The representation

of polysemy

in the mental lexicon and its

processing

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Abstract

Polysemy, the lexical semantic phenomenon in which a word form has different but related senses, is pervasive in natural languages. Examples of polysemy encompass regular polysemy and idiosyncratic forms, such as *paper* and *atmosphere* respectively. Nonetheless, regardless of its abundance in languages, it was not until 1980, with the appearance of cognitive grammar, that polysemy was given considerable attention. While this phenomenon does not seem to pose a problem in everyday communication, it has proved to be notably difficult to treat both theoretically and empirically (Falkum & Vicente, 2015, p. 3). At present, there is discussion regarding the representation of polysemy in the mental lexicon and its processing. The purpose of this dissertation is to present the main theories which are currently being discussed by linguists on this topic. In order to achieve this aim, I start by defining and comparing polysemy to homonymy, the phenomenon by which one word form has, at least, two different and unrelated meanings. I explain the criteria and some of the tests which can be applied to distinguish them (e.g. etymological derivation, native intuition, pronominalization and ellipsis). Moreover, I define the types in which polysemy can be subdivided, emphasizing metonymically and metaphorically motivated polysemy. After polysemy has been distinguished from homonymy and its subdivisions have been explained, I move on to the main section of this paper: The representation and processing of polysemy in the mental lexicon. The representation is the information which is stored in the mental lexicon for the different types of word forms. The processing is how that information is accessed and used in language production and comprehension. This being explained, I discuss what I consider to be the two main approaches regarding this issue. On the one hand, the theory named Sense Enumeration approach which postulates that the related senses of polysemous words are both stored and processed like the unrelated senses of homonymous terms. On the other hand, the other main theory is the One Representation approach, which proposes that polysemous and homonymous terms differ in how their meanings are stored and processed. There are various views with different perspectives which lie within this theory. Then, I present empirical evidence which partially support both theories. However, I conclude my paper by taking a stance for the One Representation approach.

Keywords: polysemy, mental lexicon, representation, processing.

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1. Introduction

In order to analyse and distinguish the sense or senses that a certain word may have, the main types of ambiguity namely, polysemy and homonymy, must be explained. On the one hand, polysemous words are those which are described as having several related senses while sharing the same word form. The noun *paper* can be used as an example, as it has got at least 2 different related meanings which are expressed in the following sentences: *I need some paper* ('material') and *I wrote a paper* ('piece of work'), where the meaning of the word *paper* varies in both sentences but shares part of the meaning (in its origins, pieces of work were generally written on paper, therefore the senses are related in terms of the material). On the other hand, polysemy must not be confused with homonymy, which is the phenomenon in which two unrelated word senses happen to share the same phonological form. This is the case of the word form *pupil,* whose meanings differ and do not share a relation: "the dark circular opening in the centre of the eye that becomes smaller in bright light and larger in the dark" and "a person who is taught in school or privately" (Oxford Advanced Learner's Dictionary of Current English, 1995, p. 941). In addition, it is important to mention that there are different forms of polysemy. On the one hand, the vast majority of polysemous words are what is known as conventional or regular polysemy, namely they result from lexical rules, for example, one can use the same word form to refer to an institution and the person: *The school fired the teacher* vs. *The school will be demolished tomorrow.* Another example of conventional polysemy can be the use of the same word form to refer to an animal and its meat, for example: *When I was younger I used to have a rabbit as a pet* vs. *I would love to have some rabbit for dinner.* On the other hand, other forms of polysemy are less frequent, they are idiosyncratic. Foraker and Murphy (2012) give as an example the following uses of the word form *atmosphere*: "*The city's atmosphere was polluted* vs. *The restaurant's atmosphere was relaxed*" (p. 423). Another example of this form of polysemy is the term *good*, which has a different (related) sense in each of the following sentences: *a good novel, a good day, a good person*, *a good voice,* etc. Moreover, polysemy and homonymy differ from monosemy, which is the case of a word form which contains a single meaning (Riemer, 2010, pp. 168-170), such as the word form *byline* whose unique meaning is "a line at the beginning or end of an article in a newspaper, etc, giving the writer's name." (Oxford Advanced Learner's Dictionary of Current English, 1995, p. 155).

Moreover, according to Falkum and Vicente (2015), even though polysemy is much more frequent in language than homonymy, in general linguistics, not much attention was given to polysemy until the 1980s. This change was due to the appearance of cognitive grammar, where there was a high growth in the study of polysemy. Furthermore, ambiguity is very common in English, and when encountering an ambiguous word, deciding which sense is intended on each occasion is commonly not a problem in people's mother tongue and very rare for somebody whose level in a second language is advanced. However, even though it is apparently easy to distinguish between the different related senses of a polysemous word, this task has proved to be notoriously difficult to characterise both theoretically and empirically (p. 3).

There is currently an intense discussion regarding the way in which the related senses of polysemous word forms are represented in the mental lexicon and accessed in language use compared to the unrelated meanings of homonymous terms. It is a matter which has given rise to a wide variety of approaches from different perspectives. These different views will be described in this work, in which the aim will be to explain carefully the current theories in regard with how the meanings of polysemous terms are stored in the mental lexicon and how we process the different but related meanings of polysemous words in the phrasal and sentential contexts in which they occur, and also in the situational and discourse contexts.

It is therefore necessary to make a distinction between the representation and the processing of senses. On the one hand, the representation of senses is the way in which they are stored, how they are structured in the mental lexicon. On the other hand, the processing of word senses is the act through which the representations in the mental lexicon are accessed, selected and combined with other meanings in the sentence. It deals with time-related aspects and the processing of words can take place both in context or out of it.

