

The spectrum of sense remoteness in polysemy: Bridging computational and theoretical lexicography with psycholinguistics

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Abstract: In this study, we bridge insights from psycholinguistics and from theoretical and computational lexicography to develop a fine-grained classification of polysemy organized along a wider spectrum of sense remoteness of ambiguous words in Polish based on the investigation of a wide spectrum of data. In our quantitative research on a large sample of sense pairs randomly extracted from plWordNet (Słowosieć), we observed that the most widely represented are nested polysemy, polysemy by metaphor and polysemy by metonymy. We present a detailed discussion of nested polysemy, so far underestimated in psycholinguistic research. We also show that polysemy is not a stable phenomenon and relations between senses may differ across language users. For instance, our fifty-fifty class or borderline cases may be represented differently by different language users depending on their perception of the world, world knowledge, associations. We point to some parameters of variation in the class of polysemy by metonymy and polysemy by metaphor which may affect their sense remoteness and consequently also the way they are represented in the mental lexicon.

Keywords: polysemy, spectrum of sense remoteness, plWordNet – Słowosieć, Polish, mental lexicon, homonymy, metonymy, metaphor, nested polysemy

The goal of this study is to contribute to a recent line of theoretical as well as psycho- and neurolinguistic research on the representation of ambiguous (homonymous and polysemous) words in the mental lexicon by positing a fine-grained classification of polysemy organized along a spectrum of sense remoteness.

There have been many studies on how homonymous words are represented in the memory (e.g., Swinney, 1979; Van Petten and Kutas, 1987; Azuma and Van Orden, 1997; Hino and Lupker, 1996; Rayner and Duffy, 1986; Beretta, Fiorentino and Poeppel, 2005). Recently, there has been a growing interest in polysemy, but the results of the existing studies are far from uniform (e.g., Pickering and Frisson, 2001; Klein and Murphy, 2001, 2002; Pykkänen, Llinás, and Murphy, 2006; Falkum, 2010, 2011; Foraker and Murphy, 2012; Falkum and Vincente, 2015; Frisson, 2015; Brocher, Foraker and Koenig, 2016; Brocher et al., 2018; Carston, 2020; Murphy, 2021). While there is a general consensus that the meanings of homonymous words are represented as different lexemes in the mental lexicon, the views on how polysemous words are represented vary. An important reason for why scholars cannot reach consensus as to how polysemy is represented in the mental lexicon is that polysemy is a multifarious phenomenon and different kinds of polysemy may have different representations in the mental lexicon giving rise to different experimental results (see also Falkum and Vincente, 2015; Brocher, Foraker and Koenig, 2016; Carston, 2020). One important parameter along which polysemy varies is sense remoteness. Klepousniotou and Baum (2007), Klepousniotou, Titone and Romero (2008), Klepousniotou et al., (2012) provided experimental evidence that the degree of semantic similarity (also referred to as semantic remoteness or semantic overlap) between different

meanings or senses of ambiguous words affects their processing. Similarly, Apresjan, Lopukhina and Zarifyan (2021) show in their recent study that adjectival metonymy is heterogeneous as to its mental storage depending on sense remoteness. Our goal is to extend this line of research by developing a fine-grained classification of polysemy organized along a wider spectrum of sense remoteness of ambiguous words in Polish based on the investigation of a wide spectrum of data. Such an approach has a potential to significantly enrich our understanding of polysemy and its representation in memory and it may have important applications in further psycho- and neurolinguistic research. An important contribution of this study is that we attempt to bridge insights from computational and theoretical lexicography with an ongoing psycholinguistic discussion on the representation of polysemy in the memory.

The paper has the following organization. In section 1, we overview the prevailing psycholinguistic views on homonymy and polysemy and we introduce the notion of sense remoteness as a parameter of variation of polysemy. We also present the basic spectrum of sense remoteness proposed in the literature. In Section 2, we present the methodology of our research on polysemy in which we relied on the services, tools and resources of the CLARIN-PL Language Technology Center (the Polish section of the European research infrastructure CLARIN ERIC). We also present the results of our quantitative research on the frequency of occurrence of different types of polysemy in a randomly selected sample of sense pairs. In Section 3, we present our insights on nested polysemy, which has so far received very little attention in research on polysemy but which turned out to be the most widely represented in our sample. Section 4 discusses some examples of polysemy which can be perceived either as homonymy or as metaphor, metonymy, nested polysemy by different language users. We dub this class 50/50. We also propose an extended spectrum of sense remoteness. In Section 5, we present our insights on metaphor and metonymy and we suggest that the distinguished types of metonymy and metaphor may differ with respect to sense remoteness, which in turn may affect the way they are represented in the mental lexicon.

1. Relevant background on polysemy

1.1 Psycholinguistic and theoretical approaches to polysemy representation in the mind

There are two basic types of lexical ambiguity: homonymy and polysemy.

We define the homonymy/polysemy distinction using a semantic criterion based on the degree of semantic similarity. Homonyms are strings of letters (or phonemes) which can be assigned two or more semantically unrelated meanings (Valera and Ruz, 2020), as exemplified for Polish in (1)¹.

(1)

- a. *sprawna* AKCJA ‘a smooth action’ vs. *gieldowa* AKCJA ‘a stock market share’
- b. *wojskowy* GAZIK ‘a military car’ vs. *jałowy* GAZIK ‘a sterile gauze pad’
- c. *karnawałowy* BAL ‘a carnival ball’ vs. *sosnowy* BAL ‘a pine wood log’
- d. *pełny* GRAFIK ‘a full schedule’ vs. *zdolny* GRAFIK ‘a talented graphic designer’
- e. *baśniowy* SEZAM ‘fairy-tale Sesame’ vs. *łuskany* SEZAM ‘shelled sesame’
- f. *wielkanocna* BABKA ‘Easter cake’ vs. *ślepa* BABKA ‘a blind old woman’
- g. *ciasny* BOKS ‘a cramped cubicle’ vs. *amatorski* BOKS ‘amateur boxing’

¹All the adjective collocations are used to disambiguate each of the senses. To select proper adjective collocations we resorted to a Word Sketch collocater (an innovative NLP tool operating on large-scale corpora) embedded under Sketch Engine available at <http://www.sketchengine.eu>; (Kilgariff et al., 2014) and the PELCRA collocater (Pęzik, 2012; Janus, Przepiórkowski, 2007) embedded under the National Corpus of Polish.

- h. *ciepła KAWKA* ‘hot coffee’ vs. *ćwierkająca KAWKA* ‘a chirping jackdaw’
- i. *rozłożysty KLON* ‘a spreading maple’ vs. *ludzki KLON* ‘a human clone’
- j. *ciepła PARÓWKA* ‘a veal sausage’ vs. *ziołowa PARÓWKA* ‘herbal steam bath’
- k. *światowy POKÓJ* ‘world peace’ vs. *hotelowy POKÓJ* ‘a hotel room’
- l. *rozszerzony POR* ‘an enlarged pore’ vs. *pokrojony POR* ‘chopped leek’
- m. *jabłkowy MUS* ‘apple mousse’ vs. *bezwzględny MUS* ‘an absolute must’
- n. *buchająca PARA* ‘gushing vapour’ vs. *zakochana PARA* ‘a couple in love’

By contrast, polysemous words have multiple semantically related senses, as exemplified in (2) for Polish.

(2)

- a. *Nad Zatoką Pucką przeszła niespodziewana TRĄBA powietrzna.*
‘An unexpected whirlwind passed over the Bay of Puck.’
- b. *Głośno zagrał na blaszanej TRĄBIE.*
‘He played the tin trumpet loudly.’
- c. *Ale z ciebie TRĄBA.*
‘You’re a real dumb.’
- d. *TRĄBA służy słoniowi do polewania się wodą.*
‘The trunk is used by the elephant to pour water on itself.’

The single word *trąba* in Polish can be used to refer to a whirlwind, as in (2a), to a trumpet, as in (2b), to a very clumsy person (a dumb), as in (2c) or to an elephant trunk, as in (2d). In psycholinguistics, most scholars agree that the meanings of homonymous words are represented as different lexemes in the mental lexicon. Scholars working on the processing of homonymy postulate the *Meaning Enumeration Lexicon*, in which each meaning of a homonymous word is stored under a separate lexical entry. What is controversial, is how different senses of polysemous words are represented in the memory and how they are processed during language comprehension. Concerning homonymy scholars generally agree that there is a competition between meanings and the most frequent meaning usually wins the competition unless there is contextual support for the less frequent meaning. The frequency effects found in homonymy are not always attested in polysemy suggesting that its lexical representation differs from that of homonymy. In psycholinguistic literature, there are three main approaches to polysemy which address these questions differently:

(i) Core Meaning hypothesis, according to which the comprehenders activate a single underspecified abstract semantic representation (core meaning being some kind of summary of all the different senses of the word) when they encountering a polysemous word (see Frazier and Rayner 1990; Frisson and Pickering 1999, 2007; Frisson 2009, 2015; Pickering and Frisson 2001). Scholars postulating this view claim that the comprehenders do not immediately commit to one of the senses of a polysemous word but rather they exploit contextual cues to home in on a particular sense with a delay. In this sense, it is a top-down model of processing in that context is used to gradually home in on the desired interpretation.

(ii) Sense-Enumeration Lexicon approach which posits that different senses of a polysemous word are listed as separate lexical entries in the memory but are connected to a joint core representation (see Klein and Murphy 2001, 2002; Pykkänen, Llinás and Murphy 2006; Foraker and Murphy 2012). Under this view, the processing of polysemous words should

proceed in a bottom-up fashion in that different senses of a polysemous word should become automatically activated and the strength of their activation should depend on their meaning frequency. In other words, sense dominance should play a role immediately and early effects of sense frequency are expected.

