen17 corpus (Jakubíček et al., 2013)[4] — the number of attestations was evaluated through the annotation of random samples of 200 tokens per word. Second, selected words had to be monosemous, or possibly polysemous if only one of their meanings can be regarded as the source of the semantic neologism, so that the polysemy pattern to be tested could be the only one involved in the interpretation. Third, semantic neologisms had to be onomasiologically motivated, i.e., denote as much as possible a referent without any prior existing denomination. Finally, in case selected words are morphologically complex, their morphological base had to not instantiate the same polysemy pattern as the tested one, to ensure that words were semantic neologisms and not morphological ones. For example, *luminosité* 'brightness' was dismissed as a candidate for PHYSICAL PROPERTY → NON-PHYSICAL PROPERTY because the adjective *lumineux* 'bright' already has both a physical and non-physical meaning. Consequently, *luminosité* as a noun that denotes an intellectual property could have been analyzed as the result of the suffixation of *lumineux* 'bright' with -*ité*, as well as a metaphorical extension of *luminosité* in its 'physical property' meaning.

For each semantic neologism, we created a simple sentence (without any subordinate clause and with no more than one adjunct), at an ordinary language level (using frequent words and usual verbal tenses), and including the target word in its novel sense, as illustrated in Table 3. Sentences were formed so as to unequivocally select target meanings and block source meanings, using left and/or right disambiguating contexts (e.g., *étanchéité* 'watertightness' in Table 3 is interpreted as a non-physical property because of the right context). Neologisms were placed in different syntactic positions, except for prominent positions at the beginning or at the end of the sentence. Sociolinguistic and register variations, such as slang or specialized language, were avoided to control their effect on neologism identification.

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[4] *FrTenTen17* is a French corpus of 5.7 billion words collected from the .fr domain in 2017, available online at: https://www.sketchengine.eu/frtenten-french-corpus/.

Table 3: Examples of target words and sentences including novel word senses.

Pattern	Target word	Sentence
P12 Metaphor	*troubadour* 'troubadour'	J'ai rechargé le **troubadour** pour avoir de la musique sur la route. lit. 'I recharged the troubadour to have music on the road'
P16 Metaphor	*étanchéité* 'watertightness'	J'ai toujours été sidéré par l'**étanchéité** de sa mémoire. lit. 'I have always been stunned by the watertightness of his memory'
P23 Metonymy	*jambe* 'leg'	On cherche des **jambes** motivées pour aller porter ce message. lit. 'We are looking for motivated legs to carry this message'
P24 Metonymy	*paternalisme* 'paternalism'	Elle a toujours eu horreur des **paternalismes** de ce chef de poste. lit. 'She has always hated the paternalisms of this manager'

Procedure

The experiment took the form of an online survey completed by participants during an academic course, in an average of 13.5 minutes (SD 2.8). Each trial included the definition of a novel sense assigned to a target word (3a), and a sentence with the word in bold used in its novel sense (3b).

(3)   a. Le mot *barman* dans la phrase suivante désigne un distributeur automatique de boissons.
'The word *barman* 'bartender' in the following sentence refers to a beverage vending machine'
b. On ne peut plus mettre d'argent dans le **barman** du troisième étage.
'We can no longer put change into the barman on the third floor'

The definition and the sentence were presented to participants who had to rate the plausibility of the semantic neologism on a scale from 1 (impossible) to 7 (fully possible)[5]. Participants could also indicate that they did not know the word instead of giving it a score. They were divided into two groups of 20 and 22 persons who were presented with 60 sentences each (5 stimuli per pattern), in order to reduce the risk of pattern recognition.

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[5] Exact instructions in French were "Nous allons vous présenter des phrases l'une après l'autre. À chaque fois, un mot employé non pas dans son sens habituel mais dans un sens nouveau sera mis en gras. Nous vous indiquerons le sens qu'il prend dans la phrase. Vous devrez noter, sur une échelle de 1 à 7, dans quelle mesure l'usage de ce mot dans ce sens vous paraît possible, avec : 1 – impossible, 7 – tout à fait possible", which can be translated as 'We will show you sentences one after the other. In each sentence, a word that is not used in its usual sense but in a novel one will be highlighted in bold. This novel word sense will be defined. You will be asked to rate on a scale from 1 to 7 the extent to which you find it possible to use the word in this novel sense, with: 1 – impossible, 7 – entirely possible'.