In order to explain this complex issue, in section 2, I will distinguish in more detail the two main types of ambiguity mentioned previously, polysemy and homonymy, as well as the two further types in which polysemous words can be subdivided, metaphorical and metonymic polysemy. Then, in section 3, I will move on to defining the two main approaches regarding the way in which the senses of polysemous words are stored in the mental lexicon and how they are processed. Two principal views exist concerning this matter: The Sense Enumeration theory, according to which the different related senses of polysemous words and the distinct unrelated

senses of homonymous terms are stored equally, having all the different senses listed as individual representations in the mental lexicon. This view postulates that words are processed by choosing the right sense from a list. On the other hand, the One Representation approach postulates that the meanings of homonymous words are stored and processed differently to the senses of polysemous words. According to this theory, the distinct related senses of a polysemous word are stored as a single abstract sense which, when a polysemous word arises, gets enriched by the context (Falkum & Vicente, 2015, pp. 3-5). Then, in section 5, I will give experimental evidence supporting mainly the theory which postulates that polysemous word senses are stored and processed in a different way to homonymous word meanings. Finally, to conclude my work, I will take a stance for the One representation theory by enumerating the arguments in favour of it.

2. Lexical ambiguity

2.1 Polysemy and Homonymy

Words can either have one single meaning, which is the case of monosemous words such as *laptop*, or they can be ambiguous and therefore have multiple senses. When talking about lexical ambiguity there are two main types of ambiguous words: polysemous and homonymous words. Firstly, as explained in the introduction, a homonymous word is a single word form that has different unrelated senses, for example, the word form *lap* can be understood as 'circuit of a course' or as 'part of body when sitting down' (Saeed, 2009, p 63). Secondly, according to Riemer (2010), in polysemy, single word forms also have multiple senses which are distinct, but they differ from homonymy in that the senses of polysemous terms are related (p. 135). Saeed (2009) explains how this is a crucial distinction for lexicographers when having to design dictionaries, as polysemous and homonymous senses are not listed the same way. Polysemous words are listed under the same lexical entry, whereas homonymous senses have separate entries (p. 64). An example can be given from the Oxford Advanced Learner's Dictionary (1995) with the polysemous word *eye,* where its various senses are listed under one lexical entry:

eye¹ /aɪ/ *n* **1(a)** each of the two organs on the face that are used for seeing. **(b)** the visible coloured part of this: *have blue eyes.* **2(a)** [often *pl*] the power of seeing; the ability to see: you must have sharp eyes to be able to spot such a tiny detail. • The eyes often deteriorate as one gets older. **(b)** [usu *sing*] the ability to make good judgements about sth one sees: To her expert eye, the painting was clearly a fake. • She has a good eye for a bargain. **3** a thing like an eye: *the eye of a needle* (ie the hole for the thread to go through) • *a hook and eye* (ie a fastening with a hook and loop for a dress, etc) • *the eye of a potato* (ie a point from which a shoot will grow). (p. 410).

By contrast, the word *lap* which was mentioned above, has got different entries in the dictionary as a consequence of having unrelated senses:

lap¹ /læp/ *n* **(a)** the flat area between the stomach and knees of a person when he or she is sitting: *come and sit on my lap.* (b) the part of a dress, etc covering this: *she gathered the fallen apples and carried them in her lap.*

lap² /læp/ *v* **1** a single circuit of a track or racecourse: *he crashed on the tenth lap.*

lap³ /læp/ *v* **(-pp-) 1 ~ sth (up)** (esp of animals) to drink sth with quick movements of the tongue: *a dog noisily lapping (up) water.* (pp. 662-663).

Therefore, it could be thought that an easy way of knowing if a word is polysemous or homonymous is to look it up in a dictionary. Nevertheless, the distinction is not always so simple. Lyons (1977) explains how there are two criteria which have been proposed for the distinction between homonymy and polysemy.

The first criterion has to do with the etymological derivation of words, where words that are historically derived from distinct lexical items are taken to be homonymous. In practice, nevertheless, the etymological criterion is not always certain, as there are many words whose historical derivation is not so clear. Furthermore, another reason for this uncertainty is the difficulty of knowing with any certainty how far back in history we should go (p. 550).

The second criterion for the distinction between homonymy and polysemy has to do with meaning relatedness, which is a matter of degree and seems to be correlated with the native speakers' feeling that certain meanings are connected while others are

not. However, in a large number of cases, there does not seem to be agreement among native speakers as to whether the meanings of certain words are related, which gives rise to the belief that there is not a clear dichotomy between homonymy and polysemy, but rather a continuum from ''pure'' homonymy to ''pure'' polysemy (p. 552). Saeed (2009) gives as an example the word form *sole* whose senses can either be 'bottom of the foot' or 'flatfish'. The problem with this term is that most English speakers' intuitions coincide in that these two word senses are unrelated and that they should be classified as homonyms and therefore given separate lexical entries in the dictionary. Nevertheless, they are "historically derived via French from the same Latin word *solea* 'sandal'" (p.65). This could be used as an argument to consider it a polysemous word regardless of general intuitions.

Another test to differentiate between these two types of ambiguity is the pronominalization test, according to which if an ambiguous word can be felicitously pronominalized in a context in which the pronoun is an argument of a predicate and requires one meaning whereas its antecedent is an argument of a predicate but needs a different sense, then the word is considered to be polysemous. In addition, the ellipsis test can also be used to differ homonymy from polysemy. This test is similar to the pronominalization one, but instead of pronominalizing an ambiguous word, it is elided. To see the functioning of these tests, take the following sentences (Asher, 2011, p. 63):

a. #The bank*i* specializes in IPOs. It*i* is steep and muddy and thus slippery.
b. #The bank specializes in IPOs and is steep and muddy and thus slippery.