(iii) Relevance Theory-inspired view (due to Falkum 2010, 2011) holds that polysemy is a pragmatic phenomenon and polysemous words are not listed in the lexicon but rather the comprehenders compute them during on-line processing based on context-driven extension (in top-down processing). According to this approach, all that is represented in the lexicon is a Core Meaning of a polysemous word, and its different polysemous extensions are generated on the fly using pragmatic reasoning and world knowledge. This view says that the comprehenders exploit contextual clues to arrive at the intended reading of a polysemous expression. In the absence of such clues, that is in neutral contexts, they choose the most frequent contextual interpretation. Under this approach, sense frequency should not play a role when a preverbal context supports a specific interpretation of a polysemous word, but it should play a role in neutral contexts. In the latter case the most frequent interpretation is chosen.

Similarly, in theoretical approaches to polysemy, scholars differ in the amount of information associated with a lexical representation of a polysemous lexical item. Under rich meaning approaches, polysemous words are lexically represented as an organized structure where senses are explicitly represented. Pustojevsky (1995) in his Generative Lexicon claims that such knowledge structures are part of lexical meanings. He describes the meaning of lexical elements by means of qualia structures in terms of four roles describing hidden events or activities that are conceptually related to a given word: (i) Constitutive: describing physical characteristics of an object, its parts; (ii) Agentive: focusing on the actions related to the origin of the object; (iii) Formal: describing taxonomic information of an object and (iv) Telic: describing the purpose or function of an object. While solving mismatches we access the hidden events available in the qualia structure of a lexical representation (see also Asher and Pustojevsky 2006, Asher 2011 for a similar view). Similarly, Ortega-Andrés and Vincente (2019) in their discussion of the polysemous nature of the word *school* argue that it links to a knowledge structure that stores the typical senses of the word. They associate knowledge structures with lexical meanings of words. Senses that are part of the structure form an activation package in which the activation of one of the senses causes the activation other senses (see also Ortega-Andrés 2021). Hogeweg and Vincente (2020: 867) argue that some semantic phenomena can be explained only if we assume a rich lexical representation. These are for example coercion effects which are repair processes arising when there is a mismatch between lexical restrictions of some words and the semantics of other linguistic expressions they are composed with. Coercion processes have been shown to cause repair mechanism which are cognitively costly and lead to increased processing time. Such phenomena suggest that lexical content of words is semantically rich.

On the other hand, thin semantics approaches such as the one proposed in traditional formal semantics lexical representations consist of simple denotations and it is distinct from conceptual knowledge. Such a clear distinction between lexical meaning of words and conceptual structures associated with them was also proposed by Jackendoff (2002). Bücking & Maienborn (2019), like Jackendoff (2002), assume a strict division between lexical and conceptual knowledge but they agree that both types of knowledge are involved in resolving semantic conflicts. Bücking & Maienborn (2019) argue that Pustojevsky's (1995) qualia structures are too poor to account for the whole range of possible interpretations of lexical

items and more knowledge would have to be part of qualia structures to account for the flexibility of word meanings. They also state that if all the relevant world knowledge was part of lexical representations, the compositional system would be in danger of collapsing. Another proponent of a thin semantic approach to polysemy is Dölling (2003, 2005, 2014) who postulates that underspecification is resolved through the insertion of a coercion operator that links lexical content with pragmatic inferencing based on context and world knowledge.

Both thin and rich lexical representation approaches agree that conceptual and world knowledge is used during meaning composition but they disagree as to how much of this knowledge is part of the lexicon.

1.2 Spectrum of sense remoteness as a parameter of variation in polysemy

The reason why scholars cannot agree on how polysemy is represented and processed in the mind is that polysemy itself is not a uniform phenomenon. One important parameter along which polysemy varies is sense remoteness. Haber and Poesio (2020) show that the distinction between homonyms and polysemes is not sufficient and some polysemic sense interpretations are evaluated as significantly less similar to each other than other sense pairs suggesting that polysemy is not a homogenous phenomenon. They suggest that the interpretations of polysemic words might be grouped based on their similarity but they remain agnostic as to whether sense groupings are idiosyncratic or systematic across target words of a certain polysemy type. Similarly, in their studies using subjective judgements, reading time measures and Event Related Potentials Klepousniotou and Baum (2007), Klepousniotou et al. (2008), Klepousniotou et al., (2012) showed that the degree of semantic similarity between different meanings or senses of ambiguous words affects their processing, which may indicate that high sense remoteness words and low sense remoteness words are associated with different storage profiles in the mental lexicon. They compared three groups of lexically ambiguous words: (i) homonymy, (ii) polysemy by metaphor and (iii) polysemy by metonymy and they proposed the spectrum of their sense remoteness presented in Figure 1.

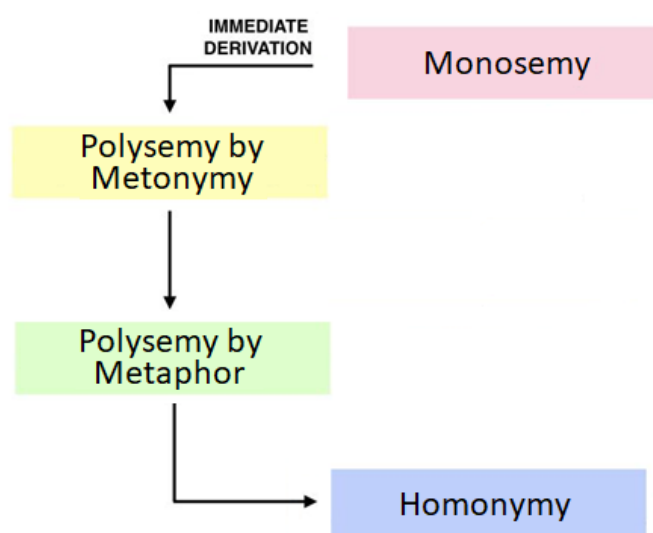


Figure 1. The spectrum of sense remoteness postulated by Klepousniotou and Baum (2007), Klepousniotou et al. (2008), Klepousniotou et al., (2012). The graphical representation is ours.

Their proposal is consistent with the findings from language development, language comprehension and language deficits research suggesting that metonymy is cognitively more basic and easier to learn and process than metaphor (see Rundblad and Annaz, 2010).

Metonymy and metaphor are two very similar mechanisms of meaning extension. In metaphor, this mechanism is based on similarity between two things or concepts while in metonymy it is based on contiguity (see Barnden, 2007; Bartsch, 2002; Bortfeld and McGlone, 2001; Bowdle and Gentner, 2005; Coulson and Matlock, 2001; Gentner, Bowdle, Wolf and Boronat, 2001; Annaz, van Herwegen, Thomas, Fishman, Karmiloff-Smith and Rundblad, 2009; Croft, 1993; Dirven, 2002; Feyaerts, 2003; Klepousniotou, 2002; Ortony, 1979; Schumacher, 2019; Bambini, Bott and Schumacher, 2021). Carston (2020: 112) points out that for example, an institution and the building where its activities take place, a container and its contents are metonymic because there is a contiguous relation between them in the real world. By contrast, a human leg and a table leg, a wing of a bird and a wing of a plane share some degree of resemblance either at the conceptual level, at the level of their range of functions or at the level of symbolic, stereotypical associations. Cognitive linguists describe metonymy as a mechanism of meaning extension which involves two related senses within the same cognitive domain. By contrast, metaphorically used words involve two senses across two conceptual domains (see Kövecses and Radden, 1998; Lakoff and Johnson, 1980; Lewandowska-Tomaszczyk, 2012; Ruiz de Mendoza Ibáñez, 2003; Spieß and Köpcke, 2015; Turner and Fauconnier, 2003; Michl, 2019). The notion of the domain has, however, not been unequivocally defined.

Polysemy by metonymy is typically regular. The regularity of polysemous words has been captured by Apresjan (1973: 181) who used the following criterion to characterize regular polysemy: ‘Polysemy of the word A with the senses a_i and a_j is regular if, in a given language, there exists at least one other word B with the meanings b_i and b_j , which are semantically distinct 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.’ Apresjan (1973) divided regular polysemy into classes, which mainly instantiate metonymy, as exemplified in (3).

(3)

- a. animal/meat e.g., *kurczak* ‘chicken’, *indyk* ‘turkey’
pyszny KURCZAK ‘delicious chicken’ vs. *puszysty KURCZAK* ‘a fluffy chicken’
- b. type of tree/wood from this type of tree e.g., *dąb* ‘oak’, *sosna* ‘pine’
rozłożysty DĄB ‘a spreading oak tree’ vs. *sękaty DĄB* ‘gnarled oak wood’
- c. container/unit of measure e.g., *butelka* ‘bottle’, *szklanka* ‘glass’
zbita SZKLANKA ‘a broken glass’ vs. *czubata SZKLANKA* ‘a heaped glass’
- d. plant/food e.g., *kawa* ‘coffee’, *herbata* ‘tea’
doniczkowa KAWA ‘potted coffee’ vs. *gorąca KAWA* ‘hot coffee’
- e. plant/fruit e.g., *pomidor* ‘tomato’, *fasola* ‘bean’
posadzony POMIDOR ‘a planted tomato’ vs. *umyty POMIDOR* ‘a washed tomato’
- f. institution/performance e.g., *balet* ‘ballet’, *teatr* ‘theater’
moskiewski BALET ‘Moscow ballet’ vs. *jednoaktowy BALET* ‘one-act ballet’
- g. activity/result of this activity e.g., *dyktando* ‘a spelling test’
dziesięciminutowe DYKTANDO ‘a ten-minute spelling test’ vs. *bezbłędne DYKTANDO* ‘an error free spelling test’
- h. organization/building e.g., *szkoła* ‘school’
wyremontowana SZKOŁA ‘a renovated school’ vs. *dobra SZKOŁA* ‘a good school’
- i. instrument/activity e.g. *szachy* ‘chess’
drewniane SZACHY ‘wooden chess’ vs. *szybkie SZACHY* ‘a quick game of chess’

Another important feature of polysemy by metonymy is zeugmaticity, also referred to as co-predication (see Dölling, 2018; Viebahn, 2020; Ortega-Andrés and Vicente, 2019; Vicente, 2021). As stated in Vicente (2021: 348), ‘co-predication is a strange phenomenon where a single NP apparently has more than one denotation, given that the predicates that modify said NP have

mutually inconsistent selectional preferences.’ Several syntactic constructions can be used to generate co-predication e.g., relative clauses, attributive adjectives or coordination of verbs or VPs. For example, in (4), the adjective ‘heavy’ selects for some physical object and the adjective ‘interesting’ applies to some abstract content.