Results

The results of the preliminary study allowed us to refine the materials used in the neologism detection experiment (see next section). To ensure maximum plausibility for both semantic neologisms and stimuli sentences, we selected for each polysemy pattern the 7 out of 10 words with the highest average plausibility score on pretest — with the exclusion of words unknown to more than two participants. Based on this lexical selection, we also computed the average plausibility score per pattern, as presented in Table 4.

Table 4: Plausibility score per polysemy pattern.

Figure	Pattern	Mean	SD
Metaphor	**P11** FOOD → PORTION OF STH	4.46	2.06
	P12 PERSON → ARTEFACT	3.46	2.06
	P13 NATURAL OBJECT → DISH	4.50	1.96
	P14 WEATHER EVENT → WAY OF OCCURRING	5.69	1.60
	P15 BODY PART → OBJECT PART	4.65	1.97
	P16 PHYSICAL PROPERTY → NON-PHYSICAL PROPERTY	3.93	2.16
	Average	**4.45**	**1.97**
Metonymy	**P21** ARTEFACT → LOCATION	3.30	2.00
	P22 HUMAN PROPERTY → GROUP OF PEOPLE	4.79	1.90
	P23 BODY PART → PERSON	4.10	2.22
	P24 PROPERTY → ACTION	5.62	1.59
	P25 FOOD SUBSTANCE → PORTION OF FOOD	4.64	2.08
	P26 CONCRETE ACTION → RESULTING OBJECT	4.89	1.94
	Average	**4.56**	**1.95**

It can be asked whether there is a relationship between the regularity of polysemy patterns and the plausibility of the novel word senses they form: The more regular patterns are, the more plausible semantic neologisms may be. To test this relationship, we calculated Pearson's correlation between regularity and plausibility based on the average plausibility scores obtained for semantic neologisms and the regularity scores of the polysemy patterns from which they are derived. A weak positive correlation can be observed ($r(82) = .29$, $p = .007$). Regularity as a possible explanatory factor for plausibility is a promising area for future research, especially when considering the important variation in plausibility that is observed

among semantic neologisms derived from the same pattern. Other factors that can influence plausibility should be investigated as well, such as concreteness of source and target meanings, word sense frequencies, or extralinguistic scenarios possibly associated with stimuli sentences. However, in the present study, the plausibility ratings were only used in the selection of the stimuli for the main experiment, as described in the next section.

Neologism detection experiment

Our goal is to determine whether the neological salience of novel senses depends on two properties of the polysemy patterns used to create them: the degree of regularity (identified by the regularity score per pattern) and the lexical figure (metaphor/metonymy). To evaluate these relationships, we tested native French speakers' intuition about semantic neologisms in an experiment that combines sentence reading with a lexical identification task.

Participants

One hundred and fifty-six students that are native French speakers (18-32 years old, Mean 22.5, SD 2.8) were recruited through the Prolific crowdsourcing platform. They were compensated with £3.50 for their participation, i.e., at the approximate rate of £10.50 per hour.

Materials

The experimental stimuli consist of 168 sentences in French containing a target word used either in its original meaning or in its newly created meaning. Stimuli sentences were selected from the preliminary study. For each of the 12 polysemy patterns, we selected the 7 words that had the highest plausibility score and were not indicated as unknown by more than two participants. Each target word, such as *troubadour* 'troubadour' in (4), appears twice in the stimuli sentences, once with its original sense (4a) and once as a semantic neologism, referring to a portable audio device in (4b). The number of characters and syllables across sentences was standardized, so that all patterns have similar mean and variance.

(4)   a. Ce petit livre raconte la vie des **troubadours** au douzième siècle.

'This little book tells the life the troubadours in the twelfth century'

b. J'ai rechargé le **troubadour** pour avoir de la musique sur la route.

'I recharged the troubadour to have music on the road'

One possible concern with our experimental design is that the syntactic simplicity of the stimuli sentences could make the semantic neologisms appear prominent, and create a ceiling effect on neologism identification. Thus, we added 16 distractor sentences containing a word used with a salient novel sense, so as to unbalance the number of neological and non-neological stimuli in the experimental materials. We assumed that participants would tend to maintain a balance between positive and negative answers, reducing the probability of a

ceiling effect for the relevant stimuli. Novel senses of distractor words were created through metaphor or metonymy, but were not instances of the polysemy patterns tested in the experiment. An example of a distractor word is the noun *bazooka* 'bazooka' used to denote a cocktail in (5).