The word form *bank*, found in sentences (a) and (b), is a clear example of a homonymous word. In sentence (a) the pronominalization test is applied and the sentence turns out to be anomalous. The same results are obtained in (b) from applying the ellipsis test. These results confirm the status of *bank* as a homonymous word. On the other hand, if the tests are applied to sentences containing word forms whose senses are related the results are different (Asher, 2011, p. 63):

c. He paid the bill*i* and threw it*i* away.
d. Lunch was delicious but took forever.

In these sentences, the terms *lunch* and *bill* are polysemous, and it can be seen how these examples are grammatical after having applied the tests of pronominalization and copredication.

Nonetheless, the following examples (e-f) demonstrate that the distinction between polysemy and homonymy cannot always be obtained by applying the pronominalization and ellipsis tests. We can see this when we apply them in other cases of clearly polysemous words (Asher, 2011, p. 63):

e. #The school*i* finished the exam period. It*i* was painted during the summer

f. #The city outlawed smoking in bars last year and has 500,000 inhabitants.

g. The city has 500,000 inhabitants and outlawed smoking in bars last year

Sentences (e-f) contain the polysemous word forms *school* and *city,* therefore, according to the tests they should correct. In sentence (e), the polysemous word form *school* has got two different related senses, and it is used in the first conjunct to refer to 'institution'. In the second conjunct, in which the word form *school* is pronominalized, it is being used with the sense of 'building'. However, if it is compared to (c), it can be appreciated how these two meanings of the word form *school* do not combine as effectively as the different senses of *bill* from sentence (c). Also, when comparing sentence (f) to (g), it can be appreciated that (f) includes the same two lexical senses of the word form *city* as (g) but the order has been changed and as a consequence the sentence is not completely correct. This indicates that the ellipsis test is affected by discourse effects, and so it is not a test that can accurately help us to identify polysemous words (Asher, 2011, p. 36)

Thus, it can be concluded that distinguishing polysemy from homonymy is not an easy task, as the distinction is not always clear. However, in this work I will not focus on words whose type of ambiguity is not clear, but rather on pure polysemy and homonymy, that is, words whose relatedness in meaning is clear. An example of pure polysemy is the previously mentioned word *eye* which is without a doubt a polysemous term, unlike the example of *sole* given earlier, in which the relatedness of its senses 'bottom of the foot' and 'flatfish' is not so clear to the user of the language.

2.2. Varieties of polysemy

Now that the two main types of lexical ambiguity have been explained, there is another distinction which must be clarified. Cruse (2000) explains how there are different varieties of polysemy, he makes an important distinction between linear and nonlinear relations between polysemes.

On the one hand, word senses have a linear relation when one of them is a specialization (a hyponym) of the other, that is to say, one of the senses is considered to be more basic than the other. This type of relations can be subdivided into 4 subtypes which will be explained briefly: Autohyponymy, Automeronymy, Autosuperordination and Autoholonymy.

Firstly, Autohyponymy occurs "when a word has a default general sense, and a contextually restricted sense which is more specific in that it denotes a subvariety of a general sense." (Cruse, 2000, p. 110). Cruse (2000) gives as an example the word *drink,* in which its general reading is exemplified in the following sentence: *if you drink* ('liquid') *whilst you eat you will be full very easily,* and the specific reading occurs in a sentence like *I do not drink* ('alcohol') *since I had the accident two years ago* (p. 111).

Secondly, Automeronymy is similar to Autohyponymy, with the only difference that the more specific reading denotes a subpart rather than a subtype. The word *door* is given as an example*,* in which it can mean either the whole door, as in the sentence *go through that door,* or it can just mean the leaf, as exemplified in *take the door of its hinges* (Cruse, 2000, p. 111).

Furthermore, in Autosuperordination, the specific sense is taken to cover a general example as a result of the lexical gap existing for general senses. Cruse (2000) explains how this can be reflected in the word *man,* referring to the human race including the female members. He also gives the example of *cow* to refer to bovines of both sexes (Cruse, 2000, p. 111).

Finally, the fourth type, namely Autoholonymy, can be explained with the word *hand*, whose meaning may include the hand or not. In the sentence *He lost an arm in the accident* the whole arm is included, whereas in *a scratch on the arm,* it is clearly referring to the non-hand part of the arm (Cruse, 2000, p. 111).

On the other hand, the non-linear relations between polysemes result from two basic semantic phenomena: metaphor and metonymy. Firstly, as Klepousniotou, Pike, Steinhauer and Gracco (2012) explain, in the type of polysemy motivated by metaphor 'a relation of analogy is assumed to hold between the senses, the basic sense is literal, whereas the secondary sense was originally figurative when this use of the word

emerged' (p. 11). An example of this is the polysemous word *eye*, which was previously mentioned and which has, on the one hand, the basic and literal sense "each of the two organs on the face that are used for seeing" and on the other hand, the secondary figurative sense "hole in a needle" (Oxford Advanced Learner's Dictionary of Current English, 1995, p. 410). Moreover, in metonymic polysemy there is an interrelation between closely associated terms, and in it, both senses, the primary and the secondary meanings, are literal and the relation between the senses is of some sort of association (Klepousniotou et al., 2012, p. 12). For example, the polysemous word *chicken* has got the literal primary sense 'animal' and the second literal sense 'meat of the animal', and both of them are related; another example is the word form *paper*, which contains the literal primary sense 'material' and the second literal sense 'content'.