(4) The book is heavy and interesting (Vicente ,2021: 348)

Examples of zeugmatic uses of metonymic words are shown for Polish in (5).

(5) a. object/activity

OBIAD (smaczny vs. rodzinny)
Zjadł smaczny rodzinny obiad.
‘He had a tasty family dinner.’

b. container/unit of measure

ŁYŻECZKA (srebrna vs. czubata)
Wsypał czubatą łyżeczkę cukru pudru i ją oblizał.
‘He poured in a heaping teaspoon of ice sugar and licked it off.’

c. tree/wood

SOSNA (rozłożysta vs. sękata)
Cały jego dom jest obłożony lokalnie rosnącą sosną.
‘His entire house is laid in locally growing pine.’

d. animal/meat

INDYK (gulgotzący vs. pieczony)
Na święta upiekłam indyka z wolnego wybiegu i smakował lepiej niż te z chowu klatkowego.
‘I roasted a free-range turkey for Christmas and it tasted better than the caged ones.’

By contrast, polysemy by metaphor is usually not regular and non-zeugmatic. It is usually defined as a poetic tool but in fact it is pervasive in everyday communication. Metaphor is often characterized in terms of conventionality (see Pouscoulous and Dulcinati, 2019). Conventional metaphors (in contrast to novel metaphors) are very familiar, highly lexicalized and productively used by language users. In this study, we focus only on highly lexicalized conventional metaphors such as the ones exemplified in (6).

(6)

- a. MUCHA (*natrętna* ‘an intrusive fly’ vs. *elegancka* ‘an elegant bow tie’)
- b. NARYBEK (*odłowiony* ‘caught fry’ vs. *piłkarski* ‘football fry’)
- c. MARGINES (*lewy* ‘a left margin’ vs. *społeczny* ‘a social underclass’)
- d. REKIN (*rafowy* ‘a reef shark’ vs. *gieldowy* ‘a stock market shark’)
- e. GŁOWA (*łysa* ‘a bald head’ vs. *mądra* ‘a wise head’)
- f. PASMO (*siwe* ‘a gray streak (of hair)’ vs. *górskie* ‘a mountain range’)
- g. DZIÓB (*kaczy* ‘a duck beak’ vs. *drewniany* ‘a ship’s bow’)
- h. AMBONA (*kościelna* ‘a pulpit in the church’ vs. *leśna* ‘a forest pulpit’)
- i. AURA (*jesienna* ‘autumn weather’ vs. *tajemnicza* ‘mysterious aura’)
- j. CIOS (*śmiertelny* ‘a deadly blow’ vs. *życiowy* ‘a life-changing blow’)
- k. KOCIAK (*pręgowany* ‘a brindle kitten’ vs. *seksowny* ‘a sexy kitty’)
- l. BARIERA (*metalowa* ‘a metal barrier’ vs. *psychiczna* ‘a mental barrier’)

- m. KREW (*pobrana* ‘drawn blood’ vs. *królewska* ‘royal blood’)
- n. KROK (*dlugi* ‘a long step’ vs. *mądry* ‘a wise step’)
- o. ORZEŁ (*matematyczny* ‘a mathematical genius’ vs. *dziki* ‘a wild eagle’)

As stated earlier in this section, Klepousniotou and Baum (2007), Klepousniotou et al. (2008), Klepousniotou et al., (2012) provide evidence in their psycholinguistic experiments that metaphor and metonymy differ in sense remoteness with the two senses of metaphorical expressions being more remote than the two senses of metonymic expressions. In this study, we extend this line of research and we propose a wider spectrum of sense remoteness of more types of polysemous words in Polish based on our research based on computational and theoretical lexicography.

2. Methodology

There is no clear answer to the question on how to divide meanings within one lexeme or how to decide which of the regular polysemes is lexicalized. Traditional lexicography distinguishes between polysemy and homonymy but it usually does not describe word formation details and inter-relationships between two words having the same lexeme. On the other hand, it emphasises etymology as a basis to prove two words to be homonyms. This distinction may not be a very practical one when it comes to studies on contemporary language through psycholinguistic experiments on its users who are not aware of the etymology of words they interpret (see section devoted to the fifty-fifty class of polysemy for further details).

Given the above constraints, the compromise between lexicographic and psycholinguistic perspectives needed to be found. The former perspective constitutes the foundation for the present study and thus must be thoroughly examined, while the latter may shed some new light on the issue of polysemy as a psychologically real phenomenon. In the next section, we describe the methodology of data collection and quantitative results of our classification of the material into different types of polysemy.

2.1. In search for a method

Probably the most intuitive source for finding polysemous and homonymous words are dictionaries. Unfortunately, as easy as it seems they are constructed in such a way that only meanings of homonymous words are presented under separate entries. In the case of polysemous senses, they are usually listed under one entry. Consequently, they do not provide sufficient material for polysemy research, often listing potential words, which indeed are systemically correct, created in accordance with word-formation rules, but which are either not lexicalized or not used in natural communication in Polish. Standard dictionaries of the Polish language present material by carefully taking into account etymological information (about homonyms), but do not pay as much attention to polysemy determination.

Yet average language users are rarely aware of the origin of words and are inclined to resort to folk etymology, i.e., finding a relationship between two etymologically unrelated meanings. Considering all of the above, data collected from dictionaries may be useful but should not constitute the basic source.

Importantly, the homonymy-polysemy distinction is for us a matter of speakers' mental representations and their perception of sense relatedness. It may happen that the speaker's perception of polysemous and homonymous words is distinct from what lexicographers propose in dictionaries where on the basis of etymology facts they set up a single dictionary entry in the case of polysemy and two or more in the case of homonymy. Bearing that in mind, it is not our purpose to argue that dictionaries are unreliable source of materials for the experiments on polysemy. All we want to say is that they are not sufficient and that not all types of polysemy

are included in the dictionaries. Throughout the article we want to stress the importance of dictionaries, but we also want to point out that research should not be based solely on them. It should be accompanied with databases which are more frequently updated. Some phenomena are ephemeral and dynamic, as is for instance homonymous polysemy decay; printed dictionaries do not take such changes into account, so research using dictionaries alone should not be approached in an uncritical way.

The issues of lexical semantic change and homonymous polysemy decay were also tackled by Giulianelli, Del Tredici and Fernández (2020) using neural contextualized word representations with the aid of quantitative procedures proposed by Schlechtweg, Schulte im Walde and Eckmann (2018). Following Hopper et al. (1991), they suggest that word meaning is virtually always accompanied with polysemous stages in the course of time rather than shifts directly from one sense to another. They additionally stress the importance of aligning the detected semantic shifts with native speakers' interpretation (i.e., human similarity judgements), which demonstrates the pressing necessity for resorting to frequently updated resources.

Beside dictionaries, our attempts at sourcing and classifying the material have been aimed at ready-made lists taken from the existing literature, e.g. from Apresjan (1974) or Markowski (2012) but again, they provide valuable material as a secondary source, not granting the general perspective of what polysemy looks like in real language usage.

In search for a suitable method, which would reflect the actual phenomenon of polysemy in Polish, we ultimately decided to rely on the services, tools and resources of the CLARIN-PL Language Technology Center (the Polish section of the European research infrastructure CLARIN ERIC) in collaboration with the members of the Computation Linguistics and Language Technology research group. CLARIN-PL infrastructure, among many other services, offers plWordNet (Słowosieć – Dziob, Piasecki and Rudnicka, 2019), which takes into account greater number of observed meanings of one lexeme than an average dictionary of the Polish language (due to the construction of the wordnet and the need to describe each meaning with a set of predefined relations). It is nonetheless important to stress out here that it is not the purpose of dictionaries to be compiled so as to reflect thought processes. All the same, a meeting point must be found between lexicographic and psycholinguistic lines of research, which traditionally have separate aims and functions. One of the aims of this work is to show that although the two perspectives have different research thoughts, they can gain much from each other.

2.2. Polysemy from a bird's eye view: Insights from computational and theoretical lexicography

Using plWordNet as a lexicographic source for the research has a number of advantages. As far as conducting observations of relations that may occur between pairs of words with the same lemma, a lexical-semantic database such as wordnet makes the task considerably easier than using standard dictionaries. It is possible to extract a random sample of word pairs with the same lemma from the database and thus obtain material presenting an averaged state of language. It is also possible (in further stages of research), thanks to the database format, to search the resource using various criteria. There is no explicit information on homonymy in plWordNet, but some information on word-formation relations between polysemes can be read as in a nested dictionary² (more information, especially on direct semantic derivation, may be added to plWordNet as a result of this research).

² Such a dictionary is based on common etymological nests of words.

SłowoSieć

Oglądasz 1 z 3 dostępnych znaczeń tego słowa

Hiperonimy

plastyk 2
domena: ludzie

Hiponimy

liternik 1
domena: ludzie

ilustrator 1
domena: ludzie

rysownik 1

grafik 1 artysta, którego domeną jest grafika

grafik 2 informatyk zajmujący się grafiką komputerową

grafik 3 harmonogram, rozkład, rozplanowanie przebieg...

DOMENA ludzie

PRZYKŁADY Moreau był też utalentowanym grafikiem.

