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A TEXT ANALYSIS OF BOUND MORPHEMES IN K-12 SCIENCE TEXTS AND THE  
IMPLICATIONS OF BOUND MORPHEMES FOR ENGLISH LANGUAGE LEARNERS'  
READING COMPREHENSION

By

Matthew Koch

A Capstone submitted in partial fulfillment of the requirements for the degree of Master of Arts  
in English as a Second Language.

Hamline University

Saint Paul, Minnesota

May 2017

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## ACKNOWLEDGEMENTS

I would like to thank my committee members, Anne Rogan, Bridget Erickson, and Rachelle Kreuser. At times writing this capstone felt a little overwhelming but your insight and enthusiasm helped to keep me focused. The suggestions and perspectives you offered throughout the committee process were so beneficial and I thank you for your much needed assistance.

I would also like to thank my family. This project would have been so difficult to complete without your amazing support and positive spirit.

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## CHAPTER ONE: INTRODUCTION

“But volcanoes don’t always cause destruction in Hawaii. In fact, all of the eight main Hawaiian islands were created by volcanoes. Millions of years ago, lava began to burst from openings on the bottom of the Pacific Ocean. It cooled and turned into solid rock. These eruptions happened over and over, creating mountains that grew taller and wider. Over time, the mountains rose above the waves and became islands. Lava flows from Kilauea continue to make the Big Island even bigger. Once the lava reaches the ocean, it cools and hardens. Since 1983, Kilauea has added land that measures about the size of 500 football fields.”

This passage was from the book, *Extreme Weather* (Squire, 2015), and it reminds me of the type of science books I read back in elementary school. I struggled with these types of readings, and it was not due to lack of interest. I was generally interested or at least mildly curious about the topics, particularly natural phenomenon and astronomy. Yet I found it difficult to keep track of all the facts and different processes taking place. It turns out that I was not alone in my frustration.

### Science and Literacy Achievement

Research has shown that there is a striking drop in literacy achievement around fourth grade and this decline steepens for struggling students as they enter middle school and high school (Fang, 2007). These findings resonate with me because I recall how books became considerably more challenging in middle school. My daily frustrations confirmed it.

Similar research also points to a change in literacy aims as students move from lower-grades to higher-grade levels in elementary school. Children enter kindergarten with the goal of learning how to read. In contrast, they are supposed to exit lower elementary grades knowing

how to read so they can continue learning. The transition between these two different aims has proven difficult and may account for the drop in literacy achievement in elementary school. In particular, some experts cite the difference in the types of reading materials as a possible cause. For example, students read more familiar narrative stories and less expository texts during lower grade levels but this dynamic reverses in later grades (Fang, 2007).

As an elementary school teacher, I am constantly working to develop my students' literacy skills. However, as an English Language (EL) teacher, I am curious what grammatical structures are prominent in common school textbooks. Specifically, I want to know how academic language structures evolve through grade levels and which ones present special challenges for English Language Learners (ELLs).

My interest in syntax and grammar led me to conduct this text analysis study, but there were other factors. According to the 2015-2016 Minnesota Department of Education's *English Learner Education in Minnesota* report, 59.5% percent of all students in Minnesota met proficiency standards for the statewide Reading Achievement Test. In contrast, 17.5% of ELLs met the same reading standards. Test scores in science show a greater disparity. In 2015, 53.4% of students statewide met the proficiency standard on the Science Achievement Test. In comparison, just 9.5% of ELLs met the same science proficiency standards. I see standardized achievement test scores as one academic component, not the entirety of a student's understanding of a subject. Nevertheless it is noteworthy to view the large disparities in statewide achievement test scores for all students versus ELLs in science and reading. These disparities along with my interest in syntax compelled me to conduct a comparative text analysis of science passages to investigate the lexical changes taking place in various content level texts.

### Role of the Researcher

I am an EL kindergarten teacher in a first ring suburban public elementary school. My instruction time is primarily focused on developing my students' phonemic awareness, alphabetic writing, sight word recognition, basic syntax, alliteration skills, rhyming abilities, and capacity to create common consonant-vowel-consonant combination words. These focus areas correspond closely with Chall's theory on the key stages of literacy growth (Chall, 1996). While Chall's theory applies to mainstream students, not specifically ELLs, it is still relevant to my work. I view the majority of my students operating at Stage 0 and working towards the aforementioned goals.

In kindergarten there is more emphasis on building phonological awareness than morphological awareness. This is common practice and I allocate my instructional time accordingly. However, the understanding of morphological structures and their importance is changing. Studies have shown that morphological structures play an increasing role in academic language. Additionally, an awareness of these structures has been shown to be beneficial for first language (L1) reading comprehension (Kraut, 2015).

Phonological awareness continues in first and second grade but the emphasis shifts toward more lexical, sentence, and passage-level comprehension. By third grade students are expected to learn a variety of key vocabulary that span across multiple subject areas. There is a growing body of research on the learning curve for those students who struggle with reading comprehension in elementary school. Some research even suggests low-level performance scores as early as second grade are solid indicators of future low-level reading comprehension in high school (Foster & Miller, 2008).

At my current school, I have observed students struggling with the increased academic language load in third grade. Similarly I have noticed teachers struggling to teach the large amount of vocabulary needed for students to understand essential classroom texts. In past teaching assignments in the United States and abroad, I recall students trying to properly use inflectional morphemes such as possessives, comparatives, and superlatives in their writing. These same students equally grappled to use derivational affixes. Academic language presents problems for both teachers and students.

### The Challenging Characteristics of Academic Language

Academic language is a conceptually rich form of text that requires a unique understanding of grammar and vocabulary. It is used as the basis to develop stronger content understanding and to communicate this knowledge with others. Academic language allows for students to make claims based on evidence, critique ideas, and refine hypotheses. The language demands required to carry out these activities are high. They require a more complex command of language rather than merely knowing vocabulary definitions in isolation (Kelly, 2016).

Many native speakers and ELLs equally struggle to comprehend academic language. Academic language includes both specialized and general academic vocabulary, various types of grammar clauses, expanded noun phrases, and passive voice construction (Heppt, et al, 2005). These language characteristics can pose difficulties and are different than the social language used in common student interactions.

The nature of what constitutes academic language shifts as a student progresses through elementary school. This shifting focus may be a main reason why academic language is so challenging. For example, narrative texts are common in lower elementary grades. These stories

have grammatical features and reference points similar to the social language used by students. However, the focus slowly shifts from fewer narrative texts to more informational expository texts, which are less analogous with social language (Fang, 2007). The ability to succeed academically in history and science requires an understanding of different language features. The paradox is that learning in school is carried out via language but the specific language needed to fulfill academic tasks is generally not explicitly taught in school (Schleppengrell, 2004).

Teaching vocabulary is generally a top priority for most Kindergarten through twelfth grade (K-12) teachers and specific word knowledge is an integral component of academic language. Teachers often focus on vocabulary lists but true academic language requires more than memorizing definitions. Word level knowledge in isolation without the ability to critique and communicate ideas coherently is not sufficient to fully achieve academic language objectives (Kelly, 2016).

Most students struggle with academic language but low-level ELLs are in a more precarious position. Native speakers draw upon their L1 to build academic literacy while low level ELLs have to build second language (L2) social language and academic literacy simultaneously (Chen & Flores, 2006). Furthermore ELLs generally lack the opportunities via sufficient scaffolding in class to meaningfully engage in real academic language discourse (Zwiers, 2009).

Limited vocabulary acquisition and passage level reading comprehension difficulties are not limited to ELLs. There is a need for all students to better understand morpheme structures but this demand is particularly critical for ELLs who historically have lacked access to the same language resources that their monolingual peers utilize (Kieffer & Lesaux, 2008).

For decades researchers have evaluated pedagogical strategies to teach academic language but in recent years there have been new areas of focus. For example, the cognitive strategies typically taught in elementary school for comprehending text such as predicting, inferring, and comparing/contrasting are staples in elementary education. These strategies are further reinforced by middle school and high school teachers looking to build on previously taught concepts. While these widespread strategies are useful for organizing information, some researchers believe they fall short. They contend that these traditional methods miss the recognition of academic language forms. Thus they are more organizational strategies, which focus on demonstrating comprehension rather than truly understanding language structures (Zhihui & Schleppegrell, 2010).

### Guiding Questions

The drop in literacy that occurs around fourth grade informed my initial guiding questions. I wondered whether this decline was connected to a shift in academic language structures. My questions were further tailored based on my observations of students struggling with academic language in science texts:

- New vocabulary is constantly being introduced but what links do new words have to previous ones?
- What lexical variations are prominent in science textbooks and how could students better understand these changes?
- Could an understanding of morpheme structures aid in lexical and passage level reading comprehension?



- How can ELLs draw upon their L1 knowledge to comprehend unfamiliar words in their L2?

These guiding questions led me to my research question, which was a synthesis of the aforementioned questions. The guiding questions were a start but needed to be consolidated into a question that allowed for quantitative results. My research question ties in with my guiding questions because the results might present implications and offer insight into how to better teach new vocabulary and academic language.

#### Research Question

My research question is:

- Does bound morpheme frequency in science texts increase by grade level and if so, are inflectional or derivational morphemes more prevalent?

#### A Brief History of Text Analysis

Both linguists and psychologists have used text analysis as an investigative tool. Before the 20<sup>th</sup> century, languages were analyzed, however, the research often focused on the similarities of one language in comparison with another. Frequently the analyses became a way of appraising and categorizing languages into a hierarchal order. Around the turn of the 20<sup>th</sup> century, researchers began advancing linguistic anthropology, which looked to assess languages on a more scientific basis rather than a cultural one (Lucy, 2016). Others cite Sigmund Freud's work on hidden intentions, apparent slips of the tongue, and the recording of these linguistic mistakes, as the beginning of modern text analysis (Tausczik & Pennebaker, 2010).

Currently computerized corpus programs allow for a broader dissemination of linguistic variables across larger samples of text. It is important to note that such a program was not used in this study. This decision was based on two main factors: 1) the smaller sampling size of data chosen to complete this Master's Capstone within its' timeframe, 2) the difficulty of finding a reasonably priced application that would accurately analyze bound morpheme structures.

### The Gap

Although there are already studies and text analyses conducted on the subject of bound morphemes, it is worthwhile to analyze the prevalence of these structures in science texts across grade levels K-12. There is a need to investigate what lexical changes are happening given the large disparity in science achievement scores between native speakers and ELLs in science. It is also worthy to investigate these variations at lower grade levels given that students who struggle with academic language in elementary school often continue to have issues in secondary school (Foster & Miller, 2008).

A large body of research exists on the process of nominalization in science texts, which is accomplished by adding derivational affixes to verbs and adjectives to make them nouns. Due to the prominence of derivational affixes in science texts, it would be useful to understand which ones are more prevalent. Possibly these derivational forms need to be taught more explicitly in order to boost reading comprehension in elementary school and provide a groundwork for reading at the secondary level.

## Chapter 1 Summary

Bound morphemes are prevalent in academic language. In the case of inflectional morphemes, the rules are more straightforward, whereas derivational morphemes tend to change root word meanings with less predictable results. Given the aim in elementary school of transitioning students from learning to read, to reading to learn, it is worthwhile to conduct a comparative text analysis to see what types of bound morphemes are most prevalent by grade level in science texts.

## Chapter Overviews

Chapter 2 will focus on current literature regarding the language of science, morphological awareness, morphological decomposition, and L2 processing of bound morphemes. Chapter 3 will focus on the methodology chosen for this study. Chapter 4 will focus on results from the study. Chapter 5 will focus on conclusions of the study. The implications of morphological awareness on language pedagogy will also be investigated in Chapter 5. However, there will not be an in-depth analysis of different pedagogical strategies for boosting morphological awareness given that it is beyond the scope of a text analysis.

## CHAPTER TWO: LITERATURE REVIEW

### The Purpose of this Study

The purpose of this comparative text analysis study is to record the frequency and types of inflectional and derivational morphemes from a sampling of academic science texts used in K-12 classrooms. The possible impact of these bound morpheme structures on ELLs reading comprehension will also be examined.

### The Language of Science

The language of science is intertwined with key academic language functions such as, developing hypotheses, collecting evidence, analyzing data, drawing conclusions, and communicating findings (Kelly-Jackson & Delacruz, 2014). It often is characterized as being information dense and built upon layers of evidence and facts.

Nominalization is a common feature across many academic language genres but it plays a more noticeable role in the language of science. The Oxford English Dictionary defines nominalization as “the action or process of converting a word or phrase into a noun” (“Nominalization,” 2003). The word *nominalization* is itself a nominalization, resulting from the process of nominalizing. In nominalization, verbs and adjectives become noun phrases, which then become the object or subject in a phrase or clause (Zwiers, 2008).