Therefore, metaphorical and metonymic polysemy differ in that in the former, one of the senses is literal and the other is figurative, while, in the latter, both senses are literal. Also, in metaphorical polysemy the relation between both senses is of analogy and in metonymic polysemy, the relation is of some form of association.

3. Storage and processing in the mental lexicon

When using a language, there seems to be hardly any problems when having to decide which sense is being used in which context when lexically ambiguous words are used. However, the study of polysemy has proved to be notoriously difficult to approach and, in this section, the different views concerning this complex issue will be explained. The difficulty does not lie in homonymy, but in how the different related senses of polysemous words are stored and processed in the mental lexicon.

The question that arises is whether the senses of polysemous and homonymous words are represented in the mental lexicon and processed equally or if they operate in a different way. In this section, I will go through all the different hypotheses that exist regarding this topic.

3.1. Homonymy

In homonymy, as I mentioned previously, there is not much discussion as there is one main hypothesis which prevails and with which there seems to be no problems. The consensus is that all the different senses of a homonymous word have separate

mental 'entries' or representations in the mental lexicon, namely, there is a distinct representation for each sense of a homonymous word. When encountering a homonymous word, all the senses which are listed in the mental lexicon are activated at a first stage, then, hearers process it by selecting one of these senses out of all the possibilities (Falkum & Vicente, 2015, p. 3). So, if someone utters the sentence *I cannot wait to see that new play,* in which the word *play* is homonymous, the different senses which are stored in the hearer's mental lexicon (i.e. 'performance' and 'activity') will be activated and the word will be processed by choosing the most appropriate sense in the particular sentential context, in this case the sense of 'performance'. Thus, the resolution of the ambiguity involves competition between senses.

Frisson (2009) explains how the frequency of the senses and the preceding contextual information have a significant influence when processing a homonymous word. In a case in which there is no contextual information, "both meanings receive low-level activation when the word is encountered, with the most frequent or dominant meaning reaching threshold faster (i.e., becoming available to the processor)" (p. 113). However, with equi-biased homonyms (both meanings are equally frequent), both senses get the same level of activation and are equally available. On the other hand, in the cases in which there is preceding contextual information, if the frequency of both meanings is equal, the context can give rise to the priming of the intended meaning so that it can be threshold faster. When the intended meaning is less frequent, contextual support will make both the intended and the most frequent meaning reach threshold (p. 113).

Furthermore, Frisson (2009) also explains why reaching the subordinate meaning of a homonymous word is generally more difficult. He explains the subordinate bias effect, according to which, when the intended meaning in a context is the subordinate sense, extra processing is observed. This extra processing occurs because at first, the most dominant sense is selected and then the preceding context indicates that the dominant sense which was selected is not the intended one. There is then a competition between the two senses before the intended one is selected (p. 114). The homonymous word form *pupil,* which was mentioned in the introduction, can be used as an example. If someone utters the following sentence: *The teacher pointed at the pupil and explained what its function in the eye is,* what will occur is that because of the context in which the word form is, the hearer will not access the subordinate meaning ('eye') which is intended immediately, he/she will first select the most

frequent sense ('student'). As this sense does not fit the sentential context, there will be competition between both senses of the word *pupil* before the intended sense is selected.

3.2. Polysemy

Moving on to polysemy, as explained in the introduction, even though polysemy is a very common phenomenon, it was not until 1980s that it was given attention as a matter of study thanks to the appearance of cognitive grammar. Unlike in homonymy, the representation and processing of related senses in the mental lexicon has turned out to be a very controversial topic (Falkum & Vicente, 2015, p. 3). As mentioned previously, there are currently two main theories which are being discussed

Firstly, one of the theories, the Sense Enumeration hypothesis, explains that the different but related senses of polysemous words are stored and generated the same way as the unrelated senses of homonymous words, that is, having a separate representation in the mental lexicon for each sense and selecting one of the meanings from within the list associated with that word form. On the other hand, the other main theory, the One Representation hypothesis, claims that polysemous words are represented and processed in a different way, having only an underspecified representation for each word form. According to this approach, when a polysemous word is encountered, the new senses are generated from the single representation which is found in the mental lexicon, as we will see in more detail in the next section. (Falkum & Vicente, 2015, pp. 3-5).

3.2.1. The Sense Enumeration hypothesis

The Sense Enumeration hypothesis is a monomorphic model in which the distinction between polysemy and homonymy is highly attenuated, as related and unrelated senses are stored and processed the same way. According to this theory, both the related and unrelated senses of polysemous and homonymous word forms are stored as distinct representations and the speakers and hearers have to select one of these fully specified senses out of a list. In this theory, words are assumed to be understood by selecting their intended sense from an exhaustive list of potential senses which are stored in the mental lexicon (Falkum and Vicente, 2015, p. 3-4). Therefore, SELs (Sense Enumeration Lexicons) make two assumptions: They believe that all senses for each polysemous word form are established in the mental lexicon separately; also, that

the intended meaning is selected from these senses when required, which is the standard way lexicographers put dictionaries together (Klepousniotou, 2001, p. 207).

This approach is the one with the least empirical support due to its limitations. Firstly, as Klepousniotou (2001) explains, there is a parsimony problem as a result of having a different representation for each sense of a word form, which ends up being an extremely uneconomical lexicon where each sense has to be stored separately ending up with a long list of senses. To clarify this limitation, Klepousniotou (2001) gives as an example the word *sad,* which can be used in multiple ways: *a sad novel*, *a sad day* or *a sad child*, and many others. In each of these examples *sad* has a slightly different meaning, and according to SELs, there is a separate representation for each of these senses in our mental lexicon. Secondly, the fact that the senses of a polysemous expression are related does not make a difference if all the different senses are stored as the distinct, unrelated meanings of homonymous words. Finally, another important problem of this approach is that it cannot explain how it is possible that creative new senses which are used in novel contexts and that are not listed can nevertheless be understood without a problem (p. 208). Apart from these problems, in the fourth section I will give some empirical evidence in which this approach is not supported.