← **Kolokacyjność**

Następne znaczenie →

Figure 2. Search result for *grafik* in plWordNet, represented under three separate entries as ‘an artist specializing in designing graphics’, ‘a computer graphic designer’ and ‘a schedule’

The CLARIN-PL team can generate a list of user-predefined characteristics. With their help, we were equipped with a list of **800 randomly selected nominal pairs of senses**. The plWordNet has a number of relations and attributes that were of help while generating the lists. For example, the part of speech that was filtered out was the noun, which had at least two senses with an assigned relation between them. An additional criterion used to retrieve the aforementioned sample was that the units should be attributed with elaborated glosses. Glosses not only facilitated the identification of meanings thanks to the definitions attributed to specific senses, but also provided useful information about the register. An important feature of the randomly selected sample is that it is averaged and rich enough to bring general conclusions to the table when one considers the relations that exist in pairs of senses based on the same lemma.

During a series of online meetings held by a group consisting of members of the CLARIN-PL team specialising in computational and theoretical lexicography and specialists in psycholinguistics, we have been working on selecting these senses which are indeed used by standard language users in order to treat polysemy as a mental phenomenon. Sigman and Cechi (2002) discuss the implications of semantic networks – such as wordnets – for the mental lexicon. Semantic networks constitute an accurate indicator of semantic relatedness based on the type of relations and the number of nodes with which two lexical units are inter-connected. Graph properties of wordnets may be significant for the apprehension of the mental representation of meaning (Spitzer, 1998). In psycholinguistic studies that are conducted with the use of the priming-related paradigms accompanied with a lexical decision task, subjects are requested to assess whether a string of letters or sounds (depending on the modality of the stimuli) is an existing word or not, decisions are made faster after a semantically related lexical item than after an unrelated one (Aujla, 2021). This semantic distance (apparent in the retrieval time) is correlated with the distance in a wordnet graph. Sigman and Cechi (2002) additionally provided evidence that a polysemous word primes the different senses linked with it. A similar line of reasoning is presented in more recent works (Vitevitch, Goldstein, Siew and Castro, 2014; Zock and Biemann, 2021) where the organization of the mental lexicon is revealed in graph models (Motter, de Moura, Lai, Dasgupta, 2002; Bieman, 2012; Baronchelli et al. 2013; Morais, Olsson and Schooler, 2013; Kenett, Anaki and Faust, 2014; Zortea, Menegola, Villavicencio, Salles, 2014; Siew, Wulff, Beckage and Kenett, 2019). The graph models rest on the premise that hubs (i.e., a local number of relations – density), the location of a particular word in the lexical network as well as connectedness and relative distance to other words may be measured via semantic relations in wordnets.

In order to make our findings applicable to psycholinguistic research, we wanted the quantitative part to deal with material that is used by an average user in everyday communication. Unfamiliar or infrequent words limited to certain environments or from specialized registers could de facto blur the general picture. We are interested in everyday polysemy of nouns as it functions in the minds of users.

That is why the first step, prior to the actual analysis of the material, was filtering out these words which are not really used. Rejection criteria included repetitions, infrequent senses, archaisms, specialised register, non-normative forms of nouns and abbreviations. This filtering was based on our knowledge and lexicographic experience of the members of our team. The frequency was measured using the Polish Corpus, PELCRA NKJP (Janus, Przepiórkowski, 2007; Pęzik, 2012). To illustrate the point, we filtered out the words with at least one sense not meeting the required criteria e.g., *dzieża* ‘kneading trough’, *scheda* ‘legacy’, *gawot* ‘gavotte’, c.o. ‘abbr. central heating’, *zachłyst* ‘choking’, *konwikt* ‘boarding school’, *lek.* ‘abbr. doctor’, *zielone* ‘green light’, *krajka* ‘selvage’, to mention but a few. Consequently, the selected material contained **403 pairs of senses**, which were then meticulously analyzed and annotated with an appropriate label (i.e., homonymy or a specific type of polysemy). The annotation process was continually accompanied with references to the relevant literature (Apresjan, 1974; Klepousniotou and Baum, 2007; Klepousniotou, Titone and Romero, 2008; Klepousniotou et al., 2012; Markowski, 2012; Falkum and Vicente, 2015; Brocher, Foraker and Koenig, 2016; Carston, 2020; Vicente, 2021). It is necessary to point out here that the selected method imposed on us the necessity to analyse exactly these senses which were randomly selected from pIWordNet (which was not always intuitive, as some of them were not salient).

The annotation process was carried out by three independent annotators. At first, we worked together in a series of meetings on some of the material in order to develop coherent guidelines (which later served as a reference point for the theoretical section on the different types of polysemy in the present work). Then each annotator clustered a third of the collected material, which was reviewed by the other two annotators and commented on in case of doubt.

Pre-determined classification included only those polysemy types that are well defined in the literature. In the case of discrepancies or doubts in our assessments or when a given pair did not fully fall into any of the types of polysemy defined in the literature, we used the so-called clustering, i.e. we assigned numbers and then we attempted to find common features that these different clusters had in common.

Ultimately, the selected sample was clustered into five general types, which emerged during the work of the group: polysemy by metonymy, polysemy by metaphor, nested polysemy, fifty-fifty and homonymy, with the proportions of each type illustrated in the chart below.

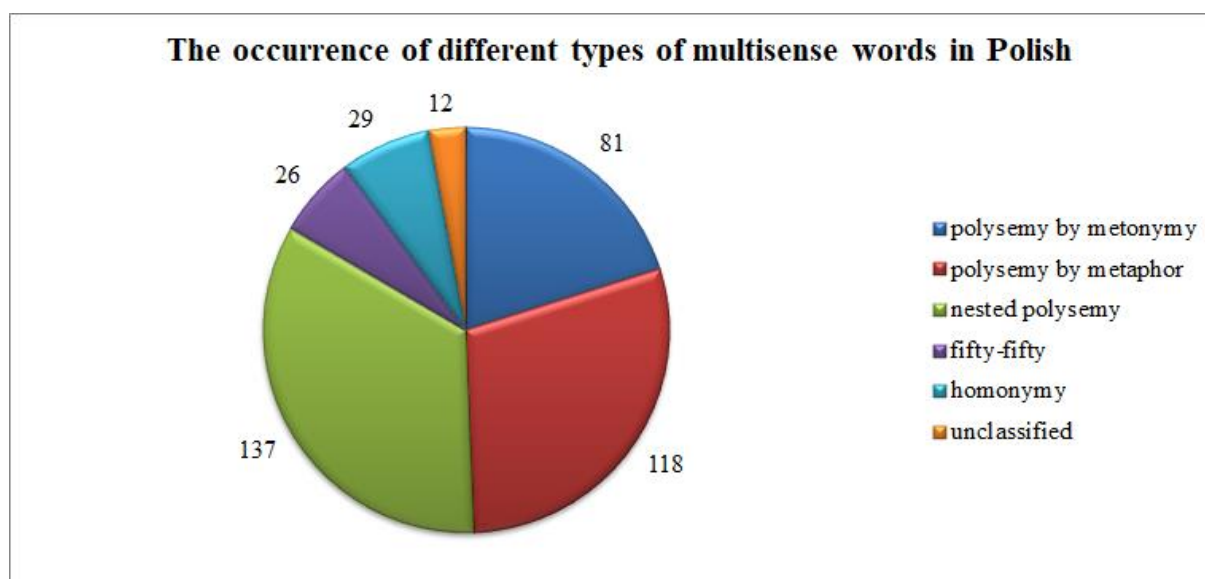


Figure 3. The occurrence of homonymy and different types of polysemy in Polish based on 403 selected pairs of nominal senses; the “unclassified” category includes problematic cases, such as *support* ‘support act/warm-up act’, *grzęda* ‘perch’, *kujawiak* ‘an inhabitant of Kujawy region/type of dance’ or *Jamajka* ‘Jamaica/a female inhabitant of Jamaica’. The pie chart reflects different types of multisense words based on a random sample.

As shown in the above numerical data, three types of multisense words emerged as dominant: nested polysemy, polysemy by metaphor and polysemy by metonymy. The other two types – namely, fifty-fifty class and homonymy – though important from the psycholinguistic perspective, constitute a rather peripheral phenomenon. Consequently, we decided to pursue a detailed investigation in order to propose a more fine-grained classification of polysemy organized along a spectrum of sense remoteness. To do that, the CLARIN-PL team generated additional lists of words aimed at particular types of polysemy: 180 ambiguous feminatives, 1127 polysemous lemmas with at least one sense in the domain of ‘food’ 2609 polysemous lemmas with at least one sense in the domain of ‘human’. These additional lists were just to provide more examples so as to better illustrate a given type of polysemy, and ultimately to understand the phenomenon better – these lists did not affect the graph with the percentage distribution of each type of polysemy (percentages are based on the list of random samples only).

In the following sections, we first devote more attention to nested polysemy, which is not well-explored in the literature but which turned out to be the most widely represented in our sample. Secondly, we introduce a new type of polysemy which emerged from our material: the so-called fifty-fifty class. Finally, we provide some insights on polysemy by metonymy and by metaphor and observe that although these types are described as uniform, this is not really the case.

3. Nested polysemy

It transpires that a significant portion of the analysed material constitutes nested polysemy, which has so far been unnoticed in the psycholinguistic literature on polysemy although it is thoroughly described in theoretical lexicography. In the next section, we will review relevant observations about nested polysemy from a lexicographic perspective, discuss selected examples, show that the class of nested polysemy itself is not homogeneous and that there are

subtypes of it as well as determine the place of these subtypes of nested polysemy in our spectrum of remoteness.

The first classification of nested polysemy was proposed by Apresjan (1974), who analyzes it in terms of typological polysemy: radial, chain and radial-chain.