(5)   Après avoir bu quatre **bazookas**, il était complètement ivre.

        'After drinking four bazookas, he was completely drunk.'

Procedure

The experiment took the form of an online survey that participants completed on their own laptop in approximately 20 minutes. The participants were randomly divided into two groups of 80 and 76. Each participant was presented with 100 stimuli in a random order, including 42 sentences with target words in their original sense, 42 sentences with target words in their novel sense, and 16 distractor sentences. The stimuli were distributed between the two groups in such a way that each participant saw all target words once, half in the original sense and the other half in the novel sense. Overall, target words appeared equally frequently in their novel and original senses, and were distributed in both versions of the experiment so that they represented the 12 patterns in the same proportions.

The experiment comprised two tasks. The first one consisted of reading stimuli sentences displayed on the screen one after the other, and deciding for each sentence, as quickly and accurately as possible, whether they included a semantic neologism or not. The exact instructions were: "We will show you sentences one after the other. For each one, you must indicate whether or not it contains a word used in a novel sense."[6] Answers were given by pressing the key R for 'no' with the left index finger or I for 'yes' with the right index finger. Each sentence was presented for as long as needed. To familiarize themselves with the task, participants were shown three test stimuli before the experiment began. The second task consisted of precisely identifying the word with a novel sense in the stimuli sentences that elicited a positive answer during the first task. All these sentences were listed in a random order on the same page, and participants were asked to highlight neologisms by clicking on them. Only one word per sentence could be identified. Participants could take as long as they wanted to perform that second task. Neologism identification was evaluated through both the first and second tasks, and target neologisms were accordingly tagged as 'identified' or 'not identified'. Importantly, when a participant gave a positive answer in the first task but was unable to identify the correct target word in the second task, the neologism was considered as 'not identified'.

Results

Some experimental measures were removed from the data before statistical analysis. To ensure that participants had correctly understood the instructions and were focused on the

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[6] The instructions in French were: "Nous allons vous présenter des phrases l'une après l'autre. Pour chacune, vous devez indiquer si elle contient, ou non, un mot employé dans un sens nouveau."

task, we excluded the data from participants whose positive answers to the stimuli with original meanings exceeded 2.5 SD from the by-participant mean (6 participants excluded). All data from the trials with a response time shorter than 1000 ms were also eliminated (120 trials, 1.9% of the data).

Data were analyzed using mixed logistic regression models with crossed random effects per participant, polysemy pattern, and/or target word (Baayen et al., 2008). Models were computed with the *lme4* package (Bates et al., 2014) in *R* (R Core Team, 2015)[7]. We compared the AIC of the models to select which one fitted the data the best and we used type III Wald χ^2 tests to determine the *p*-values of the predictor effects.

We first analyzed the difference between stimuli depending on whether they include target words in their novel or in their original sense (see Table 5 and Figure 1), to verify that regular semantic neologisms are salient as novel and do generate neological intuition. We compared logistic regression models with and without random effects using AIC. The model that best fits the data includes novelty as fixed effect, and random intercepts by participant, polysemy pattern, and target word. It shows that novel senses are significantly more identified as novel than original ones[8].

Table 5: Summary of mixed-effects regression model with the following formula: *Identification (y/n) = Novelty + (1 | Participant) + (1 | Pattern) + (1 | Word)*. Estimates indicate that original senses are less detected than novel ones.

Effect	Modality	Estimate	SE	z	p
Intercept	-	0.28976	0.2141	1.353	-
Novelty	Original	-4.23001	0.0838	-50.505	< .001

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[7] We used the sum contrast coding on all factorial predictors with the function *contr.Sum()* from the *car* package in *R* (Brehm & Alday, 2022).
[8] Similar results are obtained without excluding the data from the 6 participants with high detection rates for original meanings.
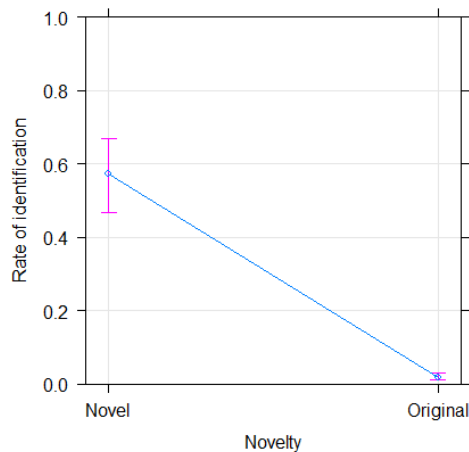
Figure 1: Prediction of the model for neologism identification based on semantic novelty.