3.2.2. The One Representation hypothesis

The other main alternative to the Sense Enumeration hypothesis and the most popular theory is the One Representation hypothesis. According to this proposal, the mental lexicon is not a fixed list of word senses where everything is stored, it is a generator of new senses (Klepousniotou, 2001, p. 208). Thus, the different senses of a polysemous word form depend on a single representation that is stored in the mental lexicon which is abstract and underspecified.

Moreover, moving on to the processing of related senses, according to this theory when a polysemous word is encountered, the general belief is that the extended senses are generated from the single sense which is stored in the mental lexicon, taking into account the sentential and situational context (Falkum & Vicente, 2015, p. 5). Therefore, if someone utters the term *school*, an underspecified sense will be accessed and the adequate sense for that specific occasion will be constructed in the sentential or situational context in which it appears.

Therefore, according to the One Representation hypothesis, only an abstract sense of the word is stored in the lexicon. Extended senses are created when required in context, making it a much more economic approach than the sense enumeration theory. Also, as mentioned previously, this hypothesis has got the most supporters and according to it, homonymy and polysemy are processed differently. To sum up, a simple explanation for the Sense Enumeration approach and the One Representation theory can be the following:

- The Sense Enumeration approach claims that the meanings of all ambiguous words are stored and processed similarly. In a sense enumeration lexicon all the related senses of a polysemous word are stored in the mental lexicon as separate representations.
- The One Representation hypothesis makes a clear distinction between the representation and processing of homonymous and polysemous words. In this approach, polysemous words only have an underspecified sense stored in the mental lexicon, which gets built and enriched in context.

There are different theories which are included within this latter approach, and I will focus on the Generative Lexicon hypothesis of Pustejovsky (1995) and the Core Meaning hypothesis. The main difference between these proposals is whether they involve 'rich' or 'thin' semantics, with Pustejovsky's proposal illustrating the former and the Core Meaning approach the latter (Falkum and Vicente, 2015, p. 5).
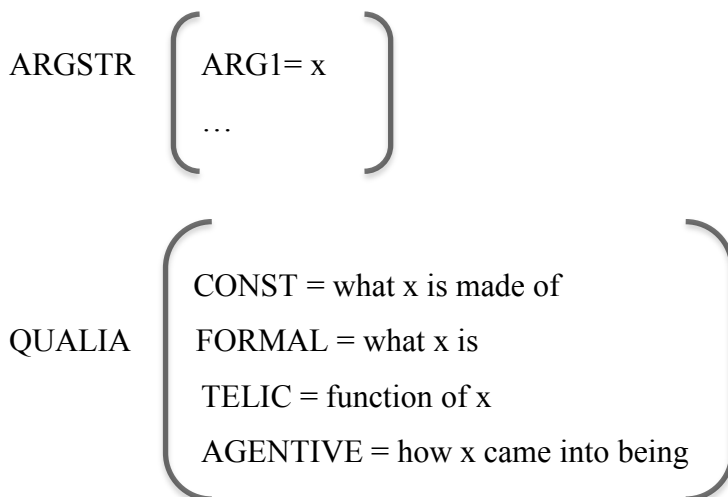
3.2.2.1. Rich semantics

The rich semantics version of the one representation hypothesis, which was proposed by Pustejovsky (1995), assumes that the lexical meanings that are stored in the mental lexicon are rich in conceptual information and that hearers select only a part of the whole informational content provided by lexical meaning. Pustejovsky (1995) creates the Generative Lexicon theory and claims to have created this approach "to provide a formal statement of language that is both expressive and flexible enough to capture the generative nature of lexical creativity and sense extension phenomena" (p.61). His aim is to give a formal account of conventional polysemy (Falkum, 2007, p. 205). In order to do this, he proposes a complex generative lexicon which acts as a

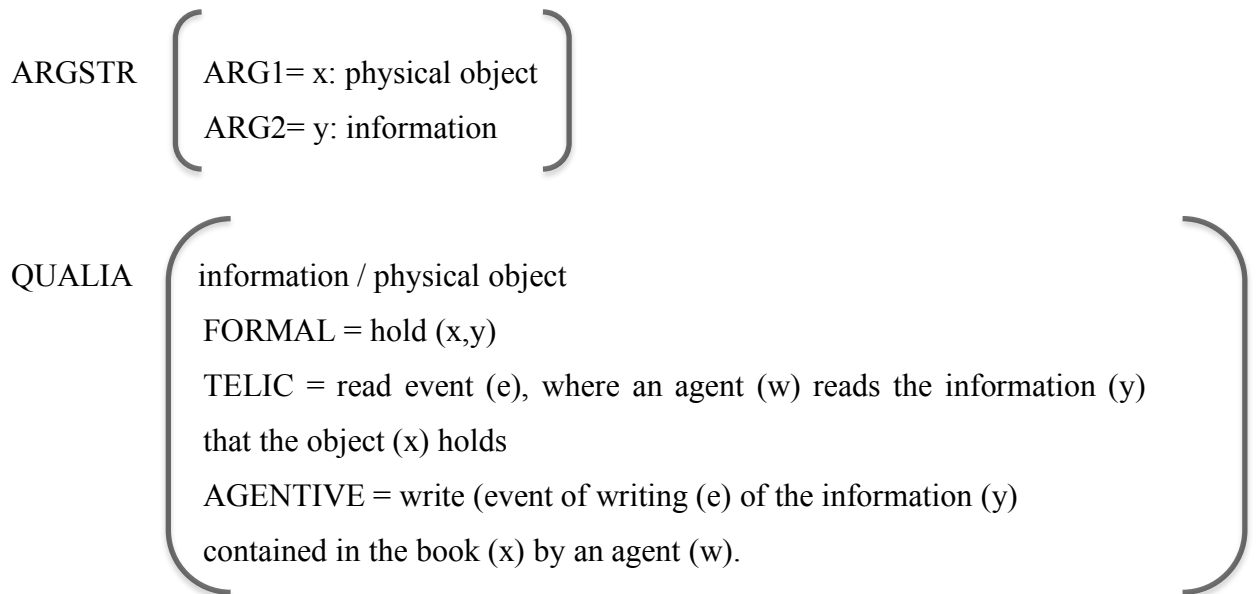computational system composed of a structure with four levels of representation (Pustejovsky, 1995, p. 61):