In radial polysemy, all meanings of a word are motivated by the same – central – sense (e.g., *baza* ‘base’ as ‘something serving as a support, element that keeps an object stable on the ground’ as the central sense for the derivation of *baza* as ‘something that constitutes the basis, making further reference possible’ as well as for the derivation of *baza* as ‘infrastructure complex providing facilities for specific activities’).

In chain polysemy, each new sense of a word is motivated by another – the closest – sense, but the extreme meanings may not share common semantic features, cf. *lewa ręka* ‘left hand’ vs. *lewa strona* ‘left side’ (located on the side of the left hand) vs. *left desk drawer* (located on the left side if the observer is facing the front of the object) vs. *left wing party* (politically radical). Chain polysemy – in its pure form – is uncommon.

In radial-chain polysemy, new senses are motivated in a two-fold manner: first by the central sense and then by the derived senses. For example, *klasa* as in *klasa przedmiotów* ‘the category of objects’ (= ‘category’) is the source for the motivation of the sense *klasa* understood as ‘degree’ as an example of radial polysemy, and then within the group of senses that have arisen through the chain polysemy from the sense ‘category’ are, among others, *klasa robotnicza* ‘the working class’ (= ‘social group’) or *klasa ssaków* ‘the class of mammals’ (= ‘group of homogeneous objects within certain systematicity’) and those that have arisen through the chain polysemy of the sense ‘degree’ are *gra wysokiej klasy* ‘the high class game’ (= ‘measure of quality’) or *pokazać klasę* ‘show (your) class’ (= ‘high quality’). This type of polysemy is the most common of the three.

When it comes to the types of typological polysemy, it is worth discussing one difference – between direct and indirect polysemy. In the case of direct polysemy, the similarity between two senses is revealed in the first stage of semantic description, while in the case of indirect polysemy, the similarity between two senses is revealed in the subsequent (second or further) stage of semantic description.

Although the description of nested polysemy posited by Apresjan (1974) constitutes a strong reference point, there still remain some open questions with regard to how these three types of typological polysemy are reflected in sense remoteness. We have observed that nested polysemy is far from being as uniform as it is observed by Apresjan (1974).

A more diversified classification is posited by Markowski (2012). Apart from radial (which he also calls “star”) and chain polysemy, thereby the types distinguished by Apresjan (1974), the spectrum is extended to concentric (broadening or narrowing), disjunctive and mixed polysemy.

The radial and chain types of polysemy are treated in a very similar fashion by both Apresjan (1974) and Markowski (2012). Markowski (2012) additionally suggests that in radial (or star) polysemy, the type of motivation may be different even within one set of senses, e.g., *ręka* ‘hand’ motivates *mistrzowska ręka* ‘master handicraft’ (= ‘making something in a certain way’) on the basis of metaphor and the same lexeme *ręka* ‘hand’ motivates *gwizdać na rękę* ‘whistle at hand play’ (= ‘type of prohibited touching of the ball in a football game’) on the basis of metonymy.

An interesting – yet relatively rare – kind of typological polysemy constitutes concentric broadening polysemy, which is defined by Markowski (2012) as the one in which the primary sense has the narrowest range and each subsequent (secondary) sense has a wider semantic range, e.g., *rodzina* ‘family’ (= ‘spouses with children’) motivates increasingly broader senses of *rodzina*, as in *zjazd całej rodziny* ‘family reunion’ (= ‘living people related by blood or affinity’), further *rodzina Golderingów od wieków zajmowała się produkcją wina* ‘the

Goldering family has been involved in wine production for centuries' (= 'people descended from a common ancestor'), and even further extended onto *rodzina języków indoeuropejskich* 'Indo-European language family' (= 'a group of objects or phenomena of the same kind').

The second subtype of the concentric polysemy constitutes the narrowing polysemy. Unlike in the broadening polysemy, here the primary sense has the widest range and each subsequent sense has a narrower range, e.g., *temperatura* 'temperature' or *pogoda* 'weather' in which the primary sense relates to the state and the secondary sense to the particular instance of the state (cf. *temperatura wody* 'water temperature' vs. *mieć temperaturę* 'have a fever' and *prognoza pogody* 'weather forecast' vs. *jutro będzie pogoda* 'weather will be good tomorrow').

The next type of polysemy classified by Markowski (2012) is disjunctive polysemy. In this case, the primary sense is general and the subsequent senses specify it, but each in a different way. The subsequent senses are not semantically related to one another, e.g. *liczba* 'number' (= 'a mathematical symbol used to express or count a given quantity') motivates three different senses, yet the range is not increasingly broader or narrower. These specific senses, listed in a random order are as follows: *liczba wolnych miejsc* 'number of places available' (= 'a number of certain units; manpower'), *liczba laureatów konkursu* 'number of competition winners' ('a group of people'), *liczba pojedyncza rodzaju męskiego* 'singular masculine' (= 'grammatical category'). Since the subsequent senses are loosely related to one another here, if the overall meaning disappears, they cease to be perceived as elements of the same entity, i.e. as senses of the polysemous word. According to Markowski (2012), this is the case in which the phenomenon of homonymous polysemy decay (Pl. 'rozpad homonimicznego polisemu') takes place and today we are inclined to treat these words as homonyms.

Correspondingly, Markowski (2012) indeed touches upon the radial-chain polysemy (referred to as such in Apresjan's taxonomy), but he calls it mixed polysemy.

The notion of semantic distance between senses is especially troublesome in nested polysemy because of the number of possible combinations for the polysemic motivation. Our contribution is not only to extend the classification proposed by Apresjan (1974) and Markowski (2012) but also to situate this heterogeneous type somewhere in the existing spectrum of sense remoteness. A feature that distinguishes nested polysemy is that there is no direct link between senses. In other words, there must be an intermediate link (a nest) between senses in nested polysemy. An important observation about nested polysemy from a psycholinguistic perspective is that it may be categorized according to three distinctive features: (i) the presence of an identifiable generic nest from which the senses are derived as subclasses; (ii) the presence of a morphological root, which functions as a nest for the other senses to emerge typically via affixation, back-formation or clipping; and (iii) the presence of a root which by itself is metonymically or metaphorically polysemous and the derived senses are related to the nest via these distinct metonymic or metaphorical senses.

Based on the above features, we propose the following semantically-driven categorization (rather than structurally), which rests upon the tenets posited in Core Meaning hypothesis (Frazier and Rayner 1990; Frisson and Pickering 1999, 2007; Frisson 2009, 2015; Pickering and Frisson 2001), Sense-Enumeration Lexicon (Klein and Murphy 2001, 2002; Pylkkänen, Llinás and Murphy 2006; Foraker and Murphy 2012) and Relevance Theory-inspired view (Falkum 2010; 2011): **nested generic polysemy**, **nested morpho- semantic polysemy** and **nested meta-polysemy**. We believe that the proposed division better reflects the actual sense distance, putting aside the purely lexicographic observations and taking into account the conceptual domains and processes which come into play. By that we understand that the three proposed semantically-driven subtypes of nested polysemy may involve radial, chain, radial-chain, broadening, narrowing, disjunctive or mixed types of nested polysemy structure.

3.1. Nested generic polysemy³

During the analysis of the material we encountered examples of polysemy where it was impossible to distinguish between primary and derived senses. Rather, the senses were very closely interconnected and they were intuitively of equal rank. On closer inspection we concluded that all the senses of polysemous nouns in (7) are not directly derivationally related but they are mediated by some generic semantic concept which constitutes a derivational nest and which does not necessarily need to be explicitly expressed in the given language as having a separate hyperonomous entry. The senses are then perceived as lexicalized instances of the generic concept which involve some of its features. In this respect, all the senses of the polysemous words in (7) narrow the meaning of the generic nest to its specific subkinds. We dub this kind of polysemy **nested generic polysemy**.

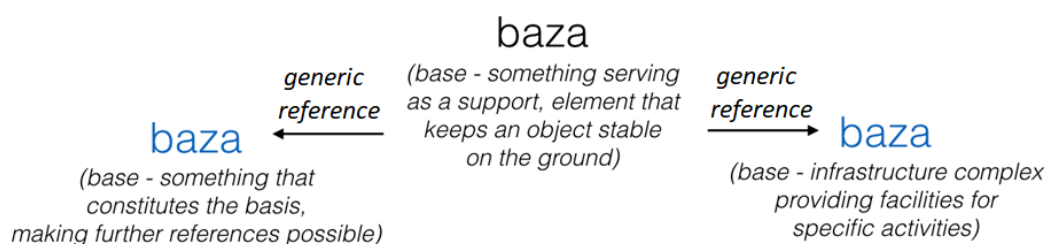


Figure 4. Excerpt of a derivational nest visualising nested conceptual polysemy for *baza* ‘base’

(7)

- a. CZEŚĆ (*znaczna* ‘a major part’ vs. *zamienna* ‘a spare part’)
- b. HISTORIA (*miłosna* ‘a love story’ vs. *powojenna* ‘postwar history’)
- c. KOSTIUM (*taliowany* ‘a fitted costume’ vs. *halloweenowy* ‘a halloween costume’)
- d. RADIO (*tranzystorowe* ‘a transistor radio’ vs. *katolickie* ‘a catholic radio’)
- e. ZESPÓŁ (*badawczy* ‘a research team’ vs. *rockowy* ‘a rock band’)
- f. WYPADEK (*tragiczny* ‘a tragic accident’ vs. *wyjątkowy* ‘a special case’)
- g. SPRAWA (*ważna* ‘an important issue’ vs. *sądowa* ‘a legal case’)
- h. GRA (*planszowa* ‘a board game’ vs. *aktorska* ‘an actor’s performance’)
- i. ZWYCZAJ (*miejscowy* ‘a local custom’ vs. *brzydki* ‘a bad habit’)
- j. GUMA (*balonowa* ‘bubble gum’ vs. *arabska* ‘arabic gum’)
- k. BAZA (*wojskowa* ‘a military base’ vs. *logiczna* ‘a logical base’)
- l. PRZERWA (*metrowa* ‘a one-meter break’ vs. *szkolna* ‘a school break’)
- m. ZBIÓR (*tegoroczny* ‘this year’s crop’ vs. *zbiór biblioteczny* ‘a library collection’)
- n. ZNACZEK (*metalowy* ‘a metal tag’ vs. *kolekcjonerski* ‘a collectors’ stamp’)
- o. DOWÓD (*mocny* ‘strong evidence’ vs. *skradziony* ‘a stolen ID’)
- p. DZIENNIK (*pokładowy* ‘a boarding log’ vs. *poczytny* ‘a high-profile journal’)
- q. PISMO (*ładne* ‘nice handwriting’ vs. *urzędowe* ‘a clerk’s letter’)
- r. NAUKA (*polska* ‘Polish science’ vs. *cenna* ‘a precious lesson’)

3.2. Nested morpho-semantic polysemy

³ One may be tempted to compare our nested generic polysemy with Pustojevsky’s (1995) and Dölling’s (2015) systematic/inherent polysemy but we believe that our examples of nested generic polysemy do not pattern with the examples of systematic/inherent polysemy provided by Pustojevsky (1995) and Dölling (2015).