For the main analysis, we focused on stimuli including target words in their novel senses, because the variables of interest, namely lexical figure and degree of regularity, were only applicable to these senses (since the original senses were neither metaphorical nor metonymic). We conducted a mixed-effects regression analysis, with rate of identification of novel senses as the dependent variable. Our main predictor variables are the lexical figure (metaphor/metonymy) and the degree of regularity, identified as the regularity score per pattern resulting from the expert assessment survey. In addition, we also considered the frequency of the target words, based on the *Frequency Dictionary of French* (Eckart et al., 2013). The best model[9] to account for the data only includes the simple effects of regularity and figure (see Table 6 and Figure 2). Neither the interaction of these two predictors, nor the frequency were significant. The model indicates that weakly regular semantic neologisms are significantly more identified than highly regular semantic ones, and that metaphors are significantly more identified than metonymies. Our initial hypotheses are therefore supported empirically.

We also quantified the variance explained by our main model through the R^2 value, computed with the function *r.squaredGLMM()* of the package *MuMIn* (Nakagawa & Schielzeth, 2013; Johnson, 2014). This function gives one value for the fixed effects only (marginal R^2) and one comprising the random effects (conditional R^2). As shown by the conditional R^2, our model explains 40.8% of the variance in our data, suggesting the possible existence of other explaining factors.

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[9] For information purposes, we also tested a model including the plausibility scores per pattern inferred from the preliminary study, instead of regularity scores — plausibility and regularity being significantly correlated, we did not combine them as predictor variables in the same regression model. The results are similar to those obtained with regularity scores and indicate a significant effect of plausibility on neologism identification, alongside the effect of lexical figure (without any interaction improving the model). However, a comparison between the regularity and the plausibility models based on AIC shows that the former better accounts for the observed data.

Table 6: Summary of mixed-effects regression model with the following formula: *Identification (y/n) = Reg. + Fig. + (1 + Fig. | Participant) + (1 | Word)*. Estimates indicate that regularity is negatively correlated to neologism identification and that metaphorical novel senses are more detected than metonymic ones.

Effect	Modality	Estimate	SE	z	p
Intercept	-	1.10993	0.38174	2.908	-
Regularity	-	-0.19102	0.09325	-2.048	.04049
Figure	Metaphor	0.69984	0.10078	6.944	< .001
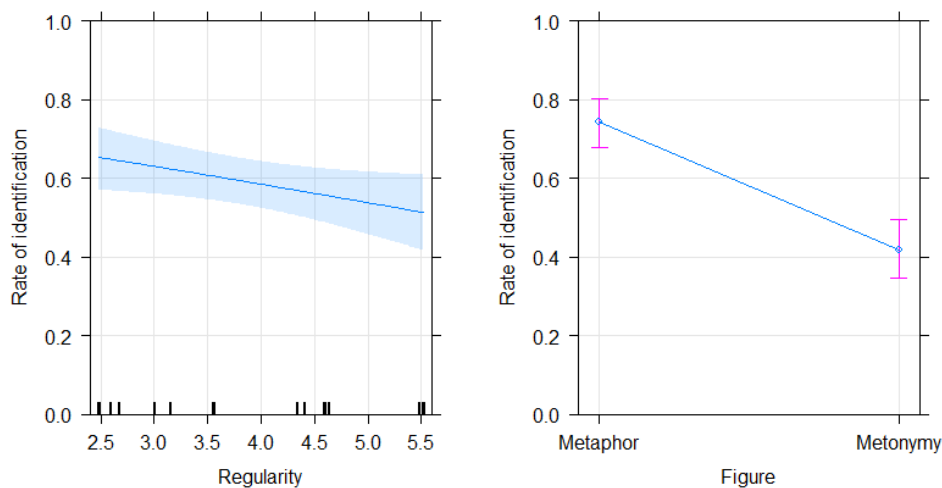
Figure 2: Prediction of the model for neologism identification based on polysemy regularity and lexical figure.

