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The Graded Co-Salience Hypothesis for Polysemous Ambiguity

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Abstract. It is well established in the theoretical (see Weinreich 1964) and empirical study (see Jastrzembski, 1981, Williams, 1992) of polysemy that its comprehension in context can lead to ambiguities arising. The present paper aims, by reviewing current literature and employing corpus methods, to determine whether the pragmatic theory of the Graded Salience Hypothesis (Giora, 1997; 2003) may be used outside of the original scope of its application to determine precisely why polysemes in context can be ambiguous. Using data from the ARCHER 3.2 (2013) corpus to analyse frequency as an input factor to mental lexica structure (see Bybee, 2006; 2010), 2,761 token instances of nine polysemes — ‘hand’, ‘head’, ‘door’, ‘once’, ‘book’, ‘run’, ‘cut’, ‘stop’, and ‘court’ — are manually tagged in a semantic decision task (from Glynn, 2016) as being either of a particular sense, or ambiguous (based on the biasing/priming effects of their context). It is found that significant incidences of polysemous ambiguity can be explained as a function of the plurality of salient senses per lexical item, among other observable characteristics. The hypothesis this paper brings is that polysemous ambiguity might be explained, following further research, with reference to the Graded Salience Hypothesis; that it may be the result of the co-activation of co-salient senses: the Graded Co-Salience Hypothesis.

Plain English Abstract. Often, one word can have multiple meanings. The word ‘door’, for instance, might be said to have two prominent meanings: the object one opens and closes, and the empty space through which one walks. Because these two meanings are similar, ‘door’ can be known as an example of *polysemy*. In both theoretical and empirical approaches to polysemy to date, it has been established that, sometimes, comprehending a polysemous word, or polyseme, can lead to ambiguities arising. This paper aims to suggest that the Graded Salience Hypothesis (Giora, 1999; 2003), a proposal about how accessing words in our minds works, can also be used to explain why polysemes are ambiguous. Using methods from corpus linguistics, 2,761 instances of nine polysemes (‘hand’, ‘head’, ‘door’, ‘once’, ‘book’, ‘run’, ‘cut’, ‘stop’, and ‘court’) are analysed to determine how frequently their placement in a particular context either has a specific meaning or is ambiguous. This study’s findings suggest that significant incidences of ambiguous polysemes can be explained by observing various characteristics about the frequency of their senses, such as the plurality of salient senses. It is posited that this data indicates, in ambiguous contexts, that a polyseme’s most salient senses are activated simultaneously in a manner that might prevent disambiguation, with further psycholinguistic study required to verify this claim. In this way, it is suggested that an alternate method of studying polysemous ambiguity, through the lens of the Graded Salience Hypothesis, might do well to be considered. Thus, this paper suggests the Graded Co-Salience Hypothesis.

Keywords: corpus pragmatics; polysemy; ambiguity; salience; cognition

1 Introduction

1.1 Polysemy

In ordinary language use, the words with which we communicate can quite plainly be seen to possess, relate to, or represent multiple meanings. When one person tells another, ‘I went to the bank on Wednesday’, without sufficient context or supplementary information, it might be potentially ambiguous as to whether this person visited a build-up of earth by the side of a flowing body of water or a building that contains a financial institution whose role it is to protect, save, and invest its clients’ assets. Should it have been the case that this person was recently experiencing financial difficulties, the

hearer might have been safe in the assumption that the latter sense of the word ‘bank’ had been intended; had the speaker been a potamologist, however, one might be excused for assuming the former.

This problem, represented in the ambiguity of the lexical item ‘bank’, has been of interest to linguists for well over a century. Although the notion of the multiplicity of word meanings was first broached in Bréal (1897), an introduction into the underlying theory is best given with reference to Weinreich (1964). Lexical ambiguity can be thought of as a blanket or family term for two interrelated linguistic phenomena between which Weinreich (1964) is able to distinguish: *polysemy* and *homonymy*. This division is chiefly rooted in the extent to which the alternate meanings, or senses, of lexical items are interrelated: if a word’s senses seem unrelated, it is homonymous; if its senses appear semantically similar, it is polysemous. So, homonymy is exemplified with reference to the example involving ‘bank’ above, as financial institutions and riversides do not seem semantically related. For polysemy, consider the example ‘I made a door’, paying particular attention to the possible readings of ‘door’. One can observe that this verb phrase might refer either to the making or opening of a passageway or to the construction of a physical object that functions as a moveable barrier between areas¹. These two readings are spelled out with examples (1) and (2).

- (1) I made an entryway by demolishing the wall.
- (2) I made a door by sawing a piece of wood and fixing it to an entrance with screws and hinges.

The analysis of Weinreich (1964) goes deeper into this issue of sense interrelatedness in the case of polysemy. It is proposed that this subtype of lexical ambiguity can be further classified by the extent of the interrelatedness of polysemes’ senses: polysemes with related senses are *complimentary*, whereas those with disparate senses are *contrastive*. Nerlich and Clarke (2003) expand on this further, understanding this distinction as a measure for the gradedness of the extent of polyseme sense interrelatedness by placing significance on both synchronic and diachronic studies of polysemy. Further to this, Nerlich and Clarke (2003) interpret Weinreich (1964) with reference to the semantic structure of the mental lexicon, suggesting that what underlies polysemy in the mind are complex networks of interconnected meanings that form around prototypes (see Rosch, 1975) and family resemblances (see Wittgenstein, 1974). It is this psychosemantic interpretation of polysemy theory and the place of polyseme sense interrelatedness that will become crucial for the discussion of this paper’s empirical findings.