In this subtype of nested polysemy the derivational nest has the form of a common morphological root. The senses are coincidentally formed by the same suffix in the case of affixation. This subtype is mainly reserved for feminatives (yet not all feminatives belong here), as exemplified in (8).

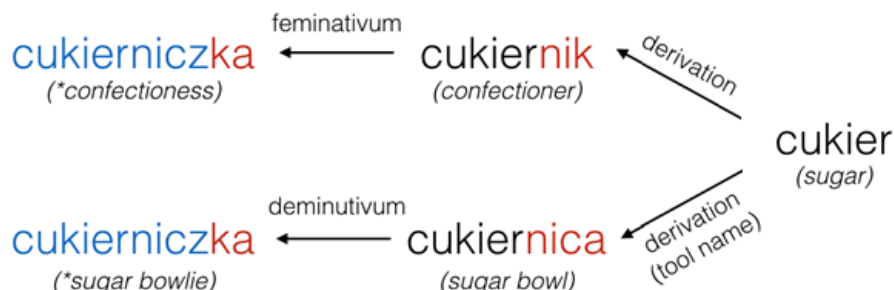


Figure 5. Excerpt of a derivational nest visualising nested morpho-semantic polysemy for *cukierniczka* ‘sugar bowl’ or ‘female confectioner’

(8)

- A. CUKIERNICZKA (*srebrna* ‘a silver sugar bowl’ vs. *doświadczona* ‘an experienced female confectioner’)
- B. PARTYZANTKA (*nielegalna* ‘illegal guerilla’ vs. *blondwłosa* ‘a blonde woman partisan’)
- C. KAWIARKA (*stalowa* ‘a steel moka pot’ vs. *uprzejma* ‘a polite female barista’)
- D. MUZYCZKA (*wybitna* ‘an outstanding female musician’ vs. *chwytliwa* ‘a catchy tune’)
- E. PASTERKA (*uśmiechnięta* ‘a smiling shepherdess’ vs. *uroczysta* ‘solemn midnight mass’)
- F. PILOTKA (*młoda* ‘a young female pilot’ vs. *skórzana* ‘a leather bomber jacket’)
- G. REKLAMÓWKA (*foliowa* ‘a foil bag’ vs. *dwuminutowa* ‘a two-minute animatic’)
- H. SIEKACZ (*kuchenny* ‘a kitchen knife chopper’ vs. *bolący* ‘an aching incisor’)
- I. DILERKA (*wytatuowana* ‘a tattooed female dealer’ vs. *nielegalna* ‘an illegal activity of drug-dealing’)

3.3. Nested meta-polysemy

The derived senses are motivated by metonymy (see Fig. 4) or by metaphor (see Fig. 5) directly from the semantic nest and then at least one of them is mapped onto a broader or narrower sense. This subtype is exemplified in (9).

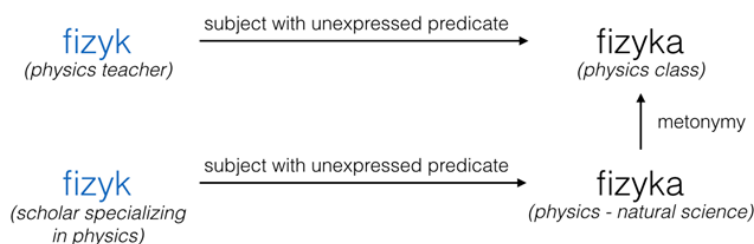


Figure 6. Excerpt of a derivational nest visualising nested metonymic polysemy for *fizyk* ‘physics

teacher’ or ‘scholar specializing in physics’

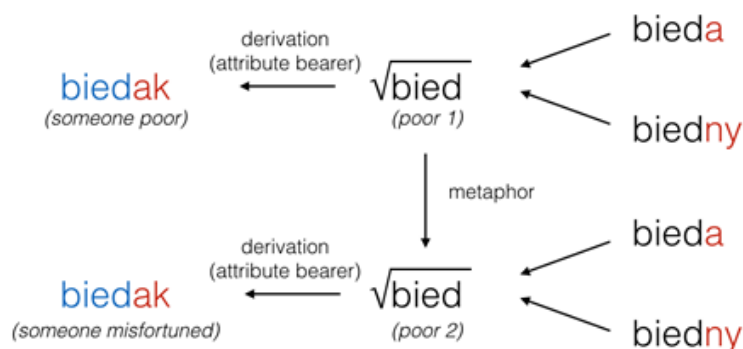


Figure 7. Excerpt of a derivational nest visualising nested metaphoric polysemy for *biedak* ‘someone poor’ or ‘someone misfortunate’

(9)

- A. FIZYK (*sławny* ‘a famous physicist’ vs. *wymagający* ‘a demanding physics teacher’)
- B. BOKSERKA (*zadziorna* ‘a quarrelsome female boxer’ vs. *bawelniana* ‘a cotton tank top’)
- C. MALARZ (*wybitny* ‘an outstanding painter’ vs. *ścienny* ‘a wall painter’)
- D. CIEMNOTA (*umysłowa* ‘intellectual ignorance’ vs. *wiejska* ‘rural narrow-mindedness’)
- E. BIEDAK (*bezdomny* ‘a homeless poor man’ vs. *nieporadny* ‘a clumsy poor thing’)
- F. CZOŁÓWKA (*filmowa* ‘a film theme song’ vs. *ściśła* ‘strict lead’)
- G. ZIEMIANKA (*zamożna* ‘a wealthy landlady’ vs. *głęboka* ‘a deep dugout’)
- H. TRĄBKA (*blaszana* ‘a tin trumpet’ vs. *sloniowa* ‘an elephant trunk’)
- I. SŁUŻBA (*wojskowa* ‘military service’ vs. *nadworna* ‘court service’)

The presented subtypes of nested polysemy should be situated in different places in our spectrum. In the case of nested generic polysemy, different senses are connected to a joint generic core; moreover, some of the words from this subtype pass the co-predication tests. Thus, nested generic polysemy should be situated rather low in our spectrum of sense remoteness. As far as nested morpho-semantic polysemy is concerned, the identical form of the senses is often coincidental because the attached suffixes carry different information. At first glance this subtype may resemble homonymy and should be situated rather high in our spectrum of sense remoteness. The last subtype – nested meta-polysemy⁴ – requires a metonymic or metaphoric shift derived from the nest and then, in the second description, another polysemic shift. Nested polysemy with a metonymic shift should be situated closer to polysemy by metonymy and nested polysemy by metaphor should be situated closer to polysemy by metaphor.

4. Fifty-fifty class

Another observation is that there are numerous words which can be classified as homonymous

⁴ It would additionally be possible to divide this subtype into meta-polysemy based on metaphor and meta-polysemy based on metonymy. Yet this class is a rare one even without this sub-division and we wanted to maintain the classes well-represented.

or polysemous. According to Carston (2020: 110-111), the phenomena of monosemy and homonymy are not stable. Many word coinages which are initially monosemous very quickly become polysemous and there may be a discrepancy between the work of lexicographers and the mental representations of words in the minds of individual language users. For example, two senses of a homonymous word may be historically related but language users may not be aware of it (etymology-oriented approach). The opposite situation is also possible where two unrelated objects referred to by a homonymous word share some resemblance with each other and they start to be represented as polysemous. Consequently, there may be individual differences in whether two senses of a word are perceived as polysemous (semantically related) or homonymous (semantically unrelated). In our spectrum we dub such ambiguous words which may be perceived as either homonymous or polysemous FIFTY-FIFTY. However, there are subtypes of this kind of ambiguity. In (10), there are some examples which may be perceived as homonymous or metonymically polysemous because one may attribute a false contingency relation between their two senses. For example, one may falsely assume that *goździk* ‘clove’ is a fruit of *goździk* ‘carnation’ or that *parkiet taneczny* ‘a dance floor’ is always made of *parkiet* ‘parquet’ or that *boczek* ‘a flank’ is made of *boczek* ‘bacon’ which is not true.

(10) HOMONYMY/METONYMY

- a. GOŹDZIK (*kwitnący* ‘a carnation in bloom’ vs. *zmielony* ‘ground clove’)
- b. BOCZEK (*wędzony* ‘smoked bacon’ vs. *lewy* ‘a left flank’)
- c. PARKIET (*jodełkowy* ‘herringbone parquet’ vs. *taneczny* ‘a dance floor’)

In (11), there are examples of homonymy which may be perceived as nested polysemy with a generic nest.