Discussion

The results of the experiment indicate that there is a greater salience of novel word senses, as opposed to original ones, which confirms that semantic neologisms have the capacity to trigger neological intuition, or to put it differently, that our linguistic competence allows us to identify semantic neologisms as such. However, some variation can be observed among semantic neologisms, depending on the properties of the polysemy patterns they are derived from. The salience of semantic neologisms is overall influenced by the existence of different degrees of regular polysemy and by the distinction between metaphor and metonymy.

The study shows that the more regular a polysemy pattern is, the less semantic neologisms created following this pattern are salient and generate neological intuition. The differences

observed between semantic neologisms fitting into different polysemy patterns can be seen as a confirmation of the scalar dimension of regular polysemy, a property that has been overlooked in both theoretical and applied studies on regular polysemy. Two non-mutually exclusive explanations can account for the effect of regular polysemy on neologism identification. On the one hand, the frequency of association between original and novel senses in the lexicon makes these associations more or less familiar to speakers. A high familiarity could favor semantic analogy and in turn reduce the cognitive effort to understand congruent novel senses (see Murphy, 2006). Accordingly these would tend to go unnoticed and be less neologically salient. On the other hand, it could be assumed that the more regular a sense alternation is, the more closely represented are the original and novel meanings in the mental lexicon. This close relatedness could cause less neological salience for semantic neologisms derived from highly regular polysemy patterns, because novel senses would be closer to original ones than in the case of weakly regular patterns, and consequently require less cognitive effort to be processed.

The experimental data also reveal a strong effect of lexical figure on neologism identification. Neological intuition is stronger for metaphor than for metonymy, which can be explained by the structural difference between the two figures. Metaphor and metonymy are based on analogy and on referential contiguity, respectively. Analogy implies referential disjunction, i.e., the referent associated with the source meaning is ontologically different from the one associated with the novel meaning, whereas contiguity implies referential coexistence, i.e., the referent associated with the source meaning is present in the background of the one associated with the novel meaning. This contrast creates a difference in semantic proximity between the multiple senses of polysemous words, which can be the reason for the variability of neological salience. Novel metaphorical senses being referentially more autonomous than novel metonymic ones, they would be more salient and, as a consequence, generate stronger neological intuition.

Importantly, our results show that the effects of regularity and lexical figure are independent of each other. No significant interaction is observed between them, as far as predicting neological salience is concerned. As a corollary, metaphors are not more salient than metonymies because the latter are (supposedly) more regular, but because of the intrinsic differences between the two figures. The relationship between regularity and figure is crucial to research on polysemy. It is often assumed that regularity is more characteristic of metonymy than of metaphor (Apresjan, 1974; Klepousniotou et al., 2012; Brocher et al., 2018; a.o.), which can be interpreted in two non-exclusive ways: (i) there are tendentially more regular vs. irregular metonymies than metaphors, (ii) regular metonymies are more regular than regular metaphors. Except for the most radical version of (i), according to which metaphor is always irregular, and which is falsified by the existence of at least one pattern of regular metaphor, the empirical validity of (i) and (ii) is uncertain. As indicated above, the practical difficulties encountered in evaluating regularity through lexical measures prevents us from accurately comparing the properties of a substantial number of metaphorical and metonymic patterns. In the patterns used in our study we found that degrees of regularity can be similarly distributed across metaphors and metonymies. Although these patterns were

not randomly selected, this similar distribution shows that assumption (ii) is not self-evident and requires further empirical evidence. Nevertheless, should it be demonstrated that regularity is overall higher for metonymy than for metaphor, then there would be a convergence of regularity and figure effects on neological intuition. In general, semantic neologisms following a metonymic pattern would be less salient than those following a metaphorical pattern, not only because metonymy is less salient than metaphor as a lexical figure but also because it is tendentially more regular.