Nominalization is prevalent in the language of science because it allows for larger amounts of information to be packed into smaller clauses. One of the main reasons it is used in scientific writing is because it allows for authors to build a chain of reasoning, which clearly shows the progression of conceptual steps in order to reach a conclusion. Nominalizations make

text more abstract because readers have to keep track of multiple abstract relationships and then incorporate them into new information discovered in later passages. The ability to understand the connections between the increasing numbers of references can be difficult, particularly for those who lack practice with conventional English (Zwiers, 2008).

The following is an example of nominalization, “The *condemnation* of dissenting *perspectives* led to *revolution*” (Zwiers, 2008). In this sentence, *condemnation*, *perspectives*, and *revolution* are nominalized. Another common example of nominalization, which would be representative in a common science text is, “The virus adapted to survive outside the body. This *mutation* allowed it to be passed on by casual contact” (Zwiers, 2013). In this passage, *mutation* is a nominalized form of the action in the previous sentence. If the second sentence did not contain a nominalization, the passage would be much lengthier and require the author to restate previous facts. It would likely be more tedious for the reader as well. Because the nominalized word, *mutation*, accurately summarizes the process explained in the preceding sentence, the author can develop a chain of interrelated facts more quickly.

The impact of nominalization on readers is that they must process more concepts per clause in nominalized texts (Schleppegrell, 2004). As children advance through the educational system and develop literacy skills, they will need to understand the distinctive language of science and social studies texts, which contain smaller clauses with greater complexity within each clause (Unsworth, 1999).

Relational processes are also a key feature of science language and they connect with the high level of nominalization present in science texts. These relational processes take two main forms; how one part is a sub-class of another category or how one part relates to a whole.

Grammatical metaphors and the relational process helps to build logical reasoning by moving information from familiar to novel (Schleppegrell, 2004).

The ability of readers to integrate meanings in multiple sentences and passages allows students to access lower cohesion texts. Science literature often requires the reader to produce inferences that extend beyond what is explicitly stated in the text because the links between sentences are not as clearly established such as in high cohesion texts (Hall et al., 2015). In high cohesion material, the text itself is generally enough for the reader to comprehend the issues or arguments presented. Science texts often contain fewer explicit links in order to reduce repetition and overall text volume.

In addition to relational processes, science texts rely heavily on technical terms to convey information. Many of these terms result from compounding and nominalization, which are used to create common vocabulary in scientific discourse (Schleppegrell, 2004). Scientific terms are treated as things and these nouns are further used as the basis to lead new inquiry.

Unlike social language, scientific concepts must be deliberately learned through schooling. This distinction is important to note because scientific reasoning often contradicts what appears logical or reasonable (Vyogtsky, 1986). The language and thought process needed to understand science texts requires the learner to interpret information very differently than he or she would do when reading a narrative or participating in social language. Science language requires the reader to recognize that the focus is solely on the presentation of facts, not the human parties who might be involved somehow in the process (Schleppegrell, 2004). This integration of different facts requires a strong level of reading comprehension beyond basic vocabulary recognition.

## Morphemes and Reading Comprehension

It is essential for students to understand academic language structures and one key component of these structures is morphemes. A morpheme is a segment of language that conveys meaning and cannot be divided into a smaller unit. A morpheme can be an affix or root word. These units combine to contribute to the word's meaning and function (Kieffer & Lesaux, 2012). A reader's ability to understand how unfamiliar or difficult words are formed from smaller units of meaning is a potentially important metalinguistic skill because morphemes contain semantic, phonological, and orthographic information. Being able to integrate these different aspects is similar to the processes needed for reading comprehension (Kieffer, 2014).

### Morpheme Overview

The general consensus is that there are three main types of morpheme categories: free, bound, and compound. Morpheme structures are critical as they form the constituents to construct word meaning. I chose to focus on bound morphemes because they are prevalent in academic language, appear to increase in frequency as readers develop literacy, and can be isolated as a unique language component in a quantitative analysis. In addition, bound morphemes can follow straightforward rules or have less predictable patterns.

### Free Morphemes

The first category is free morphemes. These are words that can stand alone without additional morphemes. Free morphemes are associated with root words. For example, the verb *create* as in, *I create* or *they create*, can stand alone in the first person singular or third person plural.

## Bound Morphemes

The second category is bound morphemes and these are further divided into one of two distinct types: inflectional or derivational. Whether inflectional or derivational, bound morphemes must connect to a free morpheme to have meaning.

### Inflectional Morphemes

Inflectional morphemes follow straightforward rules and represent specific syntactic features such as whether a noun is plural or possessive. They can mark verbs by determining the third person present tense, gerund form, past tense and past perfect forms. For example, the verb *create* can have an inflectional ending *-s* to conjugate the third person singular form such as, *he creates*. However, the inflection *-s* on its own would have no meaning. Lastly, they affect adjectives by making them comparative *-er* or superlative *-est*. An example of a comparative inflection is, *he is greater*, and a superlative example is, *he is the greatest*.

Inflectional morphemes differ from derivational morphemes because inflections always appear at the end of free morphemes and their structure is predictable and provides a consistent system given the speaker understands the base and suffix (Ford, Davis & Marslen-Wilson, 2010). Nevertheless, inflectional morphemes can still pose problems even for learners who are generally proficient in their target language (Song, 2015).



The table below lists how inflectional morphemes affect nouns, adjectives, and verbs.

*Table 2.1 - List of Inflectional Morphemes Suffixes*

| Syntax    | Morpheme                             | Form | Grammatical Function  | Examples                             |
|-----------|--------------------------------------|------|---|--------------------------------------|
| Noun      | Plural                               | -s   | Marks more than one   | Cats, dogs, animals                  |
| Noun      | Possessive                           | -‘s  | Marks ownership   | John’s house                         |
| Adjective | Comparative                          | -er  | Marks comparison  | Bigger, taller                       |
| Adjective | Superlative                          | -est | Marks superlative   | Biggest, tallest                     |
| Verb      | 3 <sup>rd</sup> person present tense | -s   | Marks singular third person (he, she, it)   | He walks<br>She walks<br>It walks    |
| Verb      | Past tense                           | -ed  | Marks verb with past action   | He walked<br>She walked<br>It walked |
| Verb      | Past participle                      | -en  | Marks past participle (after <i>Be</i> or <i>Have</i> ) with past action          | I was mistaken<br>I have forgotten   |
| Verb      | Present Participle/Gerund            | -ing | Marks present participle (after <i>Be</i> or <i>Have</i> ) with continuous action | I am walking<br>I was walking        |

### Derivational Morphemes

Derivational morphemes are the second type of bound morpheme and their rules are less systematic than inflectional morphemes. Derivational morphemes combine with root words via affixes. For example, the word *create* becomes *recreate* by adding the prefix *re*. Adding a suffix further alters word meaning. For instance, *recreate* becomes *recreation* with the addition of the suffix *-ion*.

Derivational morphemes are either prefixes or suffixes. A few examples of common derivational affixes are provided below (Ebbers, 2010). See Appendix A for a list of additional derivational affixes.

*Table 2.2 - Examples of Common Derivational Prefixes*

| Prefix | Meaning                   | Example                           |
|--------|---------------------------|-----------------------------------|
| de-    | From, reduce, or opposite | defrost, dethrone, dehydration    |
| dis-   | Opposite                  | disagree, disadvantage, dishonest |
| re-    | Back, again               | reproduce, regain                 |

*Table 2.3 - Examples of Common Derivational Suffixes*

| Suffix | Meaning                 | Syntax    | Example                         |
|--------|-------------------------|-----------|---------------------------------|
| -er    | One who                 | Noun      | teacher, barber, washer         |
| -ly    | To act in a way that is | Adverb    | bluntly, strongly, quietly      |
| -able  | Capable of, worthy of   | Adjective | honorable, reasonable           |
| -hood  | Condition of being      | Noun      | childhood, statehood, falsehood |

From a semantics standpoint, derivational morphemes combine with root words in less predictable ways compared to inflectional endings. For instance, the addition of the suffix *-ment* changes the semantics of the root words *govern* (e.g. *govern + ment*) and *apart* (e.g. *apart + ment*) with less predictable results (Ford, Davis & Marslen-Wilson, 2010). This ambiguity may be the reason why many native English and non-native speakers have difficulty grasping the semantics of derivational morphemes. The less straightforward nature of derivational morphemes has potential implications because its arbitrary structure might impair more upfront approaches to pedagogy and L2 processing strategies.

### Compound Morphemes

The third category is compound morphemes. These are two free morphemes that combine to form a new meaning. For example, the word *stockbroker* is a compound morpheme derived from two free morphemes: *stock* and *broker*. Each of these free morphemes has an individual meaning but together they combine to create a new meaning. Compound morphemes usually contain a lead word followed by a modifier. Typically the lead morpheme is singular i.e., *toothbrush* instead of *teethbrush* or *mousetrap* instead of *micetrap*. There is evidence that native English speakers are able to innately mediate the singular and plural forms of compound morphemes differently than non-native speakers (Murphy & Hayes, 2010). This seems to indicate that compound morphemes appear simple on a surface level but are actually more complex.

### Morphological Awareness

Morphological awareness is the ability to recognize word structures as groupings of meaningful constituents, known as morphemes. It requires not only an understanding of free morphemes but also inflectional and derivational suffixes. This combination of word-specific knowledge and bound morpheme familiarity allow for the reader to access previously unknown words (Kieffer & Leasaux, 2008). This awareness appears to require a stronger depth of vocabulary and morphological relationships, which can facilitate improved reading comprehension.

The development of phonological abilities has long been viewed as the primary step towards literacy, which is then proceeded by morphological abilities. In this way morphological awareness is seen as secondary or derivative but there is new research suggesting that

morphological awareness is a separate contribution to reading comprehension and this ability increases in importance with age. (Nagy, Berninger & Abbott, 2006).

These findings raise the need to understand how prevalent morphemes are in English. In a systematic sampling of the Webster's New International Dictionary, 52.5% of the words were morphologically complex and had meanings that could possibly be determined through an understanding of the component morpheme structures. Derivational morphemes were further categorized by type and it was found that 37.1% were bimorphemic, containing 2 morphemes, and 15.4% were multimorphemic, containing 3 morphemes or more (Anglin, 1993).

An awareness of derivational suffixation allows English speakers to produce morphologically unique word forms but there are several steps of comprehension. For example, a reader with a strong understanding of derivational morphemes encountering the word *elasticity* might be able to recognize the two morphemes *elastic* and *-ity*. The reader might further understand that the suffix *-ity* connects to adjectives to make nouns. Moreover, the reader would need to know how to pronounce the new suffix *-ity* and change word stress accordingly in order to demonstrate a solid understanding of the newly encountered morpheme combination (Jarmulowicz, 2006).

For decades there has been an understanding of the importance of vocabulary and how morphological awareness plays a role in its acquisition. A study done in the early 1990s focused on the vocabulary acquisition of elementary grade level students through a series of tests involving definitions, sentence use, and multiple-choice questions (Anglin, 1993). The study focused on different morphological word forms and how they might contribute to overall reading comprehension. It was found that comprehension of derivational morphemes heavily increased by grade 5. In addition, students in grade 5 were exposed to more multi-morphemic words –

words consisting of 3 morphemes. The understanding of these multi-morphemic words was associated with increased literacy growth. This development in comprehension and understanding less familiar words was attributed to knowledge of more complex morphological structures. Some words are learned through familiarity while more morphologically complex word meanings are ascertained through morpheme deciphering and morphological awareness.

There is growing research on the benefits of L1 morphological awareness but there are fewer studies regarding its correlation with L2 passage-level reading comprehension (Jeon, 2011). Passage level reading comprehension remains a major goal for most K-12 ESL teachers. Students who are adept readers are able to draw upon grammatical knowledge, decode unfamiliar words, synthesize information, utilize multiple levels of word and sentence knowledge, and even make inferences about omitted material, which the author deemed implicit (Silva & Kain 2015).

Some more recent studies have examined the role of morphological awareness with ELL groups in specific grade levels. A 2008 longitudinal study suggested that reading comprehension is a skill that requires building and obtaining meaning from text (Kieffer & Lesaux, 2008). The theoretical framework put forth by the authors was that an understanding of complex morphological relationships influences reading comprehension independent of phonological knowledge, word-specific knowledge or a reader's extensive lexicon. This study investigated the connection between reading comprehension and morphological awareness with 3 groups of Spanish-speaking ELLs from 3 different schools, all with a similar low socio-economic status. The students were assessed in both fourth grade and fifth grade on a number of tests in order to isolate the variable of morphological awareness. There were several important results from the study. First, derivational morphology awareness played a strong role in reading comprehension with Spanish speaking ELLs in upper elementary grade levels. Also there was a substantial

increase in derivational morphemes from fourth to fifth grade, which required stronger morphological awareness skills in order to better comprehend text. However, the key finding was the importance of morphological awareness for second language learners because it boosted reading comprehension independent of prior vocabulary knowledge and phonological awareness (Kieffer & Lesaux, 2008).

