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How Reference with Demonstratives Creates Cohesion in a Physical Science Textbook

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HOW REFERENCE WITH DEMONSTRATIVES CREATES COHESION IN A PHYSICAL SCIENCE TEXTBOOK

by

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To Svea Louise, who motivated me to finish, and to her sister, who inspired me to begin.

And to Gustavo, who always encourages me to keep learning.

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CHAPTER ONE: INTRODUCTION

As an English as a Second Language (ESL) teacher, I have taught in various settings and program models that were set up with the intention of best supporting a particular group of students at a given time. Last year I co-taught in a physical science classroom for the first time. This was a new experience for me and I came to it with only the content knowledge I remembered from my own high school experience years earlier. I was paired with an experienced physical science teacher who was an expert on teaching the content. I knew that a big part of my role would be to support the students with reading and writing in the physical science context. Throughout the year I learned a lot, not only about the content, but also about the challenge of making the text accessible for English learners (ELs). My degree in K-12 ESL had not prepared me for working with students on grade-level high school textbooks. In order to support the students in their reading, I attempted many strategies, including modifying the text to make it more comprehensible for ELs, teaching the students close reading strategies to scaffold their reading and break apart the text, giving them a purpose for reading, finding texts with similar content at a lower reading level and pre-teaching the vocabulary and main ideas they might encounter in the text. Despite my efforts and best intentions, I did not see my students grow as readers. While they may have come away from reading a particular text with a basic understanding of it through reading, further discussion and, often most helpful, a related lab or experiential activity that brought it to life for them, I did not see

them becoming empowered as independent readers. I often questioned the value of taking precious class time to have them sit in front of the text, knowing that the meaning was not coming to life on the pages before their eyes and they could gain greater content knowledge through more hands-on, interactive activities. I felt the dichotomy of knowing that in order to become better readers and writers, students need more time reading and writing, yet the demand of teaching the content and the number of standards that need to be covered within the course of the year does not seem to allow for taking away precious class time to develop literacy skills.

Throughout the year, my goal for my students was that they grow as readers by developing the aptitude to understand the main idea of a text, to learn new information through reading and to expand their vocabulary. I also wanted them to be able to respond to what they had read through discussion and writing and, ultimately, view the text through a critical lens, evaluating the content presented. Yet I did not see these skills developing in the majority of my students and I was at a loss for how to better prepare them to approach a new text independently with the proficiency that allowed for this level of comprehension. I had been working to build academic literacy skills, such as summarizing and questioning, that can be applied across content areas (Chauvin & Theodore, 2016), but I failed to teach them disciplinary literacy, which allows students to access and comprehend discipline-based texts, focused on the discrete ways that reading and writing are used in a particular discipline (Chauvin & Theodore, 2016; Fang & Schleppegrell, 2010; Moje & Speyer, 2008).

As the school year drew to an end, I found myself in the midst of my graduate program and at an intersection in my career, preparing for a new position as a Literacy

Specialist in a different school, where one of my primary areas of focus would be literacy development across the content areas. I would be working in an international high school serving newly-arrived immigrant and refugee students ages 17-21 with all students qualifying for English language services. One of my primary responsibilities would be to support and collaborate with the content area teachers, particularly in social studies and science, as they seek to make the content accessible and meaningful to the students. The prospect of this new path led me to an approach of linguistics that views language as a meaning-making tool and allows for understanding of how language works in different subjects (Fang & Schleppegrell, 2008; Halliday, 1985), which has brought me to this project.

This approach to linguistics originated out of Michael Halliday's work on Systemic Functional Linguistics (SFL) at the University of Sydney in Australia with the view of language as meaning-making, rather than a set of rules that specify grammatical structures (Halliday, 1985). It has been further developed by various researchers (Fang & Schleppegrell, 2008; Halliday & Hasan, 1976; Humphrey, Droga & Feez, 2012), lending itself to be used as a classroom tool, useful for examining the organizational structure of a text, as well as its language forms and vocabulary: in other words, disciplinary literacy. SFL provides a framework to examine linguistic features in a particular text and demonstrate how those features give the text the meaning it has. The kind of language chosen to make meaning varies, depending on the purpose and the immediate context of the text (Humphrey et al., 2012). One linguistic aspect within SFL is textual meaning that creates cohesive text at the clause and discourse levels (Fang & Schleppegrell, 2008; Humphrey et al., 2012).