The performance of scalar regularity and lexical figure as predictors for neologism identification (explaining 40.8% of the variance observed in the experiment) leads us to postulate the existence of additional factors that can account for neological intuition. The possible influence of properties of polysemy patterns other than figure and degree of regularity should be explored. It can be asked in particular whether the semantic types involved in patterns determine neological salience. Concreteness (vs. abstractness)[10] of meaning may be investigated in that respect, as a factor that has proven to be influential in lexical processing and semantic retrieval (Schwanenflugel & Schoben, 1983; Tokowicz & Kroll, 2007; Klepousniotou et al., 2008; Barber et al., 2013; Catricalà et al., 2014; Bonin et al., 2018; a.o.). Concrete word senses being more discrete than abstract ones, it may be suspected that concrete novel meanings will be more salient than abstract ones, even more so if the latter are themselves derived from abstract meanings. To test the predictive power of concreteness on neological intuition, we performed a post-hoc analysis based on two variables: the concreteness of novel meanings and its interaction with the concreteness of original meanings. We added each variable to our main model, to assess whether the resulting models could better explain the variance in our data. Neither the concreteness of the novel sense (p = .284) nor the interaction (p = .183) were significant, and the conditional R^2 of the two models explained less variance than the main model (39.6% and 39.5% respectively). Considering the moderate to high correlation coefficients between concreteness variables and regularity or figure, as reported in the correlation matrix of both models, we also tested two models including only the concreteness variables, still without any significant effect (p = .377 for novel sense concreteness, and p = .292 for interaction with original sense concreteness). A dedicated experiment with controlled distribution of abstract and concrete senses across metaphors and metonymies, both for original and novel senses, would be needed to draw robust conclusions about the influence of concreteness on neological intuition. However, based on the exploratory results presented here, we can extrapolate that more factors should be investigated to account for the salience of semantic neologisms. In particular, further research on neological salience should be oriented towards the influence of word-dependent properties as a complement to pattern-dependent ones.

Finally, the results of our study can lead to more general theoretical considerations. The variable salience of semantic neologisms can be related to variations in learning new words

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[10] The definition of concreteness vs. abstractness is much debated and subject to important variation (see Van de Velde, 1995; Barsalou, 2003; Kleiber & Vuillaume, 2011; Huyghe, 2015; a.o.). We adopt here a rudimentary definition, according to which concrete (vs. abstract) meanings are associated with material (vs. immaterial) referents.

and new meanings. Different cognitive efforts are required to process the meaning of semantic neologisms, depending on the regularity and figure of the polysemy pattern they instantiate. Consequently, highly regular and metonymic polysemes could be easier to learn than weakly regular and metaphorical polysemes, respectively. More broadly, models of meaning constitution should be tested and if necessary refined so as to account for neological salience. The idea that metaphorical novel meanings are more autonomous than metonymic ones echoes a position often encountered in the literature on lexical figures, according to which metaphor and metonymy are associated with different cognitive processes and mental representations, and metonymic meanings are more closely related to original meanings than metaphorical ones (see Klepousniotou & Baum, 2007; Klepousniotou et al., 2012; Weiland-Breckle & Schumacher, 2017; Lopukhina et al., 2018; Yurchenko et al., 2020; a.o.). Our findings about metaphorical and metonymic semantic neologisms could thus be seen as a confirmation of previous claims about the cognitive processing of lexical figures. However, they also show the influence of scalar regular polysemy as an additional factor determining the treatment of semantic neologisms. Highly regular neologisms seem to be more easily processed online than weakly regular neologisms, which is in line with Murphy's (2006) observations. Differentiated treatments of highly and weakly regular semantic neologisms could be due to the fact that meanings of polysemous words are associated with more or less discrete representations in the mental lexicon, depending on degrees of regular polysemy. The more regular a polysemy pattern is, the more probable would be the existence of tightly connected senses or of an underspecified meaning in the representation of polysemes (see Rabagliati & Snedeker, 2013). As a corollary, scalar regular polysemy should be more often taken into consideration when investigating the lexical structure and mental representation of polysemous words.

Conclusion

The aim of this study was to explore speakers' intuitions about semantic neologisms, and in particular to investigate the effect of lexical figure and regular polysemy on the processing of novel word senses. We decorrelated these two factors to get a better understanding of their respective influence on mental representations. The study has shown that the neological salience of semantic neologisms depends on both factors, from which it can be inferred that they involve different representations of polysemous words. In particular, we have highlighted the influence of scalar regular polysemy on the salience of semantic neologisms. Generally speaking, the variability of regular polysemy should be taken into account as a determining factor in the representation of ambiguous words in the mental lexicon. Further studies could confirm these observations, for instance through blinded experiments including sentence reading tasks, which could provide more insights on the cognitive mechanisms involved in the processing of novel word meanings.

Acknowledgements

Supplementary material

The materials, data, scripts and complete statistical analyses used in the preliminary study and in the main experiment are available online at:

https://github.com/neologisms-annotation/regular_polysemy_identification

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