- Argument structure: Specification of the number and nature of the arguments to a predicate.
- Event structure: Definition of the event type of the expression and any subeventual structure it may have.
- Qualia structure: Modes of explanation associated with a word or phrase.
- Lexical inheritance structure: Identification of how a lexical structure is related to other structures.

To account for how different senses of a word are composed in sentence comprehension, it is the information in the qualia structure that is most important. In order to explain what a lexical item means, a series of properties are given. These include information about what kind of object it is, what makes it different within a larger area (formal role); what it is used for, its function (telic role); what it is constituted of (constitutive role) and how the object was created, its origin (agentive role) (Falkum, 2007, p. 210):

$$
\text{ARGSTR} \begin{bmatrix} \text{ARG1} = x \\ \dots \end{bmatrix}
$$

$$
\text{QUALIA} \begin{bmatrix} \text{CONST} = \text{what } x \text{ is made of} \\ \text{FORMAL} = \text{what } x \text{ is} \\ \text{TELIC} = \text{function of } x \\ \text{AGENTIVE} = \text{how } x \text{ came into being} \end{bmatrix}
$$

For a common, non-relational noun, such as 'book', the Argument and Qualia structure would give us the following richly structured representation (Falkum, 2007, p. 213):

ARGSTR
$$\begin{bmatrix} \text{ARG1= x: physical object} \\ \text{ARG2= y: information} \end{bmatrix}$$

QUALIA
$$\begin{bmatrix} \text{information / physical object} \\ \text{FORMAL = hold (x,y)} \\ \text{TELIC = read event (e), where an agent (w) reads the information (y)} \\ \text{that the object (x) holds} \\ \text{AGENTIVE = write (event of writing (e) of the information (y)} \\ \text{contained in the book (x) by an agent (w).} \end{bmatrix}$$

This way we have two different lexical senses clustered into one lexical entry. Very roughly, in the process of composing the meaning of each of the two sentences below, the sense that fits in with the semantics of the verb (and its other arguments) will be selected (Falkum, 2007, p. 212):

h. *The book is sitting on the coffee table* ('book' = physical object, as 'sitting' is predicated of physical objects);
i. *Mary found the book interesting* ('book' Informational object, as reading invokes the telic role of 'book').

We might consider the inclusion of rule-based approaches in this category, as another view of the rich semantics version of the One Representation hypothesis. According to this idea, in order to process a polysemous expression, a literal sense is accessed first and then a conventional linguistic rule is applied which takes the hearer to another sense of that same polysemous expression if necessary. The supporters of this kind of approach assert that to explain the productivity of polysemy, lexical rules are necessary. This rule-based approach can be explained with the following analysis of the 'statue' case carried out by Jackendoff (1992): Imagine that we are in a wax museum and we are looking at the recreation of the Beatles and someone says *Ringo is the Beatle that I like the most* wanting to communicate 'Ringo is the wax figure that I like the most'. Jackendoff (1992) explains how there is a linguistic rule that makes this

interpretation possible which is that "any NP can stand for an object or for a physical representation of that object" (as cited in Falkum and Vicente, 2015, p. 8). So, there is on the one hand a literal sense 'Ringo the artist' and then the other non-literal sense 'the statue of Ringo' which is obtained through a linguistic rule. However, the rule-based approaches are limited to some extent, as they are not able to account for a wide range of polysemy phenomena and they do not permit much flexibility of interpretation. They only work for highly conventionalised cases of regular polysemy, the typical example being the count mass interpretation of polysemous words such as *rabbit* with its 'animal' and 'meat' senses (Falkum & Vicente, 2015, p. 8).

To sum up, the basic idea of rich semantics is that the mental lexicon is not rigid structure but rather creative and generative. The Generative Lexicon theory claims that the lexical meanings that are stored in the mental lexicon are rich in conceptual information. Then, when having to process a polysemous word, the hearers select only that part of the whole informational content that allows a coherent interpretation of the sentence. The other view, the rule-based approaches postulate that the senses stored in the mental lexicon are literal and in order to access a derived sense, a linguistic rule is used. Therefore, both of them are in agreement with the one representation hypothesis, the different related senses are not listed in the lexicon but rather generated, either by selecting from the informational content which is stored or through applying linguistic rules to what is stored in the mental lexicon.