### Morphological Decomposition

Morphological decomposition is the process whereby readers deconstruct words into familiar morphemes. It is believed to be an unconscious process for native speakers and recent studies indicate that L2 learners do not decompose morphemes in the same instinctive manner as their L1 peers (Kraut, 2015). One study tested the morphological decomposition abilities of Chinese, Japanese, and German L2 English learners. Researchers used inflectional past tense verbs and derivational suffixes *-ness* and *-ity* to assess morphological decomposition. Results showed that non-native speakers had more difficulty with inflected forms and derived morpheme forms. Based on the results, the authors suggest that L2 learners likely rely on word based knowledge rather than combinational morpheme decomposing skills for complex word recognition (Silva & Clahsen, 2006). This raises the possibility of derivational awareness playing a much larger role in reading comprehension and thus the need to understand the prevalence of bound morpheme structures in grade level texts. Since some research points to ELL transfer issues with morphological decomposition, it raises the possible need for more explicit instruction of bound morphemes rather than teaching definitions in isolation.

## L2 processing of morphemes and possible transfer issues

There is a general agreement about how native English speakers store morphemically complex words but there is little consensus regarding which intricate words are stored as morphemic units. For example, morphological decomposition appears to be stronger for words using inflectional endings rather than derivational morphemes which tend to alter meanings more considerably. (Davis, 2004) This seems probable because inflectional endings have a clearer semantic relationship with the stem word.

Morphological decomposition occurs with native English speakers and non-native speakers but is the process weakened or strengthened depending on the L1 of the learner? A 2012 Canadian study focused on two metalinguistic factors, English derivational morphemes and English-Spanish cognate awareness (Chen, et al., 2012). Subjects were 89 Spanish-speaking ELLs, 77 Chinese-speaking ELLs and a comparison group of 78 monolingual English-speaking children in Grades 4 and 7. One key finding was the strong link between derivational awareness and vocabulary acquisition. This link has been observed in other research. Length of stay in Canada was another factor of success but it only influenced non-cognate vocabulary acquisition. One implication of this study is that ELLs who have a L1 with limited inflectional markers or derivational morphemes appear to be at a disadvantage compared with students who are exposed to these structures through their L1. It suggests that explicit bound morpheme instruction could be beneficial.

A 2015 study investigated whether L2 English learners morphologically decompose lexical constituents in the automatic manner that native English speakers do (Kraut, 2015). The author conducted two experiments. The first was with native speakers and those results were used as the baseline. A second experiment was then conducted with non-native speakers. Results

showed that ELLs did not decompose words in the automatic unconscious way that native speakers do, although they did benefit from explicit morphological instruction. The author cites that ELLs with a lack of morphological exposure are at a disadvantage. However, neither low proficiency nor high proficiency ELLs were able to decompose roots and affixes at the proficiency level of native speakers, particularly if the ELLs were in earlier stages of word recognition.

There are potential pedagogical implications from this study. In particular, there may be a need to explicitly expose students to bound morpheme structures, whether the learners are beginner, intermediate, or advanced. Another point to consider is the learner's goals. An understanding of morphemes may not be as beneficial for someone who only desires to grasp social language. In contrast, morphological awareness and morphological decomposition may allow for faster and more efficient reading, which is particularly useful for students seeking a degree in an English educational system.

## Chapter Two Summary

Our understanding of the importance of morphological awareness and morphological decomposition abilities is still evolving. These abilities play an increasingly prominent role in comprehending higher-grade level academic language texts, particularly science and social studies genres. Bound morpheme structures are increasingly prevalent in secondary grade levels but they first emerge in elementary school.

The way bound morpheme structures are disseminated does not appear to be uniform across all learners. Research points to native English speakers being able to ascertain the stems



and suffixes easier than non-native speakers. Derivational morphemes may need to be explicitly taught; especially with ELLs whose L1 lacks bound morpheme structures or English cognates.

There will likely be students who fit this profile in a diverse ELL K-12 environment.

To recap, my research question is to ascertain if the bound morpheme frequency in science texts increases by grade level and if so, are inflectional or derivational morphemes more prevalent? A K-12 comparative text analysis will be conducted. A quantitative research method will be used to tabulate data. The results will help to add context to my guiding questions about what prominent lexical variations occur in science texts and how bound morpheme structures could affect ELLs reading comprehension.

## CHAPTER THREE: METHODOLOGY

### Methodology Overview

I will conduct a quantitative comparative text analysis of bound morphemes in a sampling of science texts from grades K-12. These texts are all currently used in classrooms and meet science standards set forth by the Minnesota Department of Education. The frequency of bound morpheme structures will be recorded.

### Text Genre

The initial focus of this comparative text analysis was to be non-fiction texts. Non-fiction texts present difficulties for students nationwide and this type of informational reading is rooted in state curriculum standards across the United States (Bass & Woo, 2008). I narrowed the scope further to focus on science texts because of the demanding language characteristics. Science passages tend to have possessive nouns, descriptive language, varied verb tenses, specialized vocabulary, and nominalization. In addition they often contain generalized participants such as phenomena or processes, which are more abstract. These information dense passages are full of interconnected facts and many students have difficulty connecting the interrelated language components. The science passages used in this study will be expository and focus on science processes.

### Minnesota Science Standards

The Minnesota Department of Education (MDE) sets forth K-12 academic science standards for the state. There are four content strands of science with several sub-strands beneath

each strand. The four science strands are: Nature of Science and Engineering, Physical Science, Earth and Space Science, and Life Science. There are other standards that tie in with MDE's standards. For example, 46 states, including Minnesota, have adopted the Common Core State Standards (CCSS). Unlike the majority of states that completely adopted CCSS, Minnesota only adopted Common Core's English Language Arts (ELA) standards. This is noted because the science texts sampled in this study from grades K-5 are part of Common Core's ELA standards. In K-5, students do not take individual classes in different disciplines such as social studies, science, etc. All texts used in this study meet MDE standards and can be used in K-12 classrooms.

### Quantitative Research Paradigm

Quantitative research is focused on the quantification of data and numerical analyses. Typically quantitative research is split into two distinctive forms: associational and experimental. Associational research aims to ascertain if there is a relationship between specific variables. If so, how strong is the connection? Associational research does not look at causation, only co-occurrence (Mackey & Gass, 2005). In experimental studies, independent variables are deliberately manipulated to determine the effect on a dependent variable.

This text analysis is associational in nature because no variables will be manipulated and direct causation is not a focal point. Visual displays of data are often viewed as a nice accompaniment but not an essential piece. However, graphs and charts help to convey inferential and descriptive statistics (Larson-Hall & Plonsky, 2015). This analysis will contain visual displays in order to inform the reader of relevant data and findings.

### Data Collection

There are no participants in this study. Instead data will be collected through a text analysis of bound morphemes found in a sampling of K-12 science text passages used in K-12 classrooms. I will use samples that are approximately equal in word count.

### Text Analysis Procedure

The focus of the research will be on recording the frequency and various types of inflectional and derivational morphemes. This will offer a snapshot of the overall bound morpheme frequency in standard passages by grade level. Inflectional morphemes will be underlined and the free morpheme it is attached to will be noted in a table. Derivational morphemes will be in bold. A chart will display the count of inflectional, derivational, and free morphemes in each sampled text.

### Text Analysis Criteria

I will choose science texts because they contain many of the complex academic language characteristics aforementioned. These science texts will be expository in nature. Research shows that nationwide, students struggle comprehending and using scientific language. Science language is built upon multiple levels of observations and facts, which make it particularly information dense. One text from each grade level will be analyzed in order to create a comparative sample. I will choose samples of similar word count without editing or cutting off sentences. Lower level grade texts tend to be shorter, and in some cases, a whole book may be sampled in order to collect a data sample of substance.

### Preliminary Analysis

A sample third grade science book was chosen and analyzed in order to complete a preliminary draft of this capstone for Research Methods class. This was only a preliminary analysis but it gives an indication of the process used to identify and record bound morpheme changes. The following page contains the sample and analysis of inflectional and derivational morphemes in a third grade science text.

## Grade 3 Text Analysis 1: Planet Jupiter (p. 23)

Title: The Moons of Jupiter

Jupiter has a lot of moons – 67 at last count. Jupiter's strong gravity is the reason the planet has so many moons. Some were small asteroids that came too close to Jupiter and were pulled into orbit. Not all of Jupiter's moons are captured asteroids. The four largest are similar in size to Earth's moon.

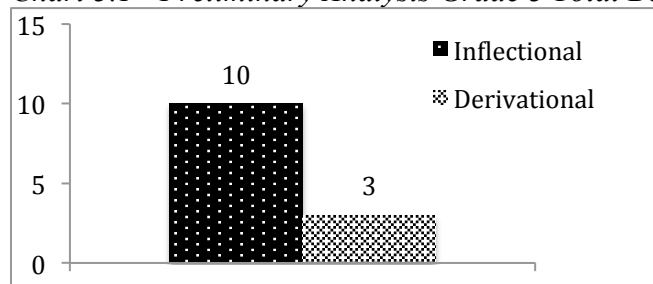
Table 3.1 – Preliminary Analysis Grade 3 Inflectional Morphemes

| Inflection form                          |     | Free morphemes | Quantity |
|--|-----|----------------|----------|
| noun plural                              | s   | Moon, asteroid | 5        |
| noun possessive                          | 's  | Jupiter        | 2        |
| verb present tense third person singular | s   |                | 0        |
| verb present participle/gerund           | ing |                | 0        |
| verb simple past tense                   | ed  | Pull, capture  | 2        |
| verb past perfect                        | en  |                | 0        |
| adjective comparative                    | er  |                | 0        |
| adjective superlative                    | est | large          | 1        |
|  |     | Total          | 10       |

Table 3.2 - Preliminary Analysis Grade 3 Derivational Affixes

| Word     | Prefix | Suffix | Derivational Meaning             | Quantity |
|----------|--------|--------|----------------------------------|----------|
| Gravity  |        | -ity   | Quality of (having weight)       | 1        |
| Asteroid |        | -oid   | Having structure of (aster/star) | 2        |
|          |        |        | Total                            | 3        |

Chart 3.1 - Preliminary Analysis Grade 3 Total Bound Morphemes



### Chapter Three Summary

Chapter 3 provided the methodology for this comparative text analysis study. It contained a preliminary study to display how information will be presented in Chapter 4. This is a quantitative research project to investigate the frequency of derivational and inflectional morphemes in K-12 science texts through the aforementioned text analysis process. My research question relates to bound morpheme frequency in K-12 science texts and whether it increases by grade level. If so, are inflectional or derivational morphemes more prevalent?

After completing the analysis, I will use my guiding questions to help interpret results in Chapter 4 and draw conclusions in Chapter 5. In particular, what types of bound morphemes were most prevalent? I predict that derivational morphemes in texts will increase by grade level but I am uncertain by how much. There is a seemingly limitless amount of derivational morphemes in the English language but will certain ones appear more frequently than others in this comparative text analysis? Could an understanding of these frequent morpheme structures aid in K-12 science reading comprehension? These are the questions I am interested in better understanding after completing the study.

## CHAPTER FOUR: RESULTS

My research question is: does bound morpheme frequency in science texts increase by grade level and if so, are inflectional or derivational morphemes more prevalent? This study investigated the frequency of inflectional and derivational morphemes in a random sampling of K-12 science texts. The following analysis offers insight into the frequency of bound morpheme in general K-12 science passages. Before delving into the analysis, the collection method and criteria will be presented.

### Collection Method and Criteria

Texts were analyzed by grade level in order to ascertain which bound morpheme forms are most prevalent as students tackle more challenging readings in higher-level grades. Inflectional morphemes are underlined and the free morpheme it is attached to is noted in a corresponding table. Derivational morphemes bolded and categorized by prefix or suffix. Additional data on etymology of affixes and percentage breakdowns are also presented.