(11) HOMONYMY/NESTED POLYSEMY WITH A GENERIC NEST

- a. ETYKIETA (*dworska* ‘court etiquette’ vs. *naklejona* ‘a sticker label’)
- b. EKSPRES (*polarny* ‘a polar express train’ vs. *zepsuty* ‘a broken coffee express’)
- c. NUMER (*siedmiocyfrowy* ‘a seven-digit number’ vs. *popisowy* ‘a good stunt’)

Finally, some homonymous words may share some accidental resemblance and hence they are often perceived as expressing polysemy by metaphor. Such words are exemplified in (12).

(12) HOMONYMY/METAPHOR

- a. GOŁĄBEK (*pocztowy* ‘a carrier pigeon’ vs. *pyszny* ‘a delicious cabbage roll’)
- b. SYRENA (*wyjąca* ‘a howling siren’ vs. *bajkowa* ‘a fairy tale mermaid’)
- c. POMPA (*ręczna* ‘a hand pump’ vs. *huczna* ‘a spectacular blast’)

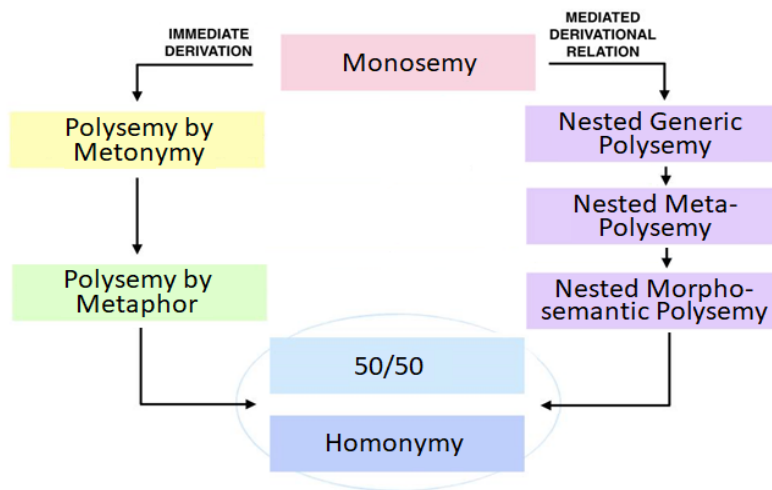


Figure 8. The extended spectrum of sense remoteness originally postulated by Klepousniotou and Baum (2007), Klepousniotou et al. (2008), Klepousniotou et al., (2012) with subcategorized nested polysemy and added 50/50 type.

Monosemy	• an unambiguous word • a rare phenomenon • over time words cease to be monosemous
Polysemy by Metonymy	• a new sense within the same conceptual domain • direct semantic derivation • often zeugmatic • some senses may be separable and thus they do not pass co-predication tests • the derived unit (sense) must be defined with a reference to the primary one • very regular
Polysemy by Metaphor	• a new sense within a different conceptual domain • direct semantic derivation (according to perceptivity: mapping between animate, inanimate, concrete, abstract senses and by functions, features, appearance or symbol) • mostly irregular but some rare instances of regular metaphor are more akin to metonymy

Figure 9. Distinctive features of monosemy, polysemy by metonymy and polysemy by metaphor which were used in the annotation process.

Nested Generic Polysemy	• a common derivational base (a generic concept) • senses closely interconnected (of equal rank) • senses perceived as lexicalized instances of the generic concept (narrowed down to its specific subkinds)
Nested Meta-Polysemy	• a common derivational base • derived senses motivated by metonymy or by metaphor • at least one sense is not directly derived from the base
Nested Morpho-semantic Polysemy	• a common morphological root • not necessarily directly related to the central unit (possible intermediate links) • coincidentally formed by the same suffix

Figure 10. Distinctive features of nested generic polysemy, nested meta-polysemy and nested morpho-semantic polysemy which were used in the annotation process.

50/50	• vague border between homonyms and polysemes • mainly: polysemes whose etymology is unclear in the minds of the language users (e.g., culturemes) • also: homonyms for whom language users establish common origin (folk etymology) • words proved in lexicology to be homonyms with an easily identifiable common root in other languages
Homonymy	• ambiguous words with unrelated meanings • two distinct words which happen to have the same phonological representation of a word

Figure 11. Distinctive features of 50/50 type and homonymy which were used in the annotation process.

5. Some insights and challenges from our work on metonymy and metaphor: Further extending the spectrum

This section is devoted to two types of polysemy which have been examined in most detail out of all the types of polysemy in both lexicographic and psycholinguistic considerations on multisense words: polysemy by metonymy and polysemy by metaphor. Yet even for them, the picture is not clear-cut.

5.1. Polysemy by metonymy

Schumacher (2019) states that we should aim at better understanding metonymy and developing its more fine-grained classification. In this vein, Dölling (2018) claims that in the case of nouns such as *book* (physical object vs. information), *speech* (information vs. event), *bank* (institution

vs. building), *newspaper* (publisher vs. publication) or *lunch* (food vs. event) there is no reasons for assuming that one sense is prior. Dölling (2018) names this kind of polysemy inherent or logical and he distinguishes it from metonymic polysemy involving a metonymic shift from a primary to a secondary sense as in such nouns as *rabbit* (animal vs. meat), *oak* (tree vs. wood), *bottle* (container vs. unit of measure). Intuitively, the animal sense of *rabbit* is prior to its meat sense, the tree sense of *oak* is prior to its wood sense and a container sense of *bottle* is prior to its unit of measure sense. Dölling (2018) claims that inherent (our neighbouring) polysemy and metonymic polysemy behave differently under co-predication. Nouns featuring inherent polysemy pass co-predication tests, as shown in (13).

(13) Mary picked up and mastered the book. [physical object and information]

By contrast, nouns featuring metonymic polysemy do not pass co-opredication tests, as presented in (14).

(14) # John lifted and drank the cup. [container vs. content]

However, some examples classified by Dölling (2018) as representing true metonymic polysemy such as *oak* (tree vs. wood), *bottle* (container vs. unit of measure) pass co-predication or anaphoric tests in Polish, contrary to what is claimed by Dölling (2018), as shown in (15).

(15)

b. container/unit of measure

BUTELKA

Wlał butelkę wody do zlewu i ją odłożył.

‘He poured in a bottle of water and put it away.’

c. tree/wood

DĄB

Cały jego dom jest obłożony lokalnie rosnącym dębem.

‘His entire house is laid in locally growing oak.’

d. animal/meat

KRÓLIK

Na święta upiekłam królika z hodowli ekologicznej i smakował wyśmienicie.

‘I roasted a rabbit from an ecological farm for Christmas and it tasted delicious.’

It appears that co-predication cannot be used as a reliable diagnostic tool for distinguishing between Dölling’s (2018) genuine metonymy with a clear prior sense and inherent polysemy which according to the author has no clear direction of derivation. We still want to maintain that Dölling’s (2018) inherent polysemy is in fact metonymic because typically there is a contiguity relation between the two senses e.g. *book* (content) and *book* (physical object) are in a vast majority of cases inseparable (they are part of the same spatio-temporal domain). The same is true of *bottle* (container) and *bottle* (unit of measure). In fact, in our study of polysemy we observed some instances of metonymy which seem to be clearly non-zeugmatic and we have a different explanation of this observation. Let us consider specific examples presented in (16) and (17).

(16) object vs. sound

GWIZDEK (*chromowany* ‘a chrome whistle’ vs. *końcowy* ‘a final whistle’)

**Chromowany gwizdek zakończył mecz.*

‘The chrome whistle ended the match.’

(17) place/people in this place

KLASA (*klimatyzowana* ‘an air-conditioned classroom’ vs. *zdolna* ‘a clever class’)

**Trzecia klasa miała dzisiaj lekcję w-fu, ale ponieważ była klimatyzowana, to się nie spociła.*

‘The third classroom/class had a gym lesson today, but because it was air-conditioned, they didn't sweat.’

We dub this type of metonymy in (16) and (17) which does not pass co-predication tests MISBEHAVING METONYMY and the metonymy presented in (15) is called WELL-BEHAVING METONYMY. We think that the only difference between WELL-BEHAVING METONYMY in (15) and MISBEHAVING METONYMY in (16) and (17) is that in the former case the metonymic senses are typically perceived as belonging to one spatio-temporal domain and are inseparable in the latter case the senses are spatio-temporally separable. It seems to be the case that this difference may have a crucial impact on the behavior of metonymic words in co-predication tests. For example *klasa* understood as a group of students is not inseparable from *klasa* understood as their classroom. Regarding the position of these two types of metonymy in our spectrum, WELL-BEHAVING METONYMY with spatio-temporally inseparable senses should feature a smaller degree of sense remoteness than MISBEHAVING METONYMY with spatio-temporally separable senses. We would like to emphasize, however, that we do not claim that metonymy is always zeugmatic but rather we want to say that polysemy by metonymy is often zeugmatic and it is one of the few types of ambiguity that allows for co-predication but in proper contexts even metonymic polysemes can be made to fail co-predication tests (see Schumacher 2013, Ortega-Andrés and Vicente 2019, Haber and Poesio 2020, Murphy 2021, among others).

Another observation made in our study of the material was that there are some borderline cases of polysemy – between nested polysemy and polysemy by metonymy. This case is a rather rare one – out of 400 pairs of words, we only found two of such cases, exemplified in (18) and (19), which we have already referred to in the section devoted to nested polysemy.

(18) RADIO (*zepsute* ‘a broken radio’ vs. *katolickie* ‘a catholic radio channel’)

(19) FIZYK (*kwantowy* ‘a quantum physicist’ vs. *szkolny* ‘a school physics teacher’)

Radio is such a borderline case because some language users may interpret *radio* as having the generic nest (radio waves) and others may treat *radio* (object vs. channel) as an instance of metonymy analogous to *gazeta* (object vs. institution). Similarly in the case of *fizyk*, some language users may perceive *fizyk* ‘a teacher of physics’ as being a scientist, which is generally not true. Most teachers of physics do not conduct research in physics.