3.2.2.2. Thin semantics

Thin semantics is the idea that "lexical or standing meanings of words are impoverished with respect to their occasional meanings" (Falkum and Vicente, 2015, p. 6). Unlike in the rich semantics version of the One Representation hypothesis, the thin semantics view asserts that the information stored in the lexicon for a polysemous word is not rich in conceptual information, but rather an abstract core meaning. According to this theory, if a polysemous word is encountered with no biasing context, then the core meaning which is stored in the mental lexicon can be recalled so that the hearer gets a general idea of the intended meaning, and then, the information in the sentence or situational context, will help to understand the specific sense intended. One problem with this view is that as mentioned previously, some senses of polysemous words do not have many semantic features in common. The polysemous word form *church* can be

used as an example: If someone finds the word *church* in a neutral context, it does not seem possible to recall a core meaning which includes both 'the building' and 'the organization' senses, as they hardly have any features in common (Foraker & Murphy, 2012, p. 408).

This kind of approach is adopted in lexical pragmatics, where it is assumed that after activation of the encoded (abstract) meaning of the lexical item, additional inference is required to get to the intended meaning. This is because according to this kind of approach, word senses experience pragmatic modulation while the process of interpreting the utterance is taking place. To clarify the process, take the following example: (1) *David is a snake,* meaning 'treacherous person'. The interpretation in (1) could not be produced merely by linguistic context, it requires the presence of a situational context, with which, its interpretation can be effortlessly inferred. Therefore, the hearer, through the context derives the speaker's intended meaning (Falkum & Vicente, 2015, p. 10).

4. Experimental evidence

After having explained what I consider to be the main approaches regarding the representation of polysemy in the mental lexicon, I will now move on to giving real data on this topic. Currently, there is an ongoing debate on empirical studies in the literature regarding the topic discussed in this work. In this section, I will give some evidence of numerous studies which support the One Representation hypothesis, by showing some facts in favour of the idea that the senses of polysemous words, unlike the meanings of homonymous words, are stored in the mental lexicon in a single 'entry', whether general or rich. Nevertheless, I will also describe a study in which the alternative, the Sense Enumeration approach, is supported. In addition, I will explain in detail a study whose results have implications for both theories.

There are several studies which suggest that homonymous and polysemous words are represented and processed differently. The following studies are only a few examples among the numerous studies which support this theory. Frazier and Rayner (1990) found in their study that participants' eye movement were different for polysemous and homonymous words, as polysemous words required shorter fixation times (the period of time when the eyes remain relatively still) while reading the sentences presented. In their study, the subjects had to read the sentences presented and

their eye's movement were tracked. At first, 10 warm up sentences were presented and then they read the experimental sentences. Frazier and Rayner (1990) explain how because the meanings of homonymous words are mutually exclusive, the selection of the intended meaning must occur before interpretation takes place. The contrary occurs with polysemous words, as they are not mutually exclusive, and taking into account the One Representation view, the underspecified meaning remains activated so that selection and disambiguation is delayed if it is necessary (as cited in Klepousniotou et al., 2012, p 12).

Moreover, the experiment carried out by Klepousniotou et al. (2012) can also be used as behavioural evidence for the distinction between homonymy and polysemy, and so in favour of the One Representation hypothesis. In their work, they observed the temporal patterns of meaning activation of homonymy and polysemy in order to provide evidence on the way in which words with multiple meanings are processed and represented in the mental lexicon. The data reported in this study was focused on the N400[1] component of the event-related potentials (ERP)[2]. It was found that for homonymous words predominantly dominant targets showed reduced N400 amplitudes, indicating effects of frequency. In contrast, for polysemous words, it was found that both dominant and subordinate related targets showed reduced N400 effects to unrelated targets, providing evident that supports the One Representation hypothesis. (pp. 14-19)

On the other hand, in contrast with the notion that homonymy and polysemy are represented and processed differently, there are a number of studies which support the Sense Enumeration approach, where polysemy is processed just like homonymy. In particular, a study carried out by Klein and Murphy (2001) found no evidence that polysemous terms placed in phrasal contexts (e.g., monthly paper vs. crumpled paper) function differently from homonymous words. The results on the first study showed that "contextual consistency facilitated comprehension while contextual inconsistency inhibited comprehension" (as cited in Klepousniotou et al., 2012, p. 12). Therefore,

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[1] An Electrophysiological measure in the brain linked to meaning processing, which is determined by its characteristic morphology and change in amplitude relative to deviant or unexpected stimuli (Ravobsky & McRae, 2012)

[2] "time-locked measure of electrical activity of the cerebral surface representing a distinct phase of cortical processing […] provides online information about neurophysiological processes related to a range of cognitive tasks […] they reflect the processing of information millisecond by millisecond" (Somani & Shukla, 2014, p. 33)

based on the results of this study, the Sense Enumeration view is supported, namely, the related senses of polysemous words are stored like the unrelated senses of homonymous words, having separate representations for each sense.