1.2 Psycholinguistic Approaches to Polysemy

Indeed, moving away from theoretical approaches to polysemy, there have been many empirical studies in the last few decades that aim to examine the structure of polysemy in the mental lexicon. In some sense, the precedent for closer examination of polysemous structure was set in Jastrzembski (1981), where it was argued that polysemous words have a kind of special structuring based on findings that words with many meanings are accessed more quickly than words with fewer. This said, discussions are ongoing in psycholinguistics regarding the exact nature of this structure. When contrasted with homonymous words’ mental representations, some say that polysemous senses share one core representation whereas homonyms have multiple (see Frazier and Rayner, 1990; Rodd et al., 2002), yet

¹ A keen reader may observe that the polysemy at issue can be analysed on the morphosyntactic level as well as on the semantic/conceptual level. With ‘door’ being ‘object’ or ‘entrance’, there is a distinction between two different readings that trade on alternate semantics whilst maintaining the same syntactic category. However, with the example ‘milk’ being either ‘liquid *x*’ as a noun or ‘to extract liquid *x*’ as a verb, there is both alternate semantics and alternate morphosyntax (with two different morphemes of two different syntactic categories).

others argue that the multiple senses of both polysemes and homonyms have similarly separate representations in the mind (Klein and Murphy, 2001; 2002).

One psycholinguistic study that is of particular interest to the present paper is Williams (1992). In supporting the suggestion that polysemous words are processed and represented differently to homonyms, one key finding is brought: sense activation for polysemous lexical items can be observed as a function of those senses' *salience* in the minds of speakers. In this study, Williams (1992) employed a lexical decision task with the polyseme 'firm' – analysed as having senses 'strict' (disciplinarily) and 'hard' (physically); of which the former was proposed to be more salient – and found that the more salient sense was activated regardless of whether it was embedded within a biasing context. In other words, Williams (1992) provides evidence for the Graded Salience Hypothesis (Giora, 1997; 2003), a model that proposes that salient senses in the semantic networks of lexical items are always processed first, and in order of their salience. This finding lays the stage for a pragmatic theory of polysemy that approaches the distinctions between polysemes' senses, and resultantly the ambiguity that can arise as a result of their co-existence, using the framework that Giora provides.

1.3 Corpus Approaches to Polysemy

While giving an overview for psycholinguistic studies into polysemous structure is useful for theoretical background, an outline of empirical work in corpus approaches to polysemy is useful to frame the methodology of the present paper. To this end, a number of important corpus investigations into polysemy are relevant (Kishner & Gibbs, 1996; Raukko, 2003, see also Berez & Gries, 2008; Navarro, 2000; Fillmore & Atkins, 2000; Gries, 2006, see also Glynn, 2014). An important point to mention in the consideration of these works is that, whilst their endeavours are of course useful in and of themselves, the extent of their respective generalisabilities can be scrutinised because all of their empirical efforts feature analyses of only one polyseme (although in great depth). Given the aims of the present paper to yield results generalisable to language more broadly, multiple polysemes are included in this study. Regardless, the precedent set by the aforementioned papers for the corpus study of polysemy is highly important.

One of the most prominent of these was Gries (2006), who, using the International Corpus of English and the Brown Corpus of American English, collected 851 instances of the verb 'to run', and analysed them based on its different senses. A total of 252 different senses were found, where 40% were manually tagged and 60% arose from collocates, and it was determined that the prototypical sense of 'to run' was 'fast pedestrian motion' given that it occurred in 203 of the instances (approximately 25%). This determination, along with the identification of other metaphorical and extended uses of 'to run' (such as in 'to flow', 'to manage', or 'to escape'), enables Gries (2006) to develop an image-schema representation of the senses of 'to run' and their interconnection.

Very useful insights also come in Glynn (2016), who collected 500 instances of the polyseme 'annoy' from the LiveJournal Corpus (Speelman & Glynn, 2005) and categorised them in terms of three usage-features, or ID-tags, that relate to Rudzka-Ostyn's (1988; 1989; 1995) work in Usage-Feature Analysis in the description of communicative verbs: cause, patient, and agent. Using a number of statistical measures (specifically a chi-square distance measure, a hierarchical cluster analysis, and a partition cluster analysis), a wide array of usage-based features of 'annoy', both semantic and morpho-syntactic, are found that attempt to paint a very full picture of the profile of usage for the word. The reason why Glynn (2016) is particularly useful for the present paper is in its methodology. In an effort to rectify a problem of unfalsifiability he identifies in cognitive linguistics, Glynn (2016) sets out an alternate method to operationalise polyseme senses: the manual annotation of multidimensional clusterings of usage-based features. In other words, Glynn (2016) proposes that the best way to

understand the complex semantic networks that underpin polysemy is by doing the hard work of taking a large body of corpus data and manually going through it to annotate each token instance based on their correspondence with particular meanings.

There are two particularly intriguing features of this methodology. The first is that it is argued one can establish the senses of a polyseme a posteriori rather than speculating and prescribing a priori to ensure that findings are reliable, and one can demonstrate adequate quantification in one's method to allow for inductive and repeatable analyses. The second is the implication that one can produce a useful account of the mental representations of polyseme networks on the basis of large-scale corpus analysis. Understanding where the mental lexicons of speakers of a particular language intersect in their shared knowledge of polysemes' senses in this way, as represented by usage, corpora can arguably be taken as productive tools for theorising about the psycholinguistic semantic structures we hold for our languages. For these reasons, Glynn (2016) acts as methodological precedent for the research undertaken in the present paper, and inspiration in large part is drawn from it.

1.4 The Graded Salience Hypothesis and Frequency

As mentioned above, there is some link to be found between empirical studies of polysemy and the Graded Salience Hypothesis of Giora (1997; 2003). To expand further, the Graded Salience Hypothesis asserts that, in the employment of the mental mechanisms responsible for lexical access, more salient senses of lexical items are accessed and activated faster than less salient senses (Giora, 2003). This activation is proposed to occur in a sequential order that represents the process of our faculties for lexical access activating, evaluating, and consequentially accepting or rejecting a particular sense on the basis of its relevance to the discourse environment in order of the salience of senses in question (Giora, 1997). In turn, the concept of salience is constituted by Giora fourfold: the conventionality, frequency, familiarity, and prototypicality (Giora, 2003) of senses corresponding to lexical items all contribute to each individual sense's salience.