The lens of cohesion allows one to examine how the text is organized (Fang & Schleppegrell, 2008) by focusing on the relationships of meaning within the text (Halliday & Hasan, 1976). Example (1) demonstrates cohesion within a sixth grade science textbook *Science Voyages* (as cited in Fang & Schleppegrell, 2008, p. 5).

> (1) The cells that line the nasal cavities have cilia, tiny hairlike extensions that can move together like whips. The whiplike motion of these cilia sweeps the mucus into the throat, where you swallow it.

In the second sentence of this example*, the whiplike motion of these cilia* is a rewording of *cilia…can move together like whips* from the first sentence, creating cohesion between the two sentences. Further cohesion is developed as the verb *move* has been repackaged into an abstract noun, *motion*, modified with the adjective *whiplike*, which has been repackaged from the noun *whips*. The author creates a discursive flow by restating what is presented in the first sentence as a starting point for the second sentence before elaborating on the function of the cells that line the nasal cavities. The analysis of textual meaning offers a way for students to learn new information through language while simultaneously learning about the language being used and thus gaining a better understanding of the content through analysis of the discipline-specific language (Fang & Schleppegrell, 2008). It provides a metalinguistic awareness for students to talk about the text structures and the meaning that is derived from them (Fang & Schleppegrell, 2008).

Research suggests that when students are aware of and notice linguistic forms and are cognizant of the complexities of readings, they are more likely to understand the text and use content-based language (Fang & Schleppegrell, 2008). Fang and Schleppegrell summarize: "…functional language analysis offers practical strategies for supporting

students' engagement with text through detailed analysis of language and accompanying discussion about the meanings of the language patterns" (2008, p. 12). This project will examine, through reference, which is one aspect of cohesion, the textual structures and meaning found within a particular text. I will look specifically at how demonstratives are used to show reference.

Reference

Reference words are words that refer to something else, rather than having independent semantic meaning. They direct the reader to meaning that must be found elsewhere and create cohesion within the text through the continuity of reference (Halliday & Hasan, 1976). To illustrate this, example (2) from *Physical, Earth and Space Science* demonstrates reference. The reference words have been italicized.

> (2) What starts as just a few water molecules quickly grows to millions of molecules that form water droplets. If the droplets become big enough, *they* form visible clouds. Clouds will produce rain when the drops get even bigger and have a volume of about 1 milliliter. At this size *they* become heavy enough to fall as raindrops. (2010, p. 257)

The first *they* refers back to *the droplets*, not to be confused with the second *they* which refers to the *drops* that *get even bigger.* The reference word *they* has no meaning apart from *the droplets* and the *drops*, respectively, to which it refers. While in both instances *they* refers to water drops, the first is as the drops just form and the second is as the drops are heavy enough to fall as raindrops.

Specifically, the focus of this project will be demonstrative reference, which is a form of verbal pointing identifying the referent on a scale of proximity (Halliday &

Hasan, 1976). In other words, demonstrative reference is used in speech to point to things that are nearby or far away. Some have a broader definition of demonstratives (Halliday & Hasan, 1976; Humphrey et al., 2012) than others, but the standard definition, which will be used in this study, includes *this*, *that*, *these* and *those*. Example (3) shows demonstrative reference in its basic form in this mother and child interaction.

(3) M: Susie, *here's* your apple.

S: Yuck! *That* piece has got a brown spot on it. I want a different one!

M: Susie, it's fine…stop fussing.

S: It's not fair. James hasn't got any brown ones. His are nice.

M: Well put it *there* and eat the others.

S: Don't want them either! Can I have one of *those* instead? (Humphrey et al., 2012, p. 148)

The demonstrative reference in this example is used to point to items showing proximity of near (*here's*) and far, or not near, (*that*, *there* and *those*). However, the basic use in speech can vary from how demonstrative reference is used in writing. The referring words often point to a whole chunk of text or even something beyond the text, to experiences and understandings that are assumed to be understood (Humphrey et al., 2012). It has been suggested that demonstrative pronouns occur frequently in written academic discourse to establish contextual ties between ideas (Hinkel, 2001) that are either anaphoric, referring back to something already mentioned in the text, or cataphoric, referring to something yet to come in the text (Halliday & Hasan, 1976). Example (4) from *Physical, Earth and Space Science* shows demonstrative reference in written text.

(4) Atoms interact with one another through their electrons. *This* is why almost all the properties of elements (except mass) are due to electrons. (2010, p. 285)

This is a demonstrative pronoun that is anaphoric (pointing back) to the interaction of atoms with one another through their electrons, in this case referring to a chunk of previous text. Explicitly teaching students to identify what a demonstrative refers to is a necessary skill for effective use of content-based language.