In addition, there are other experiments whose results have implications for various theories. That is the case of the study carried out by Brown (2008), which I will explain in detail. For this study, she used 4 groups of materials in which each contained 11 pairs of phrases and each phrase in a pair contained the same verb. The groups she used are the following (p.5):

1. Unrelated (homonymy)
2. Distantly related senses (polysemy)
3. Closely related senses (polysemy)
4. Same senses

In these four conditions, in order to balance the stimuli, there were pairs containing anomalous (noncoherent) phrases. She gives as an example for each category the following pairs of sentences (Brown, 2008, p. 5):

Homonymy	*banked the plane* and *banked the money*
Distantly related senses	*ran the track* and *ran the shop*
Closely related senses	*broke the glass* and *broke the radio*
Same senses	*cleaned the shirt* and *cleaned the cup*

Moving on to the procedure, every participant saw the 11 pairs found in each of the 4 groups, using "a one-way repeated measures[3] design" (Brown, 2008, p. 6). They saw the material on a screen and they were asked to press *yes* or *no.* Participants had to press *yes* when they considered a sentence to be coherent, and *no* when the sentence was anomalous. They were asked to answer all sentences (prime and target). The correct answer to all target phrases was *yes*, as they were all semantically coherent. The response time and accuracy in answering target sentences was measured but it was not measured for noncoherent pairs of sentences, as they were only added as "foils to the

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[3] A comparison of the means of three or more matched groups, it only applies when treatments are given repeatedly to each subject (Keppel & Wickens, 2004)

test pairs to encourage participants to fully access the meaning of all phrases" (p. 6)

In the results, there was a big difference between the 4 categories regarding response times and accuracy of the answers. If the response times are compared between the group of "same sense" pairs and all the other groups, there was an important difference, showing quicker response times when the pairs were of the same sense. Moreover, in the same sense pairs there was also a higher accuracy, with a 95.6% correct for same sense mean and 78% the other groups. Therefore, when having to move from one sentence to another, if the meaning was the same, the subjects were faster in deciding than when they encountered sentences with different meanings, regardless of whether they were related or not. Furthermore, moving from one sentence to another when the senses were closely related was faster and more accurate than moving between distantly related senses and unrelated senses. There was also a distinction in the response times and accuracy between distantly related and unrelated pairs, with 81% correct for distantly related pairs and 62% in the unrelated sentences. Thus, it can be appreciated that there is an advantage in processing related senses of polysemous words. Thus, the more closely related in meaning the more easily processed (pp. 6-7).

Looking at the comparison between the same sense pairs and the other groups, it could be said that these results support the Sense Enumeration hypothesis, that is, that all ambiguous words are stored and processed equally. As the study shows "same sense pairs strongly facilitated compared to all different sense pairs" (Brown, 2008, p. 8). However, the results obtained from this comparison do not exclude the possibility of having a single representation in the mental lexicon for related senses. Moreover, the Sense Enumeration theory would predict distantly related and closely related pairs to have similar response times and accuracy. Nevertheless, this is not the case, the results show that closely related pairs were accessed more quickly and accurately than distantly related pairs. In addition, the big difference between distantly related senses and homonyms obtained in the results is also compatible with the One Representation view, as it shows that accessing completely separate representations is a slower and less accurate process than accessing senses which share a single lexical entry. Therefore, even though Brown considers that the results are not conclusive, they are nevertheless compatible with the One Representation hypothesis (pp. 8-9).

5. Conclusion

In this paper I have tried to account for the main views regarding the representation of polysemy in the mental lexicon and the way in which it is processed, by comparing it to homonymy. It is a complex issue to treat theoretically and thus, many theories are still being discussed and no consensus has been reached yet.

I have explained how one of the main views is the Sense Enumeration approach, according to which all the different senses of polysemous terms are represented in the mental lexicon as separate entries. These senses are processed by selecting the intended meaning among the different senses which are stored in the lexicon. Therefore, polysemy and homonymy are treated equally, as both related and unrelated senses are stored and processed the same way. The other main theory, the One Representation approach, postulates the opposite view, that is, the senses of polysemous and homonymous terms are stored and processed differently. According to this theory, the different but related senses of a polysemous term are represented in the mental lexicon as a single entry which may be richly structured or very general. This view asserts that when having to process a polysemous word, the intended sense is generated from the single sense which is stored in the mental lexicon, taking into account the sentential and situational context. In addition, I have enumerated and briefly defined the theories which are compatible with the One Representation approach. These views are the Generative Lexicon hypothesis of Pustejovsky (and possibly rule-based approaches) and the Core Meaning hypothesis, which differ in whether they involve 'rich' or 'thin' semantics.

On the one hand, in the rich semantics version of the One Representation approach lie the Generative Lexicon hypothesis and rule-based approaches. The Generative Lexicon hypothesis believes what is stored in the mental lexicon to be rich in conceptual information. According to this view, in order to obtain one of the senses of a polysemous word, only a part of the whole informational content which is represented in the lexicon is selected. When the word is used in a sentence, that part which is needed to construct the meaning of the whole sentence is accessed and combined with the rest of the content of the sentence.

On the other hand, thin semantics is the One Representation version which explains that what is represented in the lexicon is not rich in conceptual information but very schematic and general. The Core Meaning hypothesis claims that what is stored is

an abstract core meaning that is shared by all the different senses of a polysemous word, and that it is through contextual inference that we arrive at the specific senses intended.

After having defined the main views and explained some empirical studies which have been carried out, I can affirm that I believe the One Representation approach to be the theory which accounts for the representation and processing of polysemy more accurately. I consider the Sense Enumeration approach to be a theory with too many limitations: As a consequence of having all the different senses stored, it ends up being a highly uneconomical lexicon; also, the fact that the senses of polysemous expressions are related does not make a difference here if the senses of homonymous and polysemous expressions are stored and processed equally; finally, it is a problem how we can understand without a problem creative new senses which are used in novel contexts that are not listed. Therefore, I agree with the idea that the related senses of a polysemous word form are stored in the mental lexicon as a unique entry, unlike the unrelated senses of homonymous terms which are stored in the lexicon as separate representations. However, even though I found enough information and empirical evidence to believe the One Representation theory to be the valid one, I cannot take a stance for the rich or thin semantics version of this theory. It is an issue for which not many empirical studies have been carried out and it is a matter that is still being highly discussed.

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