It will be useful to dissect salience's fourfold definition to understand how a sense can become salient, from Giora (2003). First, conventionality is explained as an implicitly agreed relation within a population between a situation and a linguistic form that has some kind of regularity of use. This relation, it is suggested, arises just because of a general preference for uniformity rather than because of some explicit reason. No preference is made for the motivations of conventionalisation like, say, Lewis' (1969) theory that conventions arise out of interlocutors' desire to coordinate intentions between themselves so as to economise their communicative and interpretative efforts. Though, clearly, for the mental lexicon, it does not matter *how* a sense is conventionalised, just *whether*.

Second, frequency is cashed out in two ways. Giora (2003) suggests that it might bear relations to a kind of probability of occurrence in language use (that is, if a word is more likely to appear then it possesses greater frequency), but that it also might relate to the frequency of cooccurrence of particular items (that is, 'piece' might have a more strengthened node in a lexical network because it frequently cooccurs with 'paper', even though 'piece' may not have a high frequency without). The difference between frequency and familiarity, as the third component of salience, is slightly tricky. Giora (2003) explains familiarity as a product of experience; more precisely, of encounters with a particular intended use as a result of its existence within a certain domain. So, because linguists are more familiar with 'tree' in the formal syntactic, complex node-branch-network structure sense than non-linguists might be familiar with 'tree' perhaps in the similar 'family tree' sense, 'tree' qua complex structure will have higher salience within the mental lexica of linguists. In this way, it is distinct from frequency: 'tree' qua syntax is globally low-frequency (insofar as not everyone in the world does syntax) but linguistically high-familiarity, for instance.

Fourth, an explanation of prototypicality relies on an understanding of prototype theory from psychology (e.g., Rosch, 1975). Simply, Giora (2003) suggests that the more prototypical an item within a particular category, given its proven lexical access priority, the more salient it is. Of course, the salience of a prototypically-high entry into the mental lexicon is contingent upon the context under which its prototypicality would be salient; that is, ‘robin’ is salient in the context of birds, but might not be in the context of comic superheroes (‘Superman’, ‘Batman’, etc. might be prototypical, whereas ‘Robin’, as Batman’s sidekick, might be peripheral).

To analyse the role of frequency in the creation of inner linguistic constructions in more depth (as it is the main component of salience analysable with corpora), reference can be made to the Usage-Based Grammar advocated by Bybee (2006; 2010) that descends from Construction Grammar (Fillmore et al., 1988). In Bybee’s (2006) account, linguistic (particularly grammatical) representations are formed through the process defined by exemplar theory. In this, token experiences of linguistic forms (produced and perceived) are compared and contrasted with nodes on massive network of representations. If a certain experienced form is identical to a pre-existing exemplar, then that form is mapped onto that exemplar and the overall representation is strengthened in the mental lexicon. If, however, there are only strong similarities, that experienced form is stored as a separate but similar exemplar that then ends up making larger clusters or categories (Bybee, 2006). In this way, the more one experiences a particular linguistic form, the stronger our mental representations for those forms become, the more salient they might be during the processes of lexical access.

Further to this, Usage-Based Grammar argues that the effects of frequency on the structure of linguistic representations can be seen in a number of observable phenomena found in language use. One example of this is phonological reduction, wherein the automatisation of neuromotor processes that arises from repeated use of the same, most frequent, phonological representations ends up reducing the magnitude of articulatory gestures and increases how much those gestures overlap (Bybee & Hopper, 2001). With this comparison, one can complement the claims of the Graded Salience Hypothesis (Giora, 1997; 2003) regarding the influence of frequency on lexical access with the theoretical and experimental efforts of functionalist-based approaches to understanding processes underpinning the grammars of speakers. The corpus methods employed in the present study aim to exploit this clear importance of frequency for an understanding of linguistic structure by utilising data pertaining to frequency of usage available from corpora.

Prima facie, the Graded Salience Hypothesis seems related just to the psycholinguistic processes underpinning lexical access, or, more generally, to language comprehension. Indeed, in the work of Giora and Fein (1999) on irony comprehension, one clear application of the theory arises: they use a fragment completion test to prime a particular literal or ironic interpretation of a given phrase and find that the comprehension of ironic utterances involves the activation of concepts related both to the ironic sense and the literal sense, whilst comprehension of equivalent literal utterances only involves activating concepts relating to the literal sense. The theory is applied further in Giora et al. (2012), where they test the common presupposition that individuals with Asperger’s Syndrome are less sensitive to contextual cues and more to literal senses in social communication (in which no bias towards literal senses is found).

However, this paper argues that the Graded Salience Hypothesis has uses beyond the original designation of its scope. Whilst at the outset, and in applications since its inception, the theory has been used to examine the mechanisms underpinning lexical access with respect to words whose meanings shift depending on the intention behind their usage and their corresponding contexts (see figurative language, Giora, 1997; irony, Giora & Fein, 1999; idioms, jokes, Giora, 2003; sarcasm, Giora et al., 2014), there also seems to be scope for application of the theory with respect to words with multiple meanings tout court; or, more exactly, with respect to polysemy. The Graded Salience Hypothesis so far has been used to understand how we come to understand the meaning of a particular utterance in

light of the potential ambiguity caused by external factors, but not yet has the theory been applied in the context of words whose ambiguities arise just by the interrelatedness of their senses.

1.5 Aims

In this study, whether the Graded Salience Hypothesis has any scope to be applied to the investigation of the structure and processing of polysemy networks in the mental lexicon will be examined. Understanding frequency effects as central in the construction of linguistic representation as per the definition of salience in Giora (1997; 2003) and the role of frequency in Usage-Based Grammar (Bybee, 2006; 2010), 2,761 tokens of nine frequently-occurring polysemes in the ARCHER 3.2 corpus will be manually tagged as either ambiguous or relating to a particular sense from their respective contexts. The statistical significance of the incidence of ambiguous sense token polysemes will be ascertained to determine the extent of each polyseme's individual ambiguity, and data from frequency will be analysed to work out what caused this significance. To this end, the following questions will be asked. Can the notion that lexical access is mediated by the salience of senses be applied to the study of polysemy? Could senses' salience in their respective polysemy networks give any indication as to why ambiguity arises? And, if so, what might this tell us about how polysemous words are stored psycholinguistically?