Literacy

Although the focus of this project is examining how reference is used within text, I cannot simply isolate my work to the skill of reading comprehension. Rather my project encompasses all aspects of literacy, which today are recognized as oral communication skills (speaking and listening) as well as reading and writing skills (Scarcella, 2003; Wong Fillmore & Snow, 2000). This definition of literacy as reading, writing, speaking and listening, making up the four language modalities, will be used in my study. Literacy skills are so deeply intertwined that instruction in one is inextricably tied to and enhanced by instruction in the others and it is through literacy that academic English is advanced (Scarcella, 2003). Through this study, I hope to increase my awareness and understanding of cohesion, specifically reference, in order to better equip myself to support teachers in teaching students in a way that develops their literacy skills, enabling the four language modalities to strengthen one another. Ultimately, my goal is that as the students learn the vocabulary and language functions to become stronger readers, they will also learn the strategies and structures to be able to respond to the text through discussion and writing, as these are interwoven skills.

The productive skills of speaking and writing are intricately tied to the receptive skills of listening and reading. Although speaking, listening, reading, and writing are distinct skills, all four can work together to enhance understanding of the academic language, the kind of language used in school and in the content being studied. Fisher and Frey (2011) suggest that in order to be successful in academic English, the learners must speak, listen, read, and write using the vocabulary unique to the content area. On a similar note, Dutro and Moran (2003) urge that all students deserve well-designed, on-level language instruction that demands the application of progressively higher levels of speaking, listening, reading, writing, and thinking skills. Zwiers (2014) refers to interaction utilizing the four language modalities as a means to get practice with language, communication, and the content. Specifically in regard to cohesion, McCarthy advocates that cohesive devices need to be explicitly taught in reading and writing instruction for ELs due to the important role such devices play in written texts (as cited by Hinkel, 2001). Among the greatest gifts I can imagine giving to students is more opportunity to interact with academic language through interpersonal communication, while utilizing the content.

In my new job as Literacy Specialist, I have encountered new curricula and standards and I have been eager to delve into the texts that are used. As previously mentioned, one of my primary responsibilities is to support the social studies and science teachers in their work of making the content accessible and meaningful to the students. This has inspired me to do a text analysis on a portion of the physical science curriculum that is taught to 10th grade students, including students with low literacy skills in their

first language. It is my hope that the outcome of this research will benefit the teachers at my school in their instruction and the students in the development of their literacy skills.

Nationwide students struggle with the reading of academic texts required of them at the secondary level (Fang & Scheppegrell, 2008). As students who are in the process of learning English, the young adults I work with are even more unprepared for the reading level of the text in the content classes. Yet in order to meet the standards for these classes, the rigor must remain high. Teaching students to access complex texts by equipping them with the knowledge and skills to read critically with an understanding of how the language works in a particular content area is empowering them to be successful in their content classes.

Research Question

My research was guided by the question: *How are demonstratives used as reference in a 10th grade physical science textbook?* This question will be fully developed in Chapter Two. The purpose of this study is to do a language-based analysis of a science text in order to identify how demonstratives are used as reference. As a result of this research, I hope to become better equipped to support the physical science teacher in serving the students through meaningful, explicit instruction in order for students to be successful in their use of the physical science textbook. Furthermore, due to their understanding of the text, I hope students will better be able respond to the text through meaningful discussion and writing and ultimately to engage in critical academic literacy, which is the ability to read a text actively to interpret its meaning through a critical lens and challenge the bias or perspective of its message (Coffey, 2008).

In order to complete this study, within my role as the researcher, I will analyze the language of a physical science textbook, guided by prior research on reference and cohesion to describe how demonstratives are used as reference in this portion of the science curriculum. Upon completion, the results of the analysis will be able to be used to develop materials and strategies to guide explicit instruction of this key feature of the language as part of my role as Literacy Specialist.

Chapter Overviews

This chapter introduced the challenge ELs face reading academic texts. At the secondary level there is an increasing complexity of the text as a result of the language specialized to the content area. In order to be able to comprehend, evaluate and respond to the text, advanced disciplinary specific literacy skills are needed. In response to this demand for disciplinary literacy skills, my research was guided by examining the cohesion of the text, specifically how demonstratives are used as reference in a physical science text. In Chapter Two, I examine existing research pertaining to academic language and disciplinary literacy, specifically in science, as well as cohesion, with a deeper look at reference with demonstratives. In Chapter Three I describe the methodological approach that I used to identify how reference with demonstratives is used within the physical science text. Chapter Four relates the results of my study and the analysis of it. In Chapter Five I summarize the research, and document the limitations and implications of the analysis.