All texts analyzed were expository passages with a word count between 34-48. Lower grade books contained far fewer words and in some cases an entire book was used for the sample grade text. Higher-grade level texts contained a far greater amount of passages so the sample text was chosen randomly and represents a small fraction of the overall text. Frequency totals are based on the number of inflections and affixes in a passage. In some cases, a word containing an inflection or affix appeared multiple times in a passage. Each instance of the bound morpheme was noted and counted towards the overall frequency. Sentences were not cut off in order to



retain the text's full meaning. The etymology of derivational affixes was researched using the Oxford English Dictionary. All text samples originate from textbooks currently in use in K-12 classrooms.

## K-12 Text Analyses

Grade K – Is It Heavy or Light? (pp. 2-8). Word Count: 34

This brick is heavy. This feather is light. This pumpkin is heavy. This glass is light. This box is heavy. This glass is light. This box is heavy. This egg is light. Are you heavy or light?

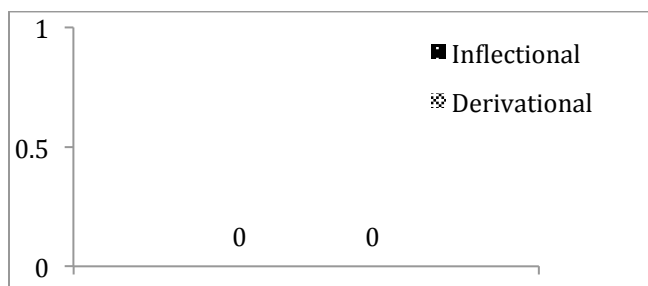
*Table 4.1 - Grade K Inflectional Morphemes*

| Inflection form                          |      | Root words | Frequency |
|--|------|------------|-----------|
| noun plural                              | -s   |            | 0         |
| noun possessive                          | -'s  |            | 0         |
| verb present tense third person singular | -s   |            | 0         |
| verb present participle/gerund           | -ing |            | 0         |
| verb simple past tense                   | -ed  |            | 0         |
| verb past perfect                        | -en  |            | 0         |
| adjective comparative                    | -er  |            | 0         |
| adjective superlative                    | -est |            | 0         |
|  |      | Total      | 0         |

*Table 4.2 - Grade K Derivational Affixes*

| Word | Prefix | Suffix | Derivational Meaning | Frequency |
|------|--------|--------|----------------------|-----------|
| NA   |        |        |                      | 0         |
|      |        |        | Total                | 0         |

*Chart 4.1 - Grade K Total Bound Morphemes*



Grade 1 – Ways Things Move (pp. 2-6). Word Count: 37

A force is a push or a pull. Forces make things move in different ways. Children walk in a straight line. A train moves in a straight line. A crayon draws a zigzag line.

Table 4.3 - Grade 1 Inflectional Morphemes

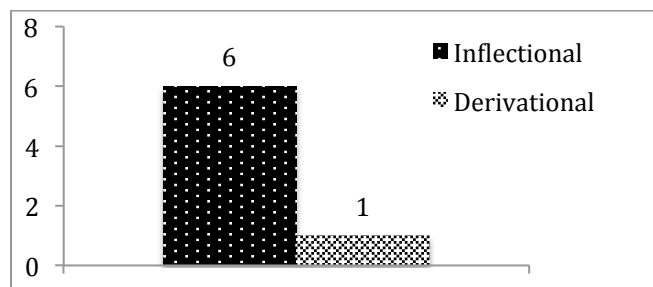
| Inflection Types                         | Form      | Root words                | Frequency |
|--|-----------|---------------------------|-----------|
| noun plural                              | -s, -ren* | Force, thing, way, child* | 4         |
| noun possessive                          | -'s       |                           | 0         |
| verb present tense third person singular | -s        | Move, draw                | 2         |
| verb present participle/gerund           | -ing      |                           | 0         |
| verb simple past tense                   | -ed       |                           | 0         |
| verb past perfect (irregular)            | -en       |                           | 0         |
| adjective comparative                    | -er       |                           | 0         |
| adjective superlative                    | -est      |                           | 0         |
| Total                                    |           |                           | 6         |

\* Irregular plural inflection

Table 4.4 - Grade 1 Derivational Affixes

| Word      | Prefix | Suffix | Derivational Meaning                    | Frequency |
|-----------|--------|--------|---|-----------|
| Different |        | -ent   | Inclined to, something that is (differ) | 1         |
| Total     |        |        |   | 1         |

Chart 4.2 - Grade 1 Total Bound Morphemes



Grade 2 – My Bean Plant (pp. 7-8). Word Count: 40

I check on the seeds. They are starting to grow. I can see a root growing from the bottom of a seed. I can see a shoot growing from the top of a seed. My bean plant is growing bigger.

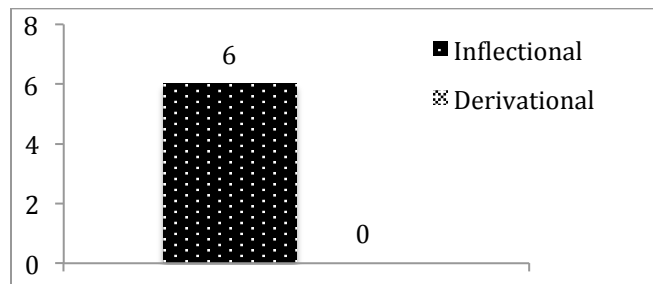
*Table 4.5 - Grade 2 Inflectional Morphemes*

| Inflection Types                         | Form | Root words  | Frequency |
|--|------|-------------|-----------|
| noun plural                              | -s   | seed        | 1         |
| noun possessive                          | -'s  |             | 0         |
| verb present tense third person singular | -s   |             | 0         |
| verb present participle/gerund           | -ing | start, grow | 4         |
| verb simple past tense                   | -ed  |             | 0         |
| verb past perfect                        | -en  |             | 0         |
| adjective comparative                    | -er  | big         | 1         |
| adjective superlative                    | -est |             | 0         |
| Total                                    |      |             | 6         |

*Table 4.6 - Grade 2 Derivational Affixes*

| Word  | Prefix | Suffix | Derivational Meaning | Frequency |
|-------|--------|--------|----------------------|-----------|
| NA    |        |        |                      | 0         |
| Total |        |        |                      | 0         |

*Chart 4.3 - Grade 2 Total Bound Morphemes*



Grade 3 – Using Your Senses (p. 5). Word Count: 35

What is the first thing you notice about someone's eyes? You probably look at the color. The ring of color is called the iris. The hole in the middle of the iris is the pupil.

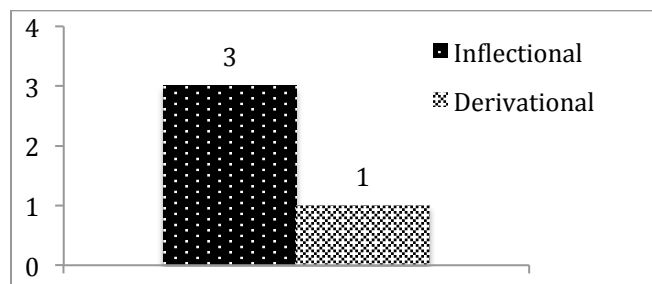
*Table 4.7 - Grade 3 Inflectional Morphemes*

| Inflection Types                         | Form | Root words | Frequency |
|--|------|------------|-----------|
| noun plural                              | -s   | eye        | 1         |
| noun possessive                          | -'s  | someone    | 1         |
| verb present tense third person singular | -s   |            | 0         |
| verb present participle/gerund           | -ing |            | 0         |
| verb simple past tense                   | -ed  | call       | 1         |
| verb past perfect                        | -en  |            | 0         |
| adjective comparative                    | -er  |            | 0         |
| adjective superlative                    | -est |            | 0         |
| Total                                    |      |            | 3         |

*Table 4.8 - Grade 3 Derivational Affixes*

| Word     | Prefix | Suffix | Derivational Meaning               | Frequency |
|----------|--------|--------|------------------------------------|-----------|
| Probably |        | -ly    | To act in a way that is (probable) | 1         |
| Total    |        |        |                                    | 1         |

*Chart 4.4 - Grade 3 Total Bound Morphemes*



Grade 4 – Animals Called Mammals (p. 11). Word Count: 40

Coming up for air. Fish can breathe under water, but mammals cannot. Mammals that live in water must swim to the surface of the water to breathe air. Dolphins are mammals that live in water. They breathe air through blowholes.

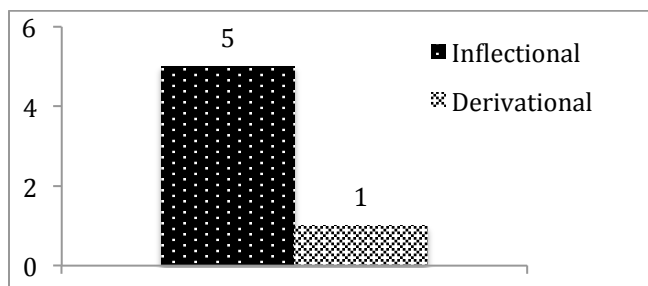
Table 4.9 - Grade 4 Inflectional Morphemes

| Inflection Types                         | Form | Root words                | Frequency |
|--|------|---------------------------|-----------|
| noun plural                              | -s   | mammal, dolphin, blowhole | 4         |
| noun possessive                          | -'s  |                           | 0         |
| verb present tense third person singular | -s   |                           | 0         |
| verb present participle/gerund           | -ing | come                      | 1         |
| verb simple past tense                   | -ed  |                           | 0         |
| verb past perfect                        | -en  |                           | 0         |
| adjective comparative                    | -er  |                           | 0         |
| adjective superlative                    | -est |                           | 0         |
| Total                                    |      |                           | 5         |

Table 4.10 - Grade 4 Derivational Affixes

| Word    | Prefix | Suffix | Derivational Meaning      | Frequency |
|---------|--------|--------|---------------------------|-----------|
| Surface | Sur    |        | Over, above the (face of) | 1         |
| Total   |        |        |                           | 1         |

Chart 4.5 - Grade 4 Total Bound Morphemes



Grade 5 – Great Inventions (p. 9). Word Count: 41

Printing moved into a new era with the invention of the printing press in 1438. Johannes Guttenberg, a German goldsmith, made printing with blocks cheaper and easier by using movable type. He fit together small metal letters on a frame.

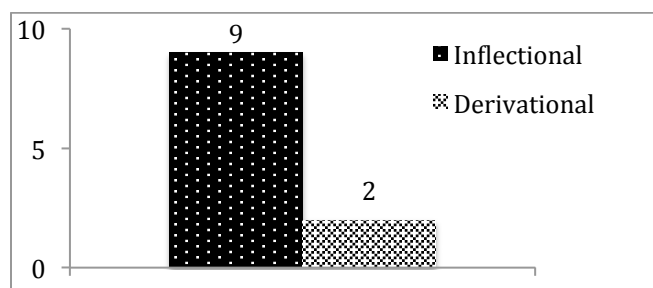
*Table 4.11 - Grade 5 Inflectional Morphemes*

| Inflection Types                         | Form | Root words    | Frequency |
|--|------|---------------|-----------|
| noun plural                              | -s   | block, letter | 2         |
| noun possessive                          | -'s  |               | 0         |
| verb present tense third person singular | -s   |               | 0         |
| verb present participle/gerund           | -ing | print, use    | 4         |
| verb simple past tense                   | -ed  | move          | 1         |
| verb past perfect                        | -en  |               | 0         |
| adjective comparative                    | -er  | cheap, easy   | 2         |
| adjective superlative                    | -est |               | 0         |
|  |      | Total         | 9         |

*Table 4.12 - Grade 5 Derivational Affixes*

| Word      | Prefix | Suffix | Derivational Meaning                              | Frequency |
|-----------|--------|--------|---|-----------|
| Invention |        | -ion   | Indicating action, process, or condition (invent) | 1         |
| Movable   |        | -able  | Capable of (movement)                             | 1         |
|           |        |        | Total   | 2         |

*Chart 4.6 - Grade 5 Total Bound Morphemes*



Grade 6 – Introduction to Matter (p.70). Word Count: 42

The particles in a colloid are much smaller than the particles in a suspension. However, the particles are large enough to scatter light. A colloid cannot be separated by filtration. The particles are small enough to pass through a filter.