2 Methodology

2.1 Data Selection

All data used in this paper was collected from the ARCHER (A Representative Corpus of Historical English Registers) 3.2 corpus (2013), which is a multi-genre, diachronic corpus of British and American English covering the period 1600-1999. It consists of 3,298,080 words (1,957,499 British English and 1,340,581 American English). ARCHER 3.2 was selected for its size and variety in dialect and kinds of contexts (see Section 2.2) featured — to paint the broadest picture possible of polysemy across the English language, such types of variety are essential. To ensure that historical semantic change did not affect the findings here, only a short period of time could have been selected. This was balanced with the desire to ensure the possibility for the collection of a sufficient number of materials for analysis, so it was decided that a century's worth of corpus data would be sufficient. It was also noted that the senses of lexical items employed from previous centuries would have been more inaccessible for unambiguous comprehension, so the century 1900–1999 was chosen. This period contains a total of 1,294,244 lexical items in the corpus.

Nine polysemous words were selected for analysis in this study. In past studies on polysemy and corpora (see above) the only rationale for the selection of the polysemes analysed has been that there were distinct senses to scrutinise. As a criticism of those, and to make this methodology more rigorous, the polysemes in this study have been selected against a range of others, and with a specific criterion in mind. First, a list of 26 polysemes was made, chosen from studies with similar methodologies to this one (see Table 1) and by the researcher. For data collected to be as representative of polysemy more broadly, the selected polysemes were required to occur frequently in the corpus. Thus, the frequency per million scores of all 26 polysemes was analysed for their selection in this study, as shown in Table 1.

Table 1: *Frequency per million scores in ARCHER 3.2 of 26 polysemes*

Polysemes	Freq./million
In (Navarro, 2000)	15,913.54
Over (Tyler & Evans, 2001)	1,199.57
Just (Kishner & Gibbs, 1996)	968.13
Man	961.18
Get (Raukko, 2003)	941.09
Make (Kishner & Gibbs, 1996)	679.16
Hand	387.10
Head	345.38
Door	342.28
Once	316.01
Book	220.98
Run	175.39
Cut	139.85
Stop	132.90
Court	108.96
Foot	87.13
Character	84.99
Drink	79.58
Shop	72.63
Milk	60.27
Game (Wittgenstein, 1953)	58.72
Funny	57.95
Path	39.41
Paint	17.77
Crawl (Fillmore & Atkins, 2000)	4.64
Annoy (Glynn, 2016)	3.86

Polysemes already analysed or discussed by other researchers were not included in the present study to prioritise novelty. That said, the study by Gries (2006) focused on *to run* specifically, and as such the polyseme ‘run’ has been included here as a separate lexical item. Additionally, the polyseme ‘man’ was not included because it occurred much more frequently in the corpus than any other unresearched polyseme such that it might have skewed the dataset: homogeneity was favoured to preserve reliability. Presented with 16 polysemes remaining, it was decided that the criterion for polyseme selection was a frequency of 100/million or higher in the ARCHER 3.2 corpus, keeping in mind the aforementioned desire to study a range of frequently used polysemes – thus, nine were chosen: ‘hand’, ‘head’, ‘door’,

‘once’, ‘book’, ‘run’, ‘cut’, ‘stop’, and ‘court’. Table 2 shows these selections with their frequency per million scores.

Table 2: *Frequency per million scores in ARCHER 3.2 of the nine polysemes selected for this study*

Polysemes	Freq./million
Hand	387.10
Head	345.38
Door	342.28
Once	316.01
Book	220.98
Run	175.39
Cut	139.85
Stop	132.90
Court	108.96

2.2 Data Collection

The ARCHER 3.2 corpus was accessed through the website CQPweb (Hardie, 2012). Data for each polyseme was downloaded as a .txt (Text Document) file, and then copied into an .xlsx (Microsoft Excel Document) file for analysis. By copying over downloaded data to an .xlsx file, it was much easier to manually annotate the corpus data. Search parameters remained the same throughout data collection: all instances of each polyseme from both 1900–1949 and 1950–1999 were included. However, only root forms of polysemes were included in searches: words such as ‘runs’, ‘doorway’, or ‘stopper’ were considered to be separate lexical items, and even though polysemies may be shared between inflected or morphologically adapted forms, they were not included to narrow the scope of this study.

To ensure the reliability of sense disambiguation, the corpus data was analysed with the broadest possible context: polysemes were downloaded with the maximum context of 20 words before and after. To ensure that data here might be generalisable to wider contexts of language use, it was important that the sample represented ordinary discourse as much as possible. To this end, data from all genres available in the corpus was collected for selection and then analysis; these were: *Advertising, Drama, Fiction, Sermons, Journal, Legal, Medicine, News and periodicals, Early prose, Science, Letters, and Diary*². Potential biases were avoided by opting not to download metadata pertaining to the following categories available in the ARCHER 3.2 corpus: author sex, author, bibliographic info, publication date, genre, and regional variety.

Where polysemes occurred as a person’s name (e.g., ‘Mrs Hand’), they were excluded as unindicative of polyseme sense. Place names (for example, ‘Jefferson Market Court’; ‘court’, 1906nyt1_n7a) were included because they were considered to have inherited their name through a relation to the particular sense – Jefferson Market Court would not have been named thus without having been an ‘enclosed space’. Additionally, some lines in the corpus were reduplicated – these were eliminated from analysis, and inconsistencies in the numberings of lines in the data can be explained accordingly.

² Except *Legal* for the polyseme ‘court’ given that the term, in reports of legal proceedings (which do not really represent organic discourse anyway) almost always refers to a court of law, and as such would have diminished the significance of extra-contextual ambiguous sense tokens ‘court’ appears 412 times in *Legal* alone. The genre *Medicine* was included in spite of potential overrepresentation of ‘head’, ‘hand’, and ‘cut’ as the as they only appear 7, 11, and 4 times in the corpus within *Medicine* respectively.