CHAPTER TWO: LITERATURE REVIEW

The literacy skills necessary for using academic language, including understanding cohesion, are paramount needs I am actively seeking to meet in my school. Through a text analysis, I hope to discover how demonstratives are used to create cohesion in text, in order to inform instruction that will empower students to read with greater understanding. The guiding research question is *How are demonstratives used as reference in a 10th grade physical science textbook?*

This chapter begins by reviewing research regarding academic language, examining its comprehension as a multidimensional skill set, providing a rationale for its explicit instruction in the classroom and noting its distinct registers in each content area. Next it presents disciplinary literacy with functional linguistics as a framework for analyzing the linguistic demands within a discipline. Then the focus turns specifically to academic language in the discipline of science. Research on different areas of cohesion is briefly introduced with a greater focus on reference and then, demonstratives, as a form of reference, are examined in more depth. Finally, the gap I have found in the research is presented, followed by the research question that will guide this project.

Academic Language

Multidimensional Skill Set

Academic language is defined in its broadest sense as the language students use to acquire and demonstrate knowledge in school (Schleppegrell, 2012). It differs from

conversational English in part due to its sentence complexity, specialized vocabulary, grammar and organization strategies used to advance complex ideas (Schleppegrell, 2012; Zwiers, 2008). Academic language is much more than a list of content area words, but rather requires a multidimensional skill set, of which content vocabulary is only one dimension (Zwiers, 2014). Language structures and non-academic words are needed as well in order to make meaning. Grammatical devices are used that enable the information to be packed into coherent and logical sequences that allow for accurate interpretation, as academic discourse is usually delivered through print (Wong Fillmore, 2004). Not only is academic language multi-faceted, it is also not a singular type of language proficiency that students either have learned or have not (Wright, 2016). Encompassed within academic language are a wide range of language demands specific to various academic tasks that occur during the school day.

Another feature of academic registers is that each sentence often contains more than one clause. This is particularly challenging for EL readers who have to understand not only the content of each of the clauses, but also the relationship between them (Freeman & Freeman, 2003). This complex discourse makes for cognitively demanding language. According to Freeman and Freeman (2003), written academic language is also typically context reduced, meaning that the contextual clues come only from the text itself, unless the reader already has read many similar texts and can rely on their familiarity with such texts. Depending on their exposure to similar texts, pictures, graphs and charts may not be particularly helpful in giving ELs a sense of the context surrounding the information.

Discipline-specific vocabulary is another aspect of academic language, including unfamiliar words and familiar words with specialized meanings. A word that may seem common, for example, *table*, can mean the flat surface with legs that we eat at in the kitchen; but in the context of science, it may refer to the periodic *table* of elements; or in the context of an English class, it could refer to the *table* of contents; while in social studies it may refer to a water *table*; and in math class, it may refer to a mathematical *table*. The meaning is specialized for each context.

Need for Explicit Instruction

Lack of proficiency in academic language, cited as one of the primary contributors to the achievement gap existing between high- and low-performing groups of students, becomes more visible in the upper grades (Wong Fillmore, 2004). Of the students in the low-performing groups, the majority have not had the same exposure as their high-performing peers to the types of English that are valued by schools (Zwiers, 2014). Unfortunately, the gap only continues to widen because the academic language required for success is not acquired as readily as social language (Zwiers, 2014). At the secondary level, more than two-thirds of students are reported to struggle with reading and writing in academic content (Carnegie Council on Advancing Adolescent Literacy, 2010; Carnine & Carnine, 2004), evidence that academic language must be intentionally taught at all levels.

Substantial research supports the need for explicit instruction of academic language within the content areas (Fang, 2008; Zwiers, 2014). Academic language proficiency is described as the ability to construe and infer meaning from oral and written language, determine exact meaning from text, relate ideas and information, recognize the

conventions of various genres and apply different linguistic strategies for various communicative purposes (Dutro & Moran, 2003). Academic language is linked to complex thinking processes, complex relationships and abstract concepts (Zwiers, 2007). It is recommended that teachers model and instruct students in the language they will need to express their thinking, as well as create the opportunity for students to practice their thinking processes and language. However, academic language and its teaching is complex and not well understood by teachers.