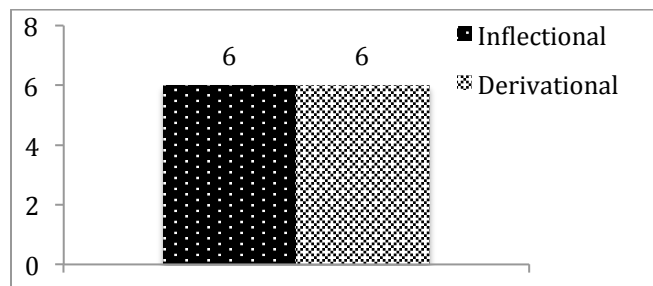
Table 4.13 - Grade 6 Inflectional Morphemes

| Inflection Types                         | Form | Root words | Frequency |
|--|------|------------|-----------|
| noun plural                              | -s   | particle   | 4         |
| noun possessive                          | -'s  |            | 0         |
| verb present tense third person singular | -s   |            | 0         |
| verb present participle/gerund           | -ing |            | 0         |
| verb simple past tense                   | -ed  | separate   | 1         |
| verb past perfect                        | -en  |            | 0         |
| adjective comparative                    | -er  | small      | 1         |
| adjective superlative                    | -est |            | 0         |
|  |      | Total      | 6         |

Table 4.14 - Grade 6 Derivational Affixes

| Word       | Prefix | Suffix | Derivational Meaning                               | Frequency |
|------------|--------|--------|--|-----------|
| Particles  |        | -cle   | Indicating diminutive (part)                       | 4         |
| Suspension |        | -ion   | Indicating action, process, or condition (suspend) | 1         |
| Filtration |        | -ion   | Indicating action, process, or condition (filter)  | 1         |
|            |        |        | Total  | 6         |

Chart 4.7 - Grade 6 Total Bound Morphemes





Grade 7 – Human Body Systems and Health (p. 61). Word Count: 43

The stomach continues the **mechanical digestion** of your meal by **squeezing** the food with **muscular contractions**. While this **squeezing** is **taking** place, tiny **glands** in the stomach produce **enzymes** and acid. The **enzymes** and acid work together to break food into **nutrients**.

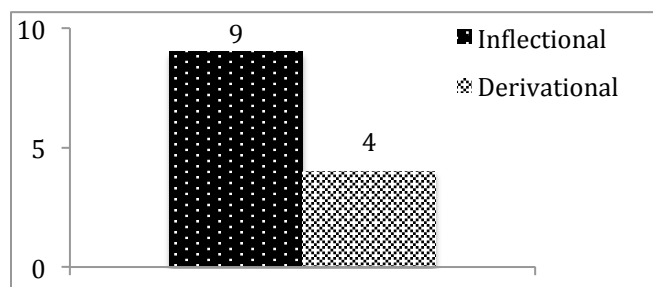
Table 4.15 - Grade 7 Inflectional Morphemes

| Inflection Types                         | Form | Root words                           | Frequency |
|--|------|--------------------------------------|-----------|
| noun plural                              | -s   | contraction, gland, enzyme, nutrient | 5         |
| noun possessive                          | -'s  |                                      | 0         |
| verb present tense third person singular | -s   | continue                             | 1         |
| verb present participle/gerund           | -ing | squeeze, take                        | 3         |
| verb simple past tense                   | -ed  |                                      | 0         |
| verb past perfect                        | -en  |                                      | 0         |
| adjective comparative                    | -er  |                                      | 0         |
| adjective superlative                    | -est |                                      | 0         |
| Total                                    |      |                                      | 9         |

Table 4.16 - Grade 7 Derivational Affixes

| Word        | Prefix | Suffix | Derivational Meaning                                | Frequency |
|-------------|--------|--------|---|-----------|
| Mechanical  |        | -ical  | Of or pertaining to (mechanic)                      | 1         |
| Digestion   |        | -ion   | Indicating action, process, or condition (digest)   | 1         |
| Muscular    |        | -ular  | Related to or resembling (muscle)                   | 1         |
| Contraction |        | -ion   | Indicating action, process, or condition (contract) | 1         |
| Total       |        |        |   | 4         |

Chart 4.8 - Grade 7 Total Bound Morphemes



Grade 8 – Inside the Restless Earth (p. 68). Word Count: 37

The most common type of **unconformity** is a **disconformity**, which is illustrated in figure 5.

**Disconformities** are found where part of a sequence of parallel rock layers is missing. A

**disconformity** can form in the following way.

*Table 4.17 - Grade 8 Inflectional Morphemes*

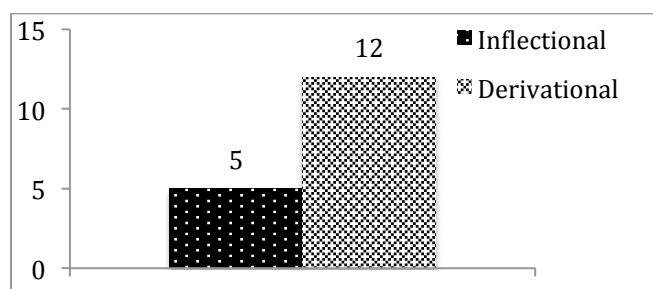
| Inflection Types                         | Form | Root words           | Frequency |
|--|------|----------------------|-----------|
| noun plural                              | -s   | disconformity, layer | 2         |
| noun possessive                          | -'s  |                      | 0         |
| verb present tense third person singular | -s   |                      | 0         |
| verb present participle/gerund           | -ing | miss, follow         | 2         |
| verb simple past tense                   | -ed  | illustrate           | 1         |
| verb past perfect                        | -en  |                      | 0         |
| adjective comparative                    | -er  |                      | 0         |
| adjective superlative                    | -est |                      | 0         |
| Total                                    |      |                      | 5         |

*Table 4.18 - Grade 8 Derivational Affixes*

| Word          | Prefix | Suffix        | Derivational Meaning                | Frequency |
|---------------|--------|---------------|-------------------------------------|-----------|
| Disconformity | dis-   |               | Indicating opposite of (conform)    | 3         |
| Disconformity | con-   |               | Indicating together or with (form)  | 3         |
| Disconformity |        | -ity, *-ities | State or quality of (disconforming) | 3         |
| Unconformity  | un-    |               | Indicating negative of (conform)    | 1         |
| Unconformity  | con-   |               | Indicating together or with (form)  | 1         |
| Unconformity  |        | -ity          | State or quality of (unconforming)  | 1         |
| Total         |        |               |                                     | 12        |

\*Plural form of suffix

*Chart 4.9 - Grade 8 Total Bound Morphemes*



Grade 9 – Conceptual Physics (p. 266). Word Count: 40

The **triangle** is the strongest shape for building. You have probably noticed **triangular** shapes in steel bridges, sports domes, and the framed corners of homes. The **triangle** is the only shape that does not twist and collapse when under **pressure**.

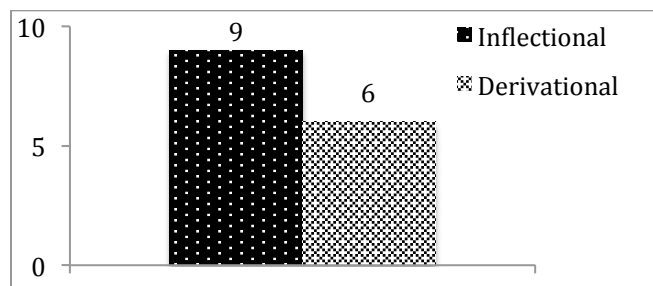
*Table 4.19 - Grade 9 Inflectional Morphemes*

| Inflection Types                         | Form | Root words                               | Frequency |
|--|------|--|-----------|
| noun plural                              | -s   | shape, bridge, sport, dome, corner, home | 6         |
| noun possessive                          | -'s  |  | 0         |
| verb present tense third person singular | -s   |  | 0         |
| verb present participle/gerund           | -ing | build                                    | 1         |
| verb simple past tense                   | -ed  | frame                                    | 1         |
| verb past perfect                        | -en  |  | 0         |
| adjective comparative                    | -er  |  | 0         |
| adjective superlative                    | -est | strong                                   | 1         |
| Total                                    |      |  | 9         |

*Table 4.20 - Grade 9 Derivational Affixes*

| Word       | Prefix | Suffix | Derivational Meaning                | Frequency |
|------------|--------|--------|-------------------------------------|-----------|
| Triangle   | tri-   |        | Indicating three (angles)           | 3         |
| Triangular |        | -ular  | Related to or resembling (triangle) | 1         |
| Probably   |        | -ly    | To act in a way that is (probable)  | 1         |
| Pressure   |        | -ure   | Action or condition of (pressing)   | 1         |
| Total      |        |        |                                     | 6         |

*Chart 4.10 - Grade 9 Total Bound Morphemes*



Grade 10 – Biology Visualizing Life (p. 344). Word Count: 44

**Antibiotic resistance** evolves in bacteria in a number of ways. For example, every time an **antibiotic** is used, it kills the majority of bacteria. But the few bacteria that remain alive after **treatment** with an **antibiotic** will **reproduce**, as you can see in figure 18-13.

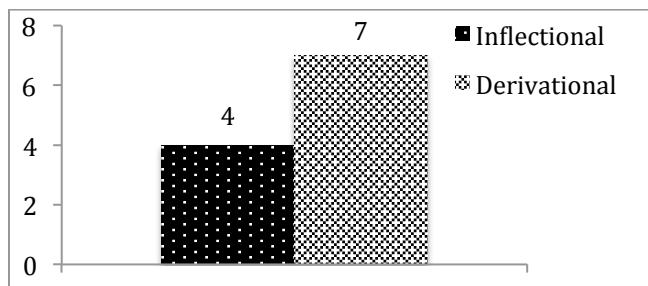
*Table 4.21 - Grade 10 Inflectional Morphemes*

| Inflection Types                         | Form | Root words   | Frequency |
|--|------|--------------|-----------|
| noun plural                              | -s   | way          | 1         |
| noun possessive                          | -'s  |              | 0         |
| verb present tense third person singular | -s   | evolve, kill | 2         |
| verb present participle/gerund           | -ing |              | 0         |
| verb simple past tense                   | -ed  | use          | 1         |
| verb past perfect                        | -en  |              | 0         |
| adjective comparative                    | -er  |              | 0         |
| adjective superlative                    | -est |              | 0         |
| Total                                    |      |              | 4         |

*Table 4.22 - Grade 10 Derivational Affixes*

| Word       | Prefix | Suffix | Derivational Meaning                             | Frequency |
|------------|--------|--------|--|-----------|
| Antibiotic | Anti-  |        | Indicating opposition to (biotic)                | 3         |
| Resistance |        | -ance  | Indicating an action or condition of (resisting) | 1         |
| Majority   |        | -ity   | State or quality of being (major)                | 1         |
| Treatment  |        | -ment  | State or act of (treating)                       | 1         |
| Reproduce  | Re-    |        | Indicating repetition of an action (producing)   | 1         |
| Total      |        |        |  | 7         |

*Chart 4.11 - Grade 10 Total Bound Morphemes*



Grade 11 – Physics for Scientists and Engineers (p. 269). Word Count: 48

This **expression** shows that the **gravitational** **potential** energy for any pair of **particles** varies as  $1/r$ , whereas the force between them varies as  $1/r^2$ . Furthermore, the **potential** energy is **negative** because the force is **attractive** and we have **chosen** the **potential** energy as zero when the **particle** **separation** is **infinite**.

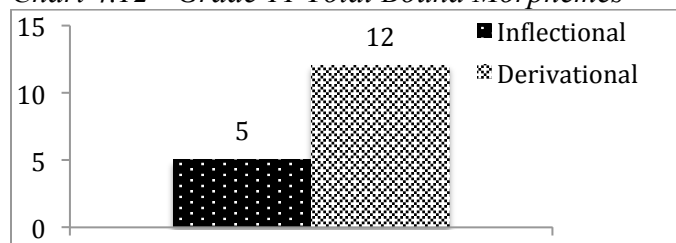
Table 4.23 - Grade 11 Inflectional Morphemes

| Inflection Types                         | Form | Root words    | Frequency |
|--|------|---------------|-----------|
| noun plural                              | -s   | Particle      | 1         |
| noun possessive                          | 's   |               | 0         |
| verb present tense third person singular | -s   | Shows, varies | 3         |
| verb present participle/gerund           | -ing |               | 0         |
| verb simple past tense                   | -ed  |               | 0         |
| verb past perfect                        | -en  | Chosen        | 1         |
| adjective comparative                    | -er  |               | 0         |
| adjective superlative                    | -est |               | 0         |
| Total                                    |      |               | 5         |

Table 4.24 - Grade 11 Derivational Affixes

| Word          | Prefix | Suffix | Derivational Meaning                                   | Frequency |
|---------------|--------|--------|--|-----------|
| Expression    |        | -ion   | Indicating action, process, or condition (express)     | 1         |
| Gravitational |        | -ion   | Indicating action, process, or condition (grave/heavy) | 1         |
| Gravitational |        | -al    | Relating to (gravitation)                              | 1         |
| Potential     |        | -ial   | Relating to (potent)                                   | 3         |
| Particles     |        | -cle   | Indicating diminutive (part)                           | 2         |
| Negative      |        | -ive   | Relating to (negate)                                   | 1         |
| Attractive    |        | -ive   | Relating to (attract)                                  | 1         |
| Separation    |        | -ion   | Indicating action, process, or condition (separate)    | 1         |
| Infinite      | In-    |        | Indicating not (finite)                                | 1         |
| Total         |        |        |  | 12        |

Chart 4.12 - Grade 11 Total Bound Morphemes



Grade 12 – Chemistry (p. 654). Word Count: 48

An **oxidation** number is a **positive** or **negative** number assigned to an atom according to a set of rules. Oxidation numbers can be thought of as a **chemical** bookkeeping device. As you will learn in section 22.5, complex redox equations can be balanced by the use of oxidation-number changes.