2.3 Data Analysis

In total, 2,761 token senses of the nine polysemes were manually tagged as either relating to a sense category, determined post-hoc, or as being ambiguous. All data analysis was done on Microsoft Excel, including the manual tagging of polyseme sense category and statistical calculations of frequency and mean. Calculations of Pearson's chi-squared test were coded in the software RStudio (2020). The sense category to which each token polyseme corresponded was determined with the help of the Oxford English Dictionary (OED), as well as by the researcher language-internally; that is, by establishing a synonymic, categorical, or metonymic connection between that sense and a related term. For instance, the sense category of '... the inguinal glands when *cut* into were matted together' ('cut', 1905robe_m7b) was analysed as synonymous with 'incise' as a verb; and the sense of '... of Charles the First's *court* ...' ('court', 1952whit_f8b) was analysed metonymically as being related to the category 'royal', and thus tagged with respect to this adjective. Some entries in the corpus were present as part of an idiomatic expression (for example, 'hand in hand' in 'hand', 1933hodg_h7b) – these were analysed as having distinct senses, rather than marking them as simply 'idiomatic', to avoid confusions within the sense category classifications.

Each sense category was manually tagged in the .xlsx document in a table adjacent to the corpus data. As more lines of each polyseme were analysed, more unambiguous senses were found and tagged: the mean number of unambiguous, disparate sense categories was 6.78 per polyseme. Although it might have made sense only to tag each polyseme token as 'ambiguous' or 'unambiguous' given the concern of the present study, the decision to distinguish between each sense of any token polyseme, and then whether it was ambiguous, was taken to clarify for the reader the rationale behind the tagging of each polyseme token specifically.

3 Results

In total, 2,761 polyseme tokens were manually tagged as being ambiguous, or unambiguous and pertaining to a certain sense category. The mean frequency of polyseme tokens per polyseme analysed in this study was 306.8. For all nine polysemes, the frequency of ambiguous sense tokens was 435, with a mean of 48.33 per polyseme. This means that 15.76% of all polyseme tokens were ambiguous in sense, calculated as the percentage of frequency of ambiguous sense tokens over the total frequency of polyseme tokens. The mean instances per million of each polyseme selected was 239.99 and the mean number of sense categories per polyseme was 6.78. The frequencies of all polyseme tokens and ambiguous sense tokens can be found in Table 3.

Table 3: *Frequency of polyseme tokens and ambiguous sense tokens (1900-1999)*

Polysemes	Freq. (total)	Freq. (ambiguous)	Freq. (ambiguous%)
Court	120	9	7.50%
Stop	172	23	13.37%
Hand	496	27	5.44%
Door	442	173	39.14%
Head	442	17	3.85%
Book	286	64	22.38%
Once	400	63	15.75%
Cut	181	27	14.92%
Run	222	32	14.41%
Mean:	306.78	48.33	15.76%

As can be seen, although ‘hand’ occurred most frequently in the ARCHER 3.2 corpus, the polyseme ‘door’ was found to have the highest frequency of ambiguous sense tokens at 173. This number was higher than any other polyseme, with the next highest being ‘book’ with 64 and then ‘once’ with 63. The frequency of ambiguous sense tokens for ‘door’ is noteworthy given that they account for 39.14% of all instances of that polyseme in the corpus data. Also interesting is that, despite ‘court’ having the lowest frequency of ambiguous sense tokens at 9, ‘head’ has the lowest frequency of ambiguous sense tokens as a percentage of total polyseme tokens at 3.85%.

To assess the significance of these findings, Pearson’s chi-squared test was used. This was done because Pearson’s chi-squared is a statistical test that assesses the probability for the observed data to have deviated from an expected distribution of data, so it can reliably indicate whether the frequency of incidence of a particular polyseme alongside the others is significant. The frequency of ambiguous sense tokens and unambiguous sense tokens were analysed for each of the nine polysemes, and the results of this test can be found in the association plot depicting Pearson residuals. In an association plot, each column, or box, represents a statistic that might either be greater or smaller than expected where the area of the box is a function of expectedness (Gries, 2009). In Figure 1, ‘amb’ denotes ambiguous sense tokens, and ‘non_amb’ denotes unambiguous sense tokens.

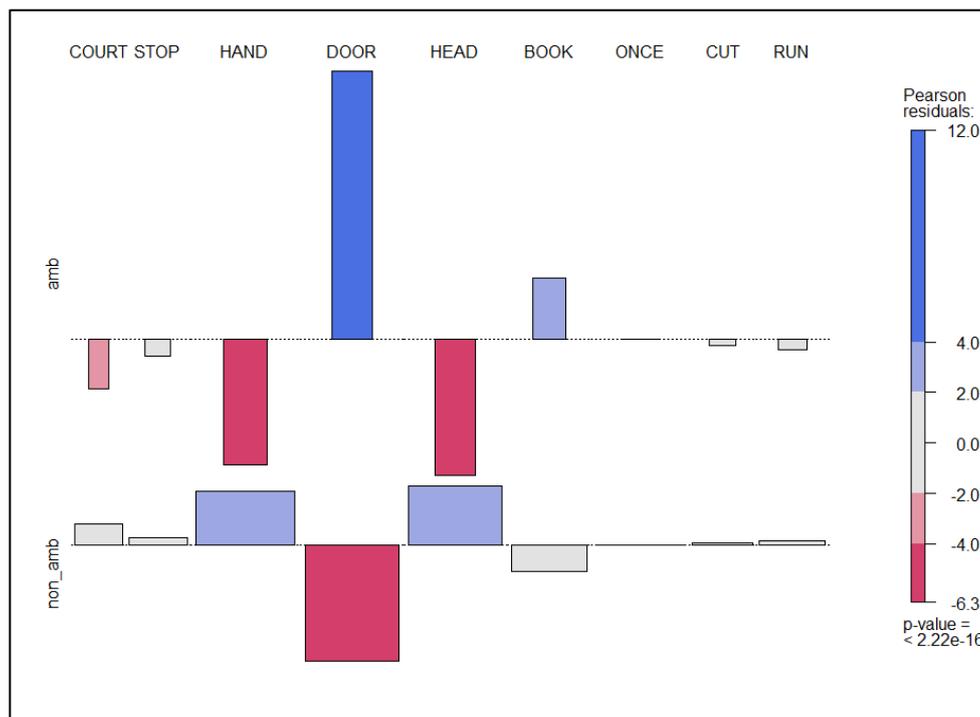


Figure 1: Association plot of Pearson residuals for the distribution of ambiguous and unambiguous sense tokens.