Consider academic English for ELs, who not only have to learn the language, but also have an urgent need to build their content knowledge and the academic registers of English in order to participate in discourse about what they are learning (Freeman & Freeman, 2003). Some ELs have not developed an academic register in their first language (L1), which typically makes it a slower process in their second language (L2) (Schleppegrell, 2012). It is, therefore, essential to use academic content to teach the language. All ELs, and particularly overage high school students who are seeking a high school diploma must dive into academic content areas while learning academic English (Freeman & Freeman, 2003). This way students are able to focus on the content and build their knowledge of the subject matter, while simultaneously studying the language. The students can be challenged cognitively with rigorous content and at the same time receive scaffolding and additional support for the linguistic structures (Freeman & Freeman, 2003).

Content Specific Register

Each of the content areas has its own register of academic language. It is essential, therefore, that educators have more pedagogical language knowledge; greater knowledge

about the language of a specific discipline that is used to describe and advance it (Zwiers, 2014). It is often difficult for an expert in a discipline to recognize the grammatical and lexical choices specific to that content that may be challenging for students and, furthermore, to make them accessible to the students. Moreover, content area teachers may argue that they are not equipped to teach the register of their disciplines, as they see language education as a separate discipline (Moje, 2008). The National Council of Teachers of English (NCTE) (2004) has put forth the demand that teachers of adolescents need to "teach literacy in their disciplines as an essential way of learning in their disciplines" (p. 3). Developing understanding of how knowledge is presented in a particular content area is essential for teachers as they approach content area reading and writing.

Disciplinary Literacy

Disciplinary literacy focuses on how reading and writing are used in specific disciplines (Chauvin & Theodore, 2016). Historically, secondary content literacy has focused more on literacy skills rather than specifically examining how language is used to learn in the subject areas (Moje, 2008). Content disciplines, in fact, "…differ extensively in their fundamental purposes, specialized genres, symbolic artifacts, traditions of communication, evaluation standards of quality and precision and use of language" (Shanahan & Shanahan, 2012, p. 9). The school subjects are constituted by disciplinary discourses recontextualized for educational purposes (Fang & Coatoam, 2013). The assumption of disciplinary literacy is that in order to produce knowledge in a discipline, a variety of ways to construct and communicate knowledge is required, as well as fluency in making and questioning claims (Moje, 2008). As such, being literate in a

discipline means understanding not only content, but the ways this content is produced, communicated, evaluated and renovated by means of reading, writing, viewing, speaking, thinking, reasoning and critiquing (Fang & Coatoam, 2013). Disciplinary literacy is a form of critical literacy, as understanding grows of how knowledge is produced in the disciplines rather than merely building knowledge in the disciplines (Bain, 2006; Lee, 2007; Moje, 2008). Disciplinary literacy offers access to the accepted knowledge of the disciplines, therefore allowing students to be critical of that knowledge (Moje, 2008), supporting young people in becoming active participants in society.

Recommendations for ELs suggest that these students benefit from disciplinary literacy instruction, even while developing foundational skills and strategies (Fang & Coatman, 2013; Meltzer & Hamann, 2004, 2005). Action research on historical reasoning instruction, an example of disciplinary literacy within social studies, found that students (including ELs), regardless of their initial learning profiles, were more capable of making sense of conflicting information or points of view and were able to write more historically accurately and persuasively in their essays (De La Paz, 2005). Implementation of disciplinary literacy for ELs may include the teacher analyzing the linguistic demands of the content in order to front-load content instruction with direct instruction of the forms or structures of language needed to understand and interact with the content (Dutro & Moran, 2003). One framework for such an analysis is functional linguistics.

Functional Linguistics: A Framework for Disciplinary Literacy

Functional linguistics, by identifying subtle, yet profound, differences identified among the disciplines, offers a way to examine disciplinary literacy (Fang &

Schleppegrell, 2008; Halliday & Martin, 1993). The patterns of language within each discipline show differences in vocabulary, points of view, attribution of causation and agency, passive and active voice, along with other linguistic differences unique to the various disciplines (Shanahan & Shanahan, 2013). A specific example of this in science is nominalization, the use of verbs and adjectives as nouns; for example, the word for describing the process of *evaporation* (noun) has been taken from *evaporate* (verb) (Fang & Schleppegrell, 2008). Nominalization in science allows a technical term to be defined or used to summarize an explanation sequence, or cause and effect, in explanations or reports (Fang & Schleppegrell, 2010). This, termed "grammatical metaphor," may be the most pervasive among challenging lexicogrammatical features of scientific English (Unsworth, 1998). The words have the same meaning, but their place in the grammar has changed, which is key for constructing technicality (Unsworth, 1998). Nominalization can also be used to create cohesion as a way to summarize what was previously mentioned and build on it (Unsworth, 1998). Within each discipline there are unique linguistic characteristics.