Table 4.25 - Grade 12 Inflectional Morphemes

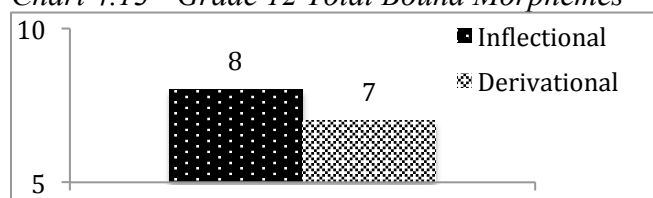
| Inflection Types                         | Form | Root words                     | Frequency |
|--|------|--------------------------------|-----------|
| noun plural                              | -s   | Rule, number, equation, change | 4         |
| noun possessive                          | -'s  |                                | 0         |
| verb present tense third person singular | -s   |                                | 0         |
| verb present participle/gerund           | -ing | Accord, bookkeep               | 2         |
| verb simple past tense                   | -ed  | Assign, balance                | 2         |
| verb past perfect                        | -en  |                                | 0         |
| adjective comparative                    | -er  |                                | 0         |
| adjective superlative                    | -est |                                | 0         |
| Total                                    |      |                                | 8         |

Table 4.26 - Grade 12 Derivational Affixes

| Word      | Prefix | Suffix | Derivational Meaning  | Frequency |
|-----------|--------|--------|---|-----------|
| Oxidation |        | -ion   | Indicating action, process, or condition (*oxidate/oxidize) | 3         |
| Positive  |        | -ive   | Relating to (posit)   | 1         |
| Negative  |        | -ive   | Relating to (negate)  | 1         |
| Chemical  |        | -ical  | Of or pertaining to (**chem)                                | 1         |
| Equation  |        | -ion   | Indicating action, process, or condition (equate)           | 1         |
| Total     |        |        |   | 7         |

\*Antiquated form, \*\* Colloquialism for chemistry

Chart 4.13 - Grade 12 Total Bound Morphemes



## Results of K-12 Text Analysis

The research question in this study dealt with determining the frequency of bound morphemes in their two distinct forms, inflectional and derivational, in K-12 science passages. This study allowed for a more in-depth look at this important grammatical aspect that plays a prominent role in higher academic language.

There are several limitations to this comparative text analysis, which will be addressed in Chapter 5. Nevertheless the data collected directly connects to my research question and guiding questions that dealt with lexical variations in science passages and how students could better understand these changes. It also helped to answer whether the understanding of morpheme structures could aid in lexical and passage level reading comprehension? The results of this study will be further investigated in Chapter 5.

The reader should refer to the appropriate grade level text analysis for more detailed information such as root words, corresponding inflections, inflectional frequency, derivational frequency, and word count. In addition, noteworthy points and trends will be presented following the K-12 grade level text analyses. The findings from the inflectional data will be presented first because inflections were the first type of bound morphemes to appear in lower level grade text samples.

### Inflectional Morpheme Variations

There were no bound morphemes at all in the kindergarten sample text. This changed in the Grade 1 sample text. Table 4.3 shows there were 6 inflections in Grade 1, primarily the plural –s form. By Grade 2, a wider variety of inflections appeared in the text. Table 4.5 lists four

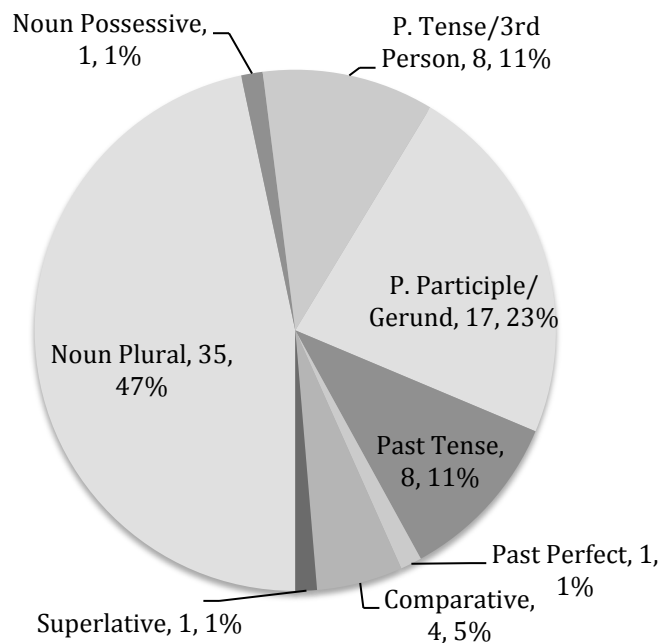
instances of the *-ing* form used to indicate the present participle/gerund. In addition the first instance of a comparative appeared in Grade 2.

In the Grade 3 sample, the first instance of the possessive *-s* and past tense *-ed* appeared as Table 4.7 illustrates. Although the majority of inflection types appeared by Grade 3, it was not until the Grade 11 text analysis that all inflection types were represented. The last one to be recorded was the past perfect inflection *-en* as Table 4.23 illustrates.

It is important to note that while there were multiple types of inflections in each grade level text analysis, plural inflections were present in every text analysis except kindergarten.

Chart 4.14 shows which plural inflections were most prominent in comparison to less frequent types. While plurals accounted for 43% of total inflections, other inflection types appeared frequently too. The present participle/gerund form *-ing* accounted for 23% of inflections. Both the simple past tense inflection *-ed* and the 3<sup>rd</sup> person present tense singular inflection *-s* were equal in frequency. Each type accounted for 11% of total inflections. The remaining categories of inflections accounted for the other 8% of the overall total.

*Chart 4.14 – K-12 Inflectional Morphemes by Category: Frequency and Percent*





### K-12 Inflectional Frequency

The average inflection frequency percentage for all text analyses was 14%, 4% greater than the average derivational frequency percentage of 10%. Only three text analyses had inflection percentages below 10% while some had percentages much higher. In particular, Grades 5, 7, and 9 all had inflection frequency percentages above 20%. While there were consecutive grades with large jumps in inflectional frequency, such as grades 3-5, it did not consistently increase every grade level. Certain grade levels even had a significant drop in inflections. For example, the Grade 9 text analysis had an inflection percentage of 23% but in Grade 10 it dropped to 9%. Table 4.27 shows the difference in percentage of inflections versus total word count.

Except for Kindergarten, all text analyses contained at least two types of inflections and many contained three. Grades 5 and 9 were noteworthy because they contained four different types of inflections.

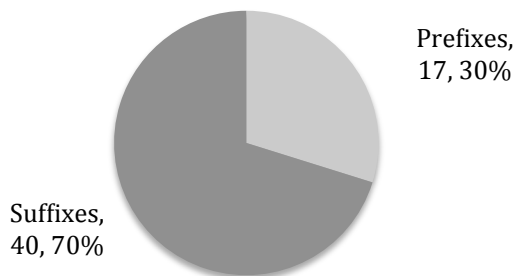
*Table 4.27 – K-12 Inflectional Morpheme Percentage by Grade*

|              | Inflectional<br>Morpheme<br>Frequency | Total<br>Word<br>Count | Inflectional<br>Morpheme<br>Percentage in<br>Text |
|--------------|---------------------------------------|------------------------|---|
| Kindergarten | 0                                     | 34                     | 0%  |
| Grade 1      | 6                                     | 37                     | 16%   |
| Grade 2      | 6                                     | 40                     | 15%   |
| Grade 3      | 3                                     | 35                     | 9%  |
| Grade 4      | 5                                     | 40                     | 13%   |
| Grade 5      | 9                                     | 41                     | 22%   |
| Grade 6      | 6                                     | 42                     | 14%   |
| Grade 7      | 9                                     | 43                     | 21%   |
| Grade 8      | 5                                     | 37                     | 14%   |
| Grade 9      | 9                                     | 40                     | 23%   |
| Grade 10     | 4                                     | 44                     | 9%  |
| Grade 11     | 5                                     | 48                     | 10%   |
| Grade 12     | 8                                     | 48                     | 17%   |
| K-12 Total   | 75                                    | 529                    | 14%   |

### Derivational Morphemes

While there are 8 types of inflectional morphemes, there is a seemingly endless amount of derivational affixes. One important insight from the data gathered was the frequency of prefixes versus suffixes in Grade 1-12 sampled passages. As chart 4.15 shows, 70% of the derivational morphemes in the text analyses were suffixes.

*Chart 4.15 - K-12 Derivational Affixes Total and Percentage*



### Derivational Prefixes

8 different derivational prefixes were recorded from the K-12 text analyses. The frequency of these prefixes is shown in chart 4.16. The etymology of these prefixes is listed in table 4.27. Etymology was evaluated because of possible implications between cognates and second language acquisition. With the exception of two prefixes, *un* and *anti*, all prefixes are derived from two Romance languages: French and Latin.

Chart 4.16 - K-12 Derivational Prefix Frequency

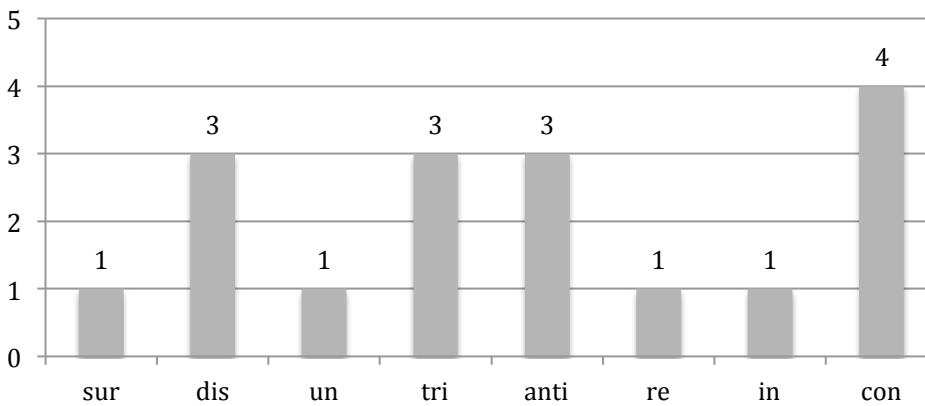


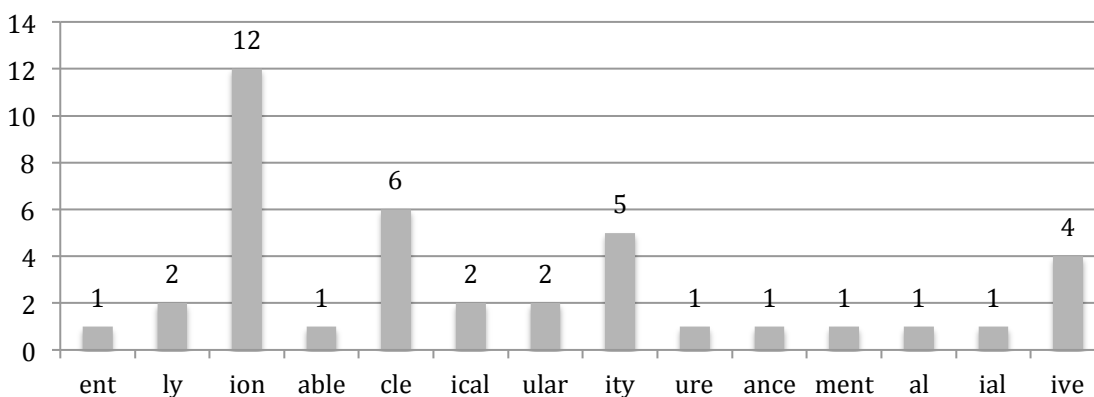
Table 4.27 – K-12 Derivational Prefix Morpheme Etymology and Frequency

| Derivational Prefix | Etymology     | Frequency |
|---------------------|---------------|-----------|
| Sur-                | French        | 1         |
| Dis-                | Latin         | 3         |
| Un-                 | Old English   | 1         |
| Tri-                | Latin         | 3         |
| Anti-               | Greek         | 3         |
| Re-                 | French, Latin | 1         |
| In-                 | Latin         | 1         |
| Con                 | Latin         | 4         |
|                     | Total         | 17        |

### Derivational Suffixes

14 different derivational suffixes were recorded from the K-12 text analyses. The frequency of these suffixes is shown in chart 4.17. The etymology of these suffixes is listed in table 4.28. Similar to the prefixes, the majority of suffixes were derived from French and Latin. Only the suffix *-ly* had an origin from another language other than French or Latin.

*Chart 4.17 - K-12 Derivational Suffix Frequency*



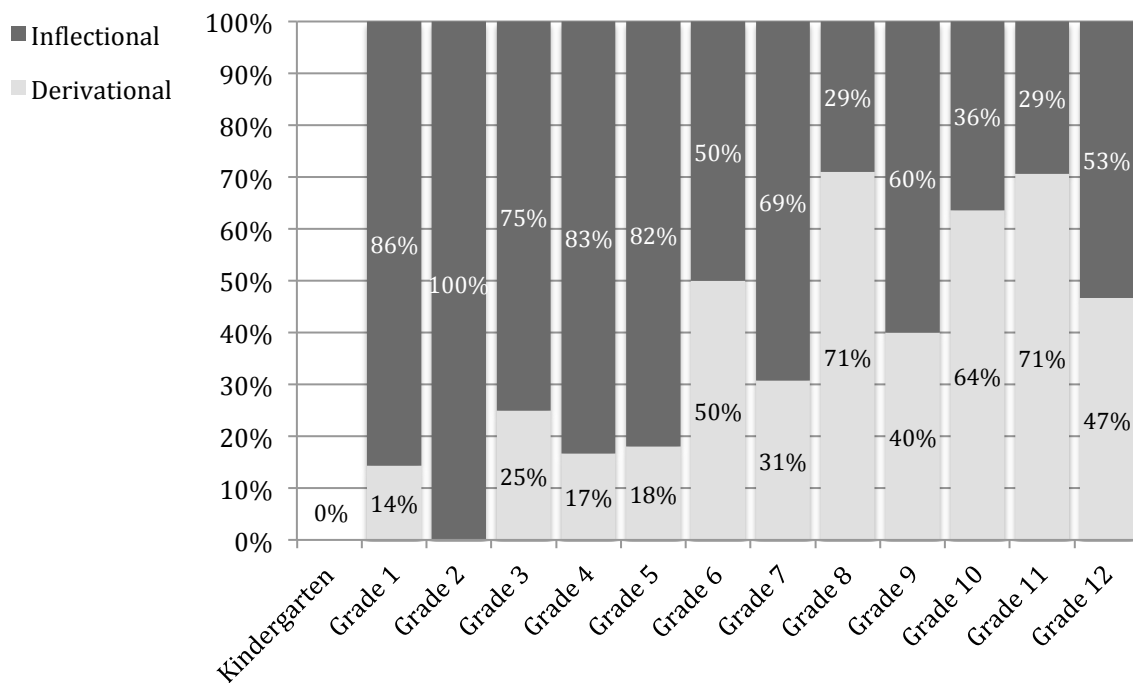
*Table 4.28 – K-12 Derivational Suffix Morpheme Etymology and Frequency*

| Derivational Suffix | Etymology     | Frequency |
|---------------------|---------------|-----------|
| -ent                | French, Latin | 1         |
| -ly                 | Old English   | 2         |
| -ion                | French        | 12        |
| -able               | French        | 1         |
| -cle                | French, Latin | 6         |
| -ical               | Latin         | 2         |
| -ular               | Latin         | 2         |
| -ity                | French, Latin | 5         |
| -ure                | French, Latin | 1         |
| -ance               | French, Latin | 1         |
| -ment               | French        | 1         |
| -al                 | French        | 1         |
| -ial                | Latin         | 1         |
| -ive                | French, Latin | 4         |
|                     | <b>Total</b>  | <b>40</b> |

### Percentage of Bound Morphemes by Type

The percentage of inflections in each grade level passage was erratic. However, comparing inflections to derivations showed an increasing trend towards derivational morphemes in higher-grade level texts. Unlike inflections, which appeared several times in the Grade 1 sample, derivations were not as frequent until the Grade 6 sample. However, from Grade 6-12, derivations accounted for 31%-71% of all bound morphemes in text samples. Chart 4.18 illustrates the upward trend of derivational morpheme frequency in higher-grade level texts. It is noteworthy that 17%-25% of all bound morphemes in Grade 3-5 texts were derivational so they appeared in elementary grade texts, albeit less frequently.

*Chart 4.18 - K-12 Bound Morphemes by Percentage*



Although the average frequency of derivations for all K-12 text analyses was lower than the average frequency of inflections, derivations tended to increase more steadily in higher-grade level texts.

Table 4.19 shows the percentage of derivational morphemes based on the total word count. Unlike inflectional frequency, which accounted for anywhere between 9% and 22% in elementary grade level text samples, derivational frequency percentage was no more than 5% until Grade 6. It was not until Grade 6 that derivations reached a frequency of at least 10%.

*Table 4.19 – K-12 Derivational Morpheme Percentage by Grade*

|              | Derivational<br>Morpheme<br>Frequency | Total<br>Word<br>Count | Derivational<br>Morpheme<br>Percentage in<br>Text |
|--------------|---------------------------------------|------------------------|---|
| Kindergarten | 0                                     | 34                     | 0%  |
| Grade 1      | 1                                     | 37                     | 3%  |
| Grade 2      | 0                                     | 40                     | 0%  |
| Grade 3      | 1                                     | 35                     | 3%  |
| Grade 4      | 1                                     | 40                     | 3%  |
| Grade 5      | 2                                     | 41                     | 5%  |
| Grade 6      | 6                                     | 42                     | 14%   |
| Grade 7      | 4                                     | 43                     | 9%  |
| Grade 8      | 12                                    | 37                     | 32%   |
| Grade 9      | 6                                     | 40                     | 13%   |
| Grade 10     | 7                                     | 44                     | 16%   |
| Grade 11     | 12                                    | 48                     | 25%   |
| Grade 12     | 7                                     | 48                     | 15%   |
| Total K-12   | 52                                    | 529                    | 10%   |

#### Chapter 4 Summary

My research question was whether bound morpheme frequency in science texts increases by grade level and if so, are inflectional or derivational morphemes more prevalent? It was answered through the results of this K-12 comparative text analysis. Additional insight was also gained about which types of bound morphemes appear in common K-12 science texts. In particular, the results showed that suffixes appear more frequently than prefixes. The majority of

affixes were from either Latin or French. Inflectional morphemes appeared first in the Grade 1 sample. Derivational morphemes were not present in earlier grade texts but became prominent by the Grade 6 sample. Since derivational morphemes are less straightforward than inflectional morphemes, additional information was recorded in an effort to better understand how their different variations might affect second language acquisition. The etymology of derivational morphemes was recorded along with the frequency of prefixes and suffixes.

There are several limitations to this comparative text analysis that prevented overgeneralizing the results from this study. These limitations will be addressed in Chapter 5.

## CHAPTER 5 CONCLUSIONS

### Chapter Overview

The goal of this comparative text analysis was to record the frequency of bound morphemes in K-12 science passages. The main reason behind completing this study was to better understand the increasing frequency of bound morphemes in academic language. In particular, the frequency of bound morphemes in science passages, because these texts traditionally feature nominalization and other challenging grammatical features, which both native speakers and ELLs struggle with. This chapter will examine the results from Chapter 4 along with connections to previous research.

### Major Findings and Connections to Previous Research

There are several conclusions based on the results from this study, which will be examined in this chapter. To briefly summarize major conclusions: both types of morphemes tended to increase in grade level texts, inflections appeared frequently even in lower grade level samples, derivations became increasingly prevalent by Grade 6, some inflections appeared more than once in the same sentence using the same form but marked different grammatical functions, and most affixes had French or Latin roots which might translate easier for L1 speakers of Romance languages.

A major conclusion from this study relates directly to the research question: does bound morpheme frequency in science texts increase by grade level and if so, are inflectional or derivational morphemes more prevalent? Based on the results from this study, bound morphemes do increase by grade level and derivations become more prevalent than inflections after Grade 6.



The average inflectional percentage was 14% for all K-12 sample passages, whereas the corresponding derivational percentage was 10%. However, that does not tell the whole story.

For Grades 6-12, the average inflectional percentage was 15%, whereas the corresponding derivational percentage was 16%. One percentage point is not a great difference but it has implications. It points towards the increasing frequency of derivations in higher grade-level academic text.

The goals of L2 learners are not the same. Assumptions should not be made about the importance of understanding bound morphemes. Some language learners acquire a new language to improve employment prospects or increase meaningful social interactions. The linguistic demand of bound morphemes and overall academic language might not apply to these learners in the same way. Yet for those seeking a High School diploma, GED, or post secondary education, the ability to construct word and passage level meaning based on morphological structures could be a great aid in academic success (Kraut, 2015).

Another conclusion from this study was how early inflections can appear in lower elementary grade readings. In Grade 1, there were 2 instances of third person present tense inflections and 4 instances of plural noun inflections, which both use the same *-s* form. Chall's theory about the key stages of literacy growth (Chall, 1996) demonstrates how emerging learners are initially focused on phonemic awareness. However, in certain instances, the same phoneme serves two different purposes. For example, the Grade 1 analysis shows how emerging readers are expected to comprehend which inflectional *-s* form is being used; a third person verb or plural noun form. This requires an understanding of the sentences' grammatical structure in order to properly construct meaning because the inflections look and sound exactly the same. That

might seem second nature but it could be difficult for emerging readers who lack exposure to English language structures outside of the classroom.

The inflection *-s* is not the only inflection that could pose problems for readers. The present participle/gerund *-ing* form represented 23% of the inflections found in the text analyses. It is similar to the inflectional *-s* form in the sense that it can be used in different ways: as a verb turned into a gerund, a verb in the continuous form with the auxiliary form of *To Be*, or a verb acting as an adjective. For example, in Grade 7, the inflection *-ing* shows up twice in the same sentence, once as a gerund followed by the present participle: “While this squeezing is taking place.” Past studies on morphological awareness and morphological decomposition bring attention to the differences between how L2 learners and native speakers deconstruct morphemes (Kraut, 2015). If L2 learners rely more on word-based knowledge rather than morphemic awareness as some research suggests (Silva & Clahsen, 2006), the science passages analyzed in this study could be problematic because they contain multiple inflections of the same form used in different ways within the same sentence.

As mentioned earlier in Chapter 2, the ability to make inferences with texts that are low in cohesion is an important skill, which aids in reading comprehension (Hall et al., 2015). As students progress they are likely to encounter sentences that are not explicitly linked together. Readers studying science will likely come across more technical vocabulary that is not accessible in the same way as other genres (Vyogtsky, 1986). In addition, science texts typically use nominalization to continuously introduce new facts and chains of reasoning. This study allowed for a comparison of K-12 science passages side by side and offered a glimpse into the increasingly complex characteristics of the language used in science by grade level. This complexity was also found in the frequency of bound morphemes, especially derivational ones.

Despite intermittent drops at certain grade levels, both types of bound morphemes increased in frequency, particularly from Grades 6-12. Morphological awareness has long been viewed as secondary or a derivative of phonemic awareness but more recent research is highlighting the importance of understanding morphemes (Nagy, Berninger & Abbott, 2006; Kraut, 2015). These more recent discoveries strongly connect with this comparative study. I was able to firsthand observe the small incremental changes that over the course of just a few grade levels resulted in more complex science passages.

I do not have a wealth of experiences to draw upon when it comes to teaching the language of science. As a Kindergarten teacher, I am mainly focused on helping my students achieve objectives that correlate with Chall's key stages of literacy growth for students at Stage 0 (Chall, 1996). However, I have had some opportunities to help students comprehend science passages and vocabulary. It is difficult not to be pulled into the content. It is easy to lose sight of the academic language features in search of a quick explanation. However, as a language teacher it is paramount to keep focused on the language. Students may struggle with the content but it is intertwined with the language. In fact, many students are not aware of or taught about the language features that exist in the reading materials they are trying to comprehend (Fang, 2007).

### Cognates and Second Language Acquisition

There is initial evidence that Spanish speakers are able to use cognate strategies to understand unfamiliar vocabulary (Chen, et al., 2012). This research is referenced because the etymology of the derivational affixes in this study showed that most affixes came from languages with common lineage. 76% of prefixes and 95% of suffixes were derived from Latin or French. Latin is no longer widely spoken but French along with Italian, Spanish, Portuguese, and

Romanian, make up the predominantly spoken Romance languages, which evolved from Latin. This could be a possible benefit to L2 learners from the aforementioned language backgrounds. These languages have affixes similar to English and this could be helpful in decoding unfamiliar words and passages.

### Limitations of Study

There are several limitations to this comparative text analysis study that will be addressed in this section. In general, limitations are rooted in the resources available and the time allotted to complete this capstone. These limitations have to be accepted given the time available to research literature, collect data, analyze findings, complete peer review procedures, and finish the capstone within program guidelines.

### Sample Size Limitation

The chief limitation was the small sample size of books analyzed. Text samples of approximate equal length and similar word counts were chosen for each grade level. If time and resources were not an issue, my sampling size and method analysis would certainly be greater. In particular, it would be noteworthy to conduct a large scale sampling of thousands of approved science texts used in K-12 classrooms nationwide, which could then be run through a linguistic text analysis program in order to isolate bound morpheme structures. This would provide a much broader reference point to draw conclusions from. However, a project of that scope would not be suitable for the timeline that must be adhered to in order to fully complete the capstone within time constraints.

### Genre Selection Limitation

The second limitation was the focus on one genre of text rather than a sampling of multiple genres. Undoubtedly it would have been helpful to itemize the different types of bound morpheme found in social studies, mathematics, and other genres. The inclusion of more genres would have provided a more accurate snapshot of the types of academic texts that K-12 students encounter during the school year.

### Impact on ELL Groups Limitation

This study briefly looked at the current understanding of bound morphemes and their impact on L1 and L2 reading comprehension. However, there are many different groups of ELLs with different L1s. Some L1s use morphemes similar to English such as cognates, which conceivably could help L2 reading comprehension. Conversely, other languages do not heavily utilize bound morphemes and they are not a major grammatical component.

I referenced current findings that applied to certain ELL populations but there are many more L1 languages that I did not address. Given the time and research constraints it would be unrealistic to conduct in-depth analysis of how bound morpheme structures impact every major ELL group's reading comprehension. Nevertheless, such an endeavor would offer greater insight into the complex and inclusive environment that most inner city and suburban K-12 EL teachers operate in.

### Implications for Pedagogy

The gap identified in this capstone was the need to investigate the prevalence of bound morpheme structures in science texts by grade level in order to ascertain what types of lexical

changes are taking place. It is clear from the previous research identified and the results from this study that grammatical complexity in science passages increases in quantifiable ways. In the case of this study, the frequency of bound morphemes was recorded and based on the results; there are several implications for pedagogy.

Before delving into the teaching implications of this study, it would be useful to revisit my guiding questions presented at the beginning of this capstone. My questions were:

- New vocabulary is constantly being introduced but what links do new words have to previous ones?
- What lexical variations are prominent in science textbooks and how could students better understand these changes?
- Could an understanding of morpheme structures aid in lexical and passage level reading comprehension?
- How can ELLs draw upon their L1 knowledge to comprehend unfamiliar words in their L2?

After tabulating results from this comparative study, it is clear that bound morphemes increase in frequency in science passages as learners encounter less straightforward texts with fewer cohesive elements. Learners will come across a plethora of bound morphemes while reading about science in elementary, secondary, and post-secondary schools. However, there will likely be some forms that are encountered with a higher frequency based on the results of this limited study,

In the case of inflections, this text analysis confirmed that multiple types of inflections occur even within three or four short sentences. Some of these inflections use one form to mark one type of change while others use the same ending to mark different grammatical functions, such as the *-s* and *-ing* forms. While inflections are more predictable and straightforward than

derivational morphemes (Ford, Davis & Marslen-Wilson, 2010), these text analyses show how multiple types of inflections can appear in passages even with small word counts. It is possible that inflections are taught more concretely than derivations given there are only 8 types of inflections. Nevertheless, inflectional morphemes are difficult even for learners who are fairly proficient in their target language (Song, 2015). Interestingly, Schleppengrell points out a common paradox in our educational system: students are constantly expected to fulfill academic goals but usually they are not taught the specific language needed to complete the tasks (Schleppengrell, 2004).

Based on the results of this study, it appears the explicit teaching of bound morphemes could be beneficial to ELLs. For instance, in this study early grade level texts used the same inflections to mark different parts of speech within the same sentence. Similarly, derivations added complexity along with nominalization in middle and higher-grade level texts. It is conceivable that many students, native speakers and ELLs, would have difficulty differentiating the varied semantics that are a result of bound morphemes.

Research points to the difficulties readers have comprehending derivational morphemes and I found similar implications in this study. Almost all derivations in these text analyses were attached to free morphemes without additional preceding derivations. However, this was not always the case as example 1 from the Grade 11 text sample illustrates.

Example 1: This expression shows that the **gravitational potential** energy for any pair of particles varies as  $1/r$ , whereas the force between them varies as  $1/r^2$ .

In this example the word *gravitational* contains the suffix *-ion*, which indicates an action, process, or condition. It is followed by the suffix *-al*, which indicates relating to. In this case, it is relating to gravitation. Research indicates that an awareness of suffixation allows readers to decode and comprehend more morphologically complex words (Jarmulowicz, 2006). ELLs typically do not receive the same amount of target language exposure outside of the classroom as native speakers do, so additional explicit instruction of suffixes to build morphological awareness could prove beneficial. This connects with studies that show how reading comprehension is based on the ability to build meaning from text (Kieffer & Lesaux, 2008). An awareness of derivational forms could serve struggling readers by solidifying the meaning of texts. Research already shows derivational morphemes combine with free morphemes resulting in less predictable results (Ford, Davis & Marslen-Wilson, 2010). There are also a countless number of derivational morphemes whereas there are only a small number of inflectional forms. In this study, 75% of derivational morphemes were suffixes. Given the larger percentage of suffixes, focusing on these morphemes could be a solid starting point.

I continue to bring up the case for more explicit instruction of derivational morphemes because the types found in this comparative study were varied but certain ones clearly appeared much more than others. It would be unrealistic to teach a multitude of suffixes at one time without the proper context. Instead focusing on the specific affixes that are more prevalent in the text being taught could be employed for a more focused approach. This idea relates back to my guiding question about the relationship between previously known words and the large amount of vocabulary that is constantly being introduced.

It could be more efficient to focus on the commonality of words with the same type of bound morphemes. It could also aid ELLs in building their morphological decomposition skills.



Some research shows that ELLs do not decompose morphemes in the same instinctive manner as their L1 peers (Kraut, 2015). Other research points to the differences in morphological decomposing skills of ELLs and native speakers. Other research indicates that ELLs rely more on word-based knowledge rather than morphological decomposing skills for complex word recognition (Silva & Clahsen, 2006). Based on these findings, it further illustrates the importance of explicit bound morpheme instruction with ELLs. This could increase lexical and passage-level reading comprehension, which are important goals for most K-12 teachers (Silva & Kain, 2015).

### Final Reflections

This comparative study helped me to better understand the lexical changes that take place in textbooks used in K-12 classrooms. This research could help other teachers struggling to help their students decipher unfamiliar vocabulary and passages. Many teachers find it difficult to meaningfully teach large lists of vocabulary. Building morphological awareness and morphological decomposition skills helps empower students by giving them the tools they need to ascertain unfamiliar words rather than them relying on word memorization or less deductive methods of reasoning.

It was fascinating to witness how the language complexity in the sampled texts increased, particularly from grades 2-5 and from grades 6-12. As a kindergarten EL teacher, I am focused on helping my students build phonemic awareness, acquire sight words, and other early literacy skills through the use of accessible materials. This is commonplace in Kindergarten but the academic goals of students evolve with each passing grade. I am not able to observe my former students in later grades dealing with more complex academic language so it was helpful to see how texts can become more morphologically complex in just a few grades after Kindergarten.

Now I can better appreciate how quickly the reading materials in Kindergarten are replaced by texts with more nominalization, technical words, and less cohesion.

My understanding of morphological awareness and how it could aid in lexical and passage level reading comprehension is more informed. I predicted that the sampled texts would increase in difficulty but I was less certain how the language would specifically evolve. The language of science can be difficult and it was useful to observe how bound morpheme frequency increases and what types of inflections and derivations are common in science passages.

Further research could include looking at the frequency of bound morphemes in a larger sampling of texts. One of the greatest limitations of this study was the small sampling size of K-12 science texts. A more definitive look at the links between cognates and L2 reading comprehension would also be worthwhile to investigate. The majority of affixes came from Latin roots. It would be helpful to see how these similarities could be channeled to improve morphological awareness with students whose L1 language also evolved from Latin. Further research into which languages utilize affixes to mark grammar and change semantics would also be useful. In many schools, there are a variety of ELLs from different countries. As educators it would be advantageous to be aware of the distinctive L1 morphological characteristics of our ELL populations.

I believe this project has made me a better teacher. I feel more aware of the intricacies that exist in the required readings we ask our students to study and comprehend. As previously mentioned, it is easy to be swayed by the content in search of the quick answer. However, as EL teachers, we must continue to highlight the structures of academic language and recognize its demands so that our students can better access a variety of texts.

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## APPENDIX A

*Appendix Table 1 - List of Common Derivational Prefixes*

| Prefix | Meaning                   | Example          |
|--------|---------------------------|------------------|
| de-    | from, reduce, or opposite | Defrost          |
| dis-   | opposite                  | Disagree         |
| trans- | across, over, through     | Transcontinental |
| dia-   | across, through           | Diameter         |
| mono-  | one, single               | Monorail         |
| uni-   | one, single               | Unicycle         |
| bi-    | Two                       | Bilateral        |
| di-    | Two, or in parts          | Diameter         |
| tri-   | Three                     | Tricycle         |
| multi- | many, much                | Multifaceted     |
| pre-   | before                    | Preheat          |
| post-  | after                     | Postdate         |
| mal-   | bad, evil                 | Malcontent       |
| mis-   | wrong, bad                | Misunderstand    |
| pro-   | forward, forth, before    | Procreate        |
| sub-   | under, beneath            | Subway           |
| re-    | back, again               | Rewind           |
| inter- | among, between            | Interstate       |
| intra- | within                    | Intranet         |
| co-    | together, with            | Coworker         |
| non-   | Not                       | Nonsense         |
| un-    | Not                       | Uncomfortable    |
| in-    | Not                       | Incapable        |
| im-    | Not                       | Imperfect        |

*Appendix Table 2 - List of Common Derivational Suffixes*

| Suffix | Meaning                     | Syntax    | Example     |
|--------|-----------------------------|-----------|-------------|
| -er    | One who                     | Noun      | Teacher     |
| -ly    | To act in a way that is     | Adverb    | Bluntly     |
| -able  | Capable of, worthy of       | Adjective | Honorable   |
| -ible  | Capable of, or worthy of    | Adjective | Responsible |
| -hood  | Condition of being          | Noun      | Childhood   |
| -ful   | Full of, having             | Adjective | Colorful    |
| -less  | Without                     | Adjective | Hopeless    |
| -ish   | Somewhat like               | Adjective | Childish    |
| -ness  | Condition or state of       | Noun      | Gladness    |
| -ic    | Relating to                 | Adjective | Energetic   |
| -ist   | One who                     | Noun      | Pianist     |
| -ian   | One who                     | Noun      | Librarian   |
| -or    | One who                     | Noun      | Governor    |
| -eer   | One who                     | Noun      | Engineer    |
| -ology | Study of                    | Noun      | Sociology   |
| -ship  | Art or skill, condition     | Noun      | Stewardship |
| -ous   | full of, having, possessing | Adjective | Joyous      |
| -ive   | Tending to                  | Adjective | Hyperactive |
| -age   | Result of an action         | Noun      | Pilgrimage  |
| -ant   | Thing or being              | Noun      | Inhalant    |
| -ent   | Someone who, something that | Noun      | Student     |
| -ent   | Inclined to                 | Adjective | Different   |
| -ment  | State or act of             | Noun      | Payment     |
| -ary   | relating to, condition      | Adjective | Secondary   |
| -ure   | action or condition of      | Noun      | Mixture     |
| -ion   | act or condition            | Noun      | Education   |

|       |                     |           |             |
|-------|---------------------|-----------|-------------|
| -ance | act or condition of | Noun      | Assistance  |
| -ence | act or condition of | Noun      | Persistence |
| -ity  | state or quality of | Noun      | Prosperity  |
| -al   | relating to         | Adjective | Magical     |
| -tude | condition of        | Noun      | Exactitude  |
| -ism  | practice, belief    | Noun      | Monotheism  |

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