From this plot of the chi-squared test, several important deductions can be made. Firstly, the frequency of the ambiguous and unambiguous sense tokens observed had high statistical significance ($p < 2.22 \times 10^{-16}$) in comparison with the test's predictions. Though somewhat self-evident, this finding gives good reason to believe that polysemy can indeed give rise to ambiguity in ordinary discourse.

Moreover, it was also found that the individual frequencies of certain polysemes, either for ambiguous or unambiguous sense tokens, were significant — the colouration of particular bars of Pearson residuals in Figure 1 reflects this prominence. Specifically, it was found that the polysemes 'door' and 'book' had significantly higher Pearson residuals for the presence ambiguous sense tokens, whereas 'court', 'hand', and 'head' had significantly lower residuals for their absence. Similarly, polysemes 'hand' and 'head' were most significant for the presence of unambiguous sense tokens, as was 'door' for their absence. These polyseme-specific findings are illustrative of an important point regarding the nature of polysemous ambiguity. While it seems true that polysemy does give rise to ambiguity, there can be no uniform statement that might that assert all polysemes individually will necessarily turn out ambiguous in some cases of their use. Lexical ambiguity should be understood on a word-to-word basis, taking the semantic networks of polysemes into account: some words are naturally more ambiguous than others. Why this is the case is discussed below.

4 Discussion

To frame these findings within the scope of the Graded Salience Hypothesis (Giora, 1997; 2003), there is a certain burden of proof to be met by the present paper: evidence ought to be found that the significance of the frequency of ambiguous sense tokens could be correlated with the salience of senses within the mental lexicon. In order to do so, a key assumption has to be made: that each instance of a

particular polyseme, analysed as the use of a particular sense (or as being ambiguous), should be taken to represent a token instance of the activation of that sense (and any others depending on the level of salience of senses within that polysemy network) according to Giora's account. As such, the presence of a particular sense in the corpus data implicates that the semantic network of the corresponding polyseme was activated and that sense was selected as appropriate. However, what exactly the presence of ambiguous sense tokens represent for the study of polysemy is less clear.

With this assumption about what frequency represents in mind, the first point for this discussion is an analysis of the polysemes that showed as statistically significant for the presence of ambiguous sense tokens. For data collected here, two polysemes were found to be significantly ambiguous: 'door' and 'book'. To understand why this was the case, closer inspection of the findings from the manually annotated corpus data is required.

Table 4: *Frequency of senses for 'door'*³

Sense	Frequency
Object (n)	186
Entrance (n)	62
Place (n)	21
<i>Ambiguous</i>	173

Table 5: *Frequency of senses for 'book'*

Sense	Frequency
Object (n)	105
Content (n)	112
To reserve (v)	5
<i>Ambiguous</i>	64

Four major observations can be made with respect to this data in comparison with the rest of the findings from this study. The first is that the number of senses recorded for both polysemes was quite well below the mean for all nine analysed: each of 'door' and 'book' both were found to pertain to three discrete senses in the corpus data, along with their being ambiguous, whilst the mean number of senses per polyseme was 6.78. The second observation is that there seems to be one discrete sense that is much less relevant in how frequently it was found: the third sense of 'door' represents 0.05% of instances and the third of 'book' represents 0.02%. The irrelevance of these senses seems almost in direct contrast with the third observation to these findings, which is that, for both polysemes, there appear to be two unambiguous senses competing for activation (or, occurring most frequently); albeit this is more so for 'book', whose first and second senses represent 75.87% of all occurrences, than 'door', whose first and second senses represent 56.11%.

Following on from this third observation, the fourth that can be made is that these noticeably high-frequency senses also bear quite strong semantic relations with one another insofar as one might say the similar locations in physical space to which the senses in question refer are quite coordinated. In other words, one can see that the two co-frequent senses for 'door' are quite conceptually similar given that one might often expect to find the 'object' door in quite the same place as an 'entrance' or

³ The letters in brackets for Tables 4 to 7 represent a designation of syntactic category; (n) designates a noun, (v) designates a verb, (adv) designates an adverb, and (adj) designates an adjective.

doorway. Likewise, it would not be amiss to propose that the ‘content’ of a book might be found somewhere locatively quite similar to the ‘object’ of a book. This notion of conceptual similarity is made clearer with reference to the corpus data itself. Below are four instances from the data that represent each of the four most relevant senses being analysed here for ‘door’ and ‘book’:

- (3) ‘...Lee?" The old lady chuckled. Her eyes lit up as Marie bent down and opened the oven **door**. A delicious hot fragrance blew out into the tidy kitchen. "My, somet'ing smell good..." (‘door’, ‘Object’ sense, 1913cath_f7a, formatting added)
- (4) ‘...heads. Alec stopped to watch. What fascinated him was how they negotiated the wide trays through the narrow **door**, just by turning their shoulders. Before he had gone to Corker's he had been offered a...' (‘door’, ‘Entrance’ sense, 1964berg_f8b, formatting added)
- (5) ‘...Can barely see to write this. But did enjoy photos. Edith Sorel of Le Monde sent me a **book** -- letter from Castellorizo -- very tiny island. You may know it. It's not even on...' (‘book’, ‘Object’ sense, 1978mill_x8a, formatting added)
- (6) ‘...When he came to my chapter he laughed. I told him that it was a very wicked **book**. Growing rice looks like short oats at this time of season. It is hung up in tiny stacks...' (‘book’, ‘Content’ sense, 1921nort_j7b, formatting added)

In this way, this paper suggests that four corpus-identifiable characteristics of significantly ambiguous polysemes can be observed:

- (1) A low number of discrete senses;
- (2) At least one very low-frequency sense;
- (3) At least two highly-frequent senses;
- (4) And, a high degree of conceptual/semantic similarity between the senses in (3).

It should be noted that this list is not meant to be prescriptive, normative, or exhaustive. At most, these four characteristics attempt at being representative of ambiguous polysemes, but only on the level of contingent (i.e., not necessary) properties. The observations that these four allow might perhaps permit a level of polyseme-spotting for future research.

Yet, why do these characteristics help us interpret the data? For the two significantly ambiguous polysemes found in this study, one can first notice (1); that the number of (relevant) sense options for the interpretation of each polyseme in context is very limited, and thus (3); that each polyseme only has two senses that seem most reflective of the majority of its occurrences. To expand on this further, a useful question can be asked: why should this impact the ambiguity of a given polyseme? In each instance of use, the process for comprehending a polyseme can be understood in terms of a sequence of semantic decisions for what that term might have meant in that context (or, might have been intended to mean; see Giora, 1997; 2003). The hearer or reader receives as input the polyseme, and, taking context into account, checks to see which of the senses they know to which it might correspond. If there are multiple senses of similar relevance in a particular context, interpreting a particular instance of a polyseme becomes more challenging from a processing perspective.

Furthermore, noticing (4), the conceptual similarity between the two polysemes’ respective senses, helps to understand the extent to which context is useful for semantic interpretation. Were the competing senses for each polyseme quite conceptually disparate, one would expect that contextual factors would help to eliminate ambiguity. This absence of the helpfulness of contextual factors (in this

case, the rest of the sentence) is made apparent in the following two examples of ambiguous sense tokens for ‘door’ and ‘book’:

- (7) ‘...Griselda was sitting on the rug taking off her stockings. They looked up when Ty Ty stopped at the *door*." What do you want, Pa?" Buck asked irritably." Son," he said...’ (‘door’, 1933cald_f7a, formatting added)
- (8) ‘...many complications as might have been expected. But I foresee the need for some very intelligent editing before the *book* sees the light. Of course I shall go on working for penal reform and individual prisoners. I much...’ (‘book’, 1981long_y8b, formatting added)

With the assumption above, that every instance of a polyseme in the corpus represents the activation of a sense in the mental lexicon, it would necessarily follow that every instance of a polyseme token found to be ambiguous also represents the occurrence of some kind of activation. From the data presented here, given the co-relevance of two particular senses for the interpretation of each of the significantly ambiguous polysemes, and those senses’ conceptual similarity for which context seems unhelpful in distinguishing between, this paper proposes that the ambiguity that arises from polysemy can be explained in terms of the co-activation of two co-salient senses. In this process, a hearer or reader of a word that bears polysemous ambiguity attempts to interpret that word’s meaning in line with the proposals of Giora (1997; 2003), wherein the access of sense nodes in the semantic network for that lexical item is ordered depending on the salience of those senses.

Understanding findings pertaining to frequency from this study as input factors into the semantic structure of polysemous networks, this paper therefore proposes that a new way of thinking about polysemous ambiguity might be explored. Simply, it is that the co-relevant senses observed for significantly ambiguous polysemes might represent *co-salient* senses within the mental lexicon. Moreover, under the assumption that each token instance from the corpus represents some form of activation in our minds, it is also proposed that these co-salient senses may be activated simultaneously within the process of interpretation in such a way that derives no result helpful for the disambiguation of that polyseme in context in cases where it becomes ambiguous. In other words, the hypothesis this paper brings for an understanding of polysemous ambiguity is that it might be the result of co-salient senses being co-activated such that the polyseme in question is rendered ambiguous. Further psycholinguistic study will be necessary to substantiate this hypothesis.

Following this assertion, an additional line of inquiry can be pursued by the present discussion to determine its credibility more certainly. Should it be the case that polysemous ambiguity can be explained as a function of the co-salience of senses being co-activated, one would expect to find in the data presented here that polysemes found to be significantly unambiguous (‘hand’ and ‘head’) would show converse observations to those noted in the given four characteristics for the polysemes ‘door’ and ‘book’ above⁴. In this way, one would expect ‘hand’ and ‘head’ to present higher numbers of discrete senses than the mean (the opposite of (1) above, henceforth $\neg 1$), without one noticeably infrequent sense ($\neg 2$), with no two co-salient senses ($\neg 3$), and without any noticeable conceptual similarity between senses ($\neg 4$). To investigate this, the findings from the manually annotated corpus data are required:

⁴ Insofar as those observations represent a cause for those lexical items’ polysemous ambiguity.

Table 6: *Frequency of senses for ‘hand’*

Sense Categories	Frequency
Limb (n)	315
Location (n)	12
Assistant (n)	2
Control (n)	8
Owner (n)	1
To pass (v)	8
To participate (v)	2
To help (v)	3
Contrastingly (adv)	66
Together (adv)	12
Available (adj)	31
Relevant (adj)	9
<i>Ambiguous</i>	27

Table 7: *Frequency of senses for ‘head’*

Sense Categories	Frequency
Body part (n)	317
Top-most part (n)	28
Heading (n)	3
Leader (n)	65
Temperament (n)	1
To lead (v)	3
To aim (v)	1
To fight (v)	7
<i>Ambiguous</i>	17

As can readily be seen, neither of these significantly unambiguous polysemes correlate with the observations presented for the significantly ambiguous ones as listed above. First, the polyseme ‘hand’ was observed to have 12 discrete senses, and ‘head’ 8, both higher than the mean number of senses per polyseme of 6.78 (-1). Second, many senses for both were noticeably infrequent; of the 12 senses of ‘hand’ had under 10 instances and 5 of the 8 senses for ‘head’ were as well (-2). Third, no two senses for either appear co-salient (insofar as there might be two that represent a high, relevant percentage of total instances) for either polyseme as well; in fact, they both seem to have one most salient sense, as ‘limb’ for ‘hand’ represents 63.51% of all its instances and ‘body part’ for ‘head’ represents 71.72% (-3). Finally, little apparent conceptual similarity between any of the two polysemes’ senses is observable, in part due to the diversity of syntactic categories designated to discrete senses found (-4). The only noticeable semantic parallels exist metaphorically between the noun senses for ‘head’, as the senses of ‘body part’, ‘top-most part’, ‘heading’, and ‘leader’ all seem to refer to an entity at the top of a vertically-construed structure or hierarchy.

5 Conclusion

5.1 Reflections, Issues, and Further Study

One clear route for further empirical work is to employ behavioural, rather than corpus, psycholinguistic methods in assessing how we deal with polysemous ambiguity under experimental conditions⁵. The Graded Co-Salience Hypothesis might predict that, for example, disambiguating a polyseme with co-salient senses in an ambiguous context might incur greater processing costs through increased time taken to identify the sense of the polyseme. Conversely, polysemes without co-salient senses might be predicted to result in lower processing costs insofar as no two or more equally salient senses would be competing for activation from a given context.

Another issue for reflection is the extent of the import of these findings for a clearer picture of ordinary language use. Some key questions one might ask are the following: does polysemous ambiguity ever actually matter on the outcomes of ordinary discourse? Could the subtle semantic distinctions proposed here to exist within an instance of ambiguity have an effect on a conversation? Does it matter all the time whether we know what a person is referring to? Answering these questions to some extent will involve future study into this area; given that findings here point to the incidence of polysemous ambiguity within the polysemes studied was statistically significant, there is some scope for its analysis as impactful upon the outcomes of discourse.

However, some recourse can be taken in answering these questions to the concept of a ‘context set’ in Stalnaker (1979). In this, it is proposed that conversational participants will have a set of beliefs in any context concerning the precise topic of discussion at different stages of that conversation. The further a conversation progresses, the closer the mutual understandings of participants will end up. With this in mind, it might be proposed that further avenues for the study of polysemous ambiguity could involve the extent to which its incidence affects the construction of interlocutors’ context sets in real time.

A final issue worth exploring with regard to the methodology of this paper concerns what precisely underpins the ability to disambiguate the senses of a polyseme and interpret it in accordance with its intended meaning. How do we end up knowing what a specific use of a specific word means? In this study, only the linguistic context in which polysemes were found to be situated from the corpus data was relevant for determining meaning, but in ordinary discourse there are a plethora of other factors involved. Examples of these might range from gesture (see Schlenker, 2019) in a physical fashion, but also the kinds of sources of information that compile a merger representation in Jaszczolt’s Default Semantics (2005; 2010) such as world knowledge or presumptions about society and culture. As such, it might be the case that findings in the present research would be enriched with the contributions of these factors unlimited.

5.2 Limitations of the Methodology and Data

This paper’s methodology could first be criticised for the manual tagging of polysemes’ senses. Although the potentially constrictive effects of using the OED to define the senses of each selected polyseme precisely were slightly offset by the researcher’s input, nevertheless using a dictionary to determine the meaning of any word will be slightly problematic in any experimental setting given its

⁵ This is not to say, however, that corpus studies like this one investigating frequency effects as if cognitively representative should be discarded. For an interesting back-and-forth discussion on this matter, see Arppe et al. (2010).

prescriptive nature. Conversely, criticism could also be aimed at the researcher's own input into determining to which particular sense category each token polyseme referred.

A third criticism might argue that the methodology for data analysis conflates ambiguity and vagueness. This critique suggests that there is an issue in how polyseme tokens were marked as ambiguous when the sense was unknown (or where there was insufficient context within the corpus data to tag as unambiguous) *and* when the term seemed to pertain to more than one of the discrete senses observed. Although the observation in this critique is true, it has been taken as unproblematic for the purposes of this study given how it must surely be the case that each vague token polyseme would have been used by its author with a specific sense in mind, and as such will still serve to represent some node on the sense network of that polyseme. Therefore, this critique can be met with the suggestion that vagueness does not arise enough as the result of speaker intentions for its possible existence in the corpus data to be potentially worrying in the attempt to understand the semantic networks of polysemes.

5.3 Concluding Remarks

In this paper, it has been argued that the occurrence of polysemous ambiguity can be understood as a function of the co-activation of co-salient senses within the polysemy network of a certain polyseme. It is proposed here that, in line with evidence for the Graded Saliency Hypothesis (Giora, 1997; 2003), lexical access for polysemy should not be taken as particularly special in comparison with processing for any other kind of word; that the mental mechanisms underpinning such operations function in an ordered fashion during which the most salient senses for each lexical item are prioritised. However, the case of ambiguous polysemes differs in the results of this process. The corpus data collected in this study suggest that the ambiguity arising from the occurrence of polysemous words in unbiassing contexts can be explained as the result of senses with similar levels of saliency in those words' polysemy networks competing for activation⁶.

Finally, this paper concludes with the suggestion that its findings can be adequately explained with an adaptation of the Graded Saliency Hypothesis (Giora 1997; 2003); findings in this corpus-led study indicate that polysemous ambiguity occurs as a result of the co-activation of co-salient senses when polysemes are comprehended in context. Statistically significant data shows some evidence that ambiguous polysemes have a smaller number of discrete senses, and that the two most conceptually similar of these senses occupy co-salient positions in their respective polysemy networks. Conversely, it is found that polysemes that were significantly unambiguous display the reverse of these properties. This paper's proposal for an understanding of the psycholinguistic factors underpinning polysemous ambiguity is thus the *Graded Co-Saliency Hypothesis*: while lexical access is ordered by a function of senses' saliency, some equally salient senses conflict and compete in the interpretation of some polysemes such that they become rendered ambiguous.

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⁶ In other words, contexts that prove unhelpful for the interpretation of the precise meaning of that polyseme, determined insofar as that particular instance was deemed ambiguous.

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