Example (5) offers a glimpse into the disciplinary literacy of secondary science from *Modern Biology* (as cited in Fang & Schleppegrell, 2010, pp. 588-589).

> (5) Organisms made up of one or more cells that have a nucleus and membrane-bound organelles are called eukaryotes. Eukaryotic cells also have a variety of subcellular structures called organelles, well-defined, intracellular bodies that perform specific functions for the cell.

This text about a specialized topic, eukaryotes, consists of a heavy load of technical vocabulary (*organisms*, *nucleus*, *cells*, *membrane*, *organelles*). The first sentence has two

embedded clauses (*made up of one or more cells*; *that have a nucleus and membrane-bound organelles*) about the noun (*organisms*), together creating a dense noun phrase as the subject of the sentence. A similar pattern of embedded clauses, form long noun phrases in the second sentence as well. These densely packed noun phrases are linked together by relating verbs (*are called*, *have*) allowing for technical definitions to be constructed together with descriptions of biological processes. Such dense, technical language emphasizes the need to understand academic language in science.

Example (6) gives another perspective on science disciplinary literacy while demonstrating reference through the use of demonstratives in a fourth grade excerpt from *FOSS Science Resources*.

> (6) Light travels at different speeds. It moves very fast through air, but it moves slowly through things that are more dense than air. The more dense the substance, the more slowly light travels through it. *That's* why a light ray moving through water, plastic, or glass seems to bend. *These* materials are more dense than air. We call *this* bending of light rays refraction. (2012, p. 78)

The first demonstrative *that's* in the phrase *that's why* refers back to the previous clause *the more dense the substance, the more slowly light travels through it*. The second demonstrative *these* modifies the noun *materials* and together this noun phrase refers back to *water*, *plastic*, or *glass*. *This* modifies the noun *bending*, which is a nominalization of the verb *to bend* and is used as a summary of the prior reference. In this example it is evident that the need to understand how demonstratives are used in a science text is essential to uncovering the meaning.

Academic Language in Science

As a discipline, science has its own ways of making meaning (Fang & Schleppegrell, 2008), particularly at the secondary level where the language of science becomes more abstract and complex as textbooks present scientists arguing their conclusions (Fang & Schleppegrell, 2008). The structure of the text tends to be dense with a lot of information packed into each sentence (Fang & Schleppegrell, 2008; Zwiers, 2014) and the language is tightly organized to make coherent, organized arguments (Fang & Schleppegrell, 2008); it is structured in a hierarchical manner with topics, subtopics and details (Zwiers, 2014). Familiarity with two overarching genres is necessary to understand and comprehend a particular topic in science: reports, used to show 'the way the world is' in a static snapshot; explanations, which describe 'how/why the world behaves' in a dynamic and evolving way (Veel, 1997). Most science information is organized through language functions such as cause and effect, classification, comparison, hypothesis and interpretation and is written in passive voice as in *The oceans are warmed by the sun*. Data representation, analysis and interpretation are emphasized in science (Moje et al., 2004; Zwiers, 2014). Students must be able to write scientific explanations including the following features (Moje, 2008, p. 101):

- making a claim
- providing evidence drawn from experimentation or research of others
- reasoning through the evidence back to the claim
- writing the explanation in precise and accurate language

Veel (1997) discusses science literacy as an apprenticeship to a worldview, as a means to think about the world in new ways. By taking on critical scientific literacy, students are able to use science-based arguments to question existing theories as well as advocate for change.

Studies have shown that secondary students do not engage in much reading from science textbooks in school (Wellington & Osborne, 2001). This may be due to the unfamiliar ways language is used in science texts, making them difficult to read. Teachers often seek to support their students by focusing on the science vocabulary. Science uses two types of technical vocabulary: nominalizations and familiar words with specialized meanings (Fang & Schleppegrell, 2008). Nominalizations have been uniquely coined for science (Zwiers, 2014); they construct a noun from a verb or adjective, such as *condensation* from *condense*, *refraction* form *refract*, *induction* from *induce*, and most other *–ation* words (Zwiers, 2014); they are often constructed from Greek and Latin roots, so analyzing the derivatives could support in understanding the science concepts (Fang & Schleppegrell, 2