There are also polysemous words which may be perceived as metonymic or metaphoric, as shown in (20-23).

(20) KARK (*złamany* ‘a broken neck’ vs. *łysy* ‘a bald muscleman’)

(21) FLAKI (*pyszne* ‘yummy tripe’ vs. *wyprute* ‘ripped out guts’)

(22) PAS (*szczupły* ‘a slim waist’ vs. *skórzany* ‘a leather belt’)

(23) GIPS (*ziarnisty* ‘grainy plaster’ vs. *zdjęty* ‘a removed cast’)

Łysy kark understood as a muscular and not very intelligent man and *kark* understood as the back of the neck may be treated as metonymic because both senses may be perceived as contiguous. However, for some language users these two senses may constitute two separate domains related by association. Similarly, *flaki* ‘a tripe soup’ is a kind of soup made of beef tripe which may be wrongly associated with *flaki* ‘guts’ leading to a metonymic relation between these two senses. Another example is *pas* ‘a waist’ and *pas* ‘a belt’. For some language users both senses may be contiguous while for others a belt is clearly separable from a waist. Regarding the word *gips* ‘gypsum’ vs. ‘a plaster’, some language users may reason that a plaster is made of gypsum (creating a metonymic relation) but in fact modern plasters are made of lighter synthetic materials. All these examples show that there may be individual differences in how some polysemous words are organized in the mental lexicons of different language users.

5.2. Polysemy by metaphor

The mapping between conceptual domains between the senses corresponds to neural mappings in the brain, which entails that the human conceptual structure is rigidly linked to its perceptual system (Lakoff, 2014). It then seems especially important to organize the relation between polysemous senses motivated by metaphor according to perceptivity. Along with this line of reasoning, we identified five subtypes of polysemy by metaphor.

In (24) we present examples in which the conceptual domain of the primary concrete sense is mapped onto the secondary abstract sense.

(24)

- a. PRZECIEK (*śródpłucny* ‘an intrapulmonary endoleak’ vs. *medialny* ‘a media leak’)
- b. KOSMOS (*bezkresny* ‘boundless universe’ vs. *istny* ‘something unusual, lit. real cosmos’)
- c. ŻYŁKA (*pulsująca* ‘a pulsating vein’ vs. *reporterska* ‘a reporter’s urge’)
- d. AURA (*mroźna* ‘frosty atmosphere’ vs. *magiczna* ‘magic aura’)
- e. CIOS (*precyzyjny* ‘an accurate blow’ vs. *życiowy* ‘a life’s blow’)
- f. BARIERA (*metalowa* ‘a metal barrier’ vs. *psychiczna* ‘a mental barrier’)
- g. MARGINES (*lewy* ‘left margin’ vs. *społeczny* ‘a social underclass’)

In (25) we present examples in which the connotation of the primary sense is mapped onto the secondary sense in the domain of “human”. Examples (a)-(h) present mapping from animate to animate domain and examples (i-p) present mapping from inanimate to animate domain. Animacy may affect processing, so these examples are good candidates to create separate subtypes of polysemy by metaphor in the future, but we did not want to assume this a priori.

(25)

- a. KOCIAK (*pręgowany* ‘a tabby kitten’ vs. *seksowny* ‘a sexy pussy’)
- b. MISIEK (*dziki* ‘a wild bear’ vs. *napakowany* ‘a jacked guy’)
- c. BÓSTWO (*celtyckie* ‘Celtic deity’ vs. *hollywoodzkie* ‘a Hollywood idol’)
- d. BABCIA (*ukochana* ‘a beloved grandma’ vs. *moherowa* ‘mohair beret (old) woman’)
- e. JĘDZA (*baśniowa* ‘a fairy-tale witch’ vs. *z dziekanatu* ‘vixen from the dean’s office’)
- f. ŻMIJA (*jadowita* ‘a venomous viper’ vs. *przemądrzała* ‘a snooty cat’)
- g. ŚWINIA (*domowa* ‘a domestic swine’ vs. *szowinistyczna* ‘a chauvinistic skunk’)
- h. BESTIA (*rogata* ‘a horned beast’ vs. *zdolna* ‘a talented person’)
- i. BURAK (*pastewny* ‘a fodder beet’ vs. *skończony* ‘a complete yap’)

- j. CYMBAŁ (*zabytkowy* ‘an antique dulcimer’ vs. *złośliwy* ‘a mean booby’)
- k. TUMAN (*gęsty* ‘a thick cloud’ vs. *szkolny* ‘a school blockhead’)
- l. PAJAC (*drewniany* ‘a wooden harlequin’ vs. *niepoważny* ‘a ridiculous buffoon’)
- m. SZYCHA (*sosnowa* ‘a pine cone’ vs. *ważna* ‘a key figure’)
- n. SKARB (*zatopiony* ‘a sunken treasure’ vs. *mój – o dziecku* ‘my dear – about a child’)
- o. KOSA (*mechaniczna* ‘a power scythe’ vs. *wymagająca* ‘a demanding teacher’)
- p. PIGUŁA (*przeciwbólowa* ‘a painkiller’ vs. *wredna* ‘a mean nurse’)

In (26) we present examples in which the function or feature of the primary sense is mapped onto the secondary sense.

(26)

- a. ŚLIZGAWKA (*lodowa* ‘an ice slide’ vs. *spadzista* ‘a sloping slide’)
- b. BIEŻNIA (*tartanowa* ‘a tartan track’ vs. *elektryczna* ‘an electric treadmill’)
- c. LÓD (*arktyczny* ‘arctic ice’ vs. *truskawkowy* ‘a strawberry ice-cream’)
- d. STATEK (*rybacki* ‘a fishing vessel’ vs. *kosmiczny* ‘space ship’)
- e. SASZETKA (*herbaciana* ‘a tea bag’ vs. *skórzana* ‘a leather pouch’)
- f. BALKONIK (*romantyczny* ‘a romantic balcony’ vs. *inwalidzki* ‘an invalid walking frame’)
- g. TAPETA (*kwiecista* ‘a flowery wallpaper’ vs. *przesadna* ‘heavy make-up’)

In (27) we present examples in which the shape (appearance) of the primary sense is mapped onto the secondary sense

(27)

- A. DZIÓB (*kaczy* ‘a duck beak’ vs. *drewniany* ‘a wooden bow’)
- B. SZPON (*tygrysi* ‘a tiger claw’ vs. *brokatowy* ‘a brocaded unguis’)
- C. BRZUSZEK (*piwny* ‘a beer belly’ vs. *koślawy* ‘a lopsided bowl’)
- D. KAPELUSZ (*góralski* ‘a highlander hat’ vs. *robaczywy* ‘a maggoty mushroom cap’)
- E. DASZEK (*spadzisty* ‘a sloping roof’ vs. *skórzany* ‘a leather peak’)
- F. SERCE (*kurze* ‘a chicken heart’ vs. *czekoladowe* ‘a chocolate heart’)
- G. GRZYB (*trujący* ‘a poisonous mushroom’ vs. *atomowy* ‘an atomic mushroom cloud’)
- H. MUCHA (*bzycząca* ‘a buzzing fly’ vs. *ślubna* ‘a wedding bowtie’)

In (28) we present examples in which the conventional symbol attached to the primary sense is mapped onto the secondary sense

(28)

- A. SERCE (*o organie* ‘a heart – about an organ’ vs. *szlachetne* ‘a noble heart’)
- B. OSIOŁ (*o zwierzęciu* ‘a donkey – about an animal’ vs. *uparty człowiek* ‘a jackass’)
- C. ORZEŁ (*dziki* ‘a wild eagle’ vs. *klasowy* ‘a top student’)
- D. LIS (*oswojony* ‘a tamed fox’ vs. *szczwany człowiek* ‘a sneaky man’)
- E. REKIN (*oceaniczny* ‘an oceanic shark’ vs. *biznesowy* ‘a business buccaneer’)

6. Conclusions

In this study we attempted to bridge insights from psycholinguistics and from theoretical and computational lexicography to develop a fine-grained classification of polysemy and to arrange

its different types along our proposed spectrum of sense remoteness. In our quantitative research on a large sample of sense pairs randomly extracted from pIWordNet (SłowoSieć), we observed that the most widely represented are nested polysemy, polysemy by metaphor and polysemy by metonymy. We present a detailed discussion of nested polysemy – so far an underrepresented type of polysemy in the literature. We identify three subtypes of nested polysemy: generic, morpho-semantic and meta-polysemy and we motivate their place in our spectrum of sense remoteness. Furthermore, we observe that polysemy is not a stable phenomenon and relations between senses may differ across language users. For instance, our fifty-fifty class or borderline cases may be represented differently by different language users depending on their perception of the world, world knowledge, associations. In our detailed research of the material clustered by us as polysemy by metonymy and polysemy by metaphor, we observed that not all examples of metonymy pass co-predication tests and we observe that these metonymic examples whose senses are spatio-temporally inseparable are by far more likely to pass co-predication tests than the ones whose senses can potentially be spatio-temporally separated; however this issue also needs further investigation. Furthermore, among metonymic examples we found some borderline cases which can be perceived as instances of polysemy by metaphor or as instances of nested polysemy by different language users. During our analysis of the material belonging to the class of polysemy by metaphor we distinguished several subclasses where two senses are related by physical resemblance, shape, function, connotation or symbol. We also observed that the derived sense may differ from the primary sense in some semantic feature e.g., animacy or concreteness. We think that all these aspects of variation in the class of polysemy by metonymy and polysemy by metaphor should be taken into consideration in future psycholinguistic research on polysemy. As illustrated repeatedly throughout the present work, polysemy stirs much discussion, especially when bridging psycholinguistic and lexicographic approaches. Consequently, it would be desirable to test the psychological reality of our proposed spectrum and to conduct experiments which would help us decide which of the distinguished types of polysemy fit which of the proposed models of polysemy representation discussed in the introductory section of this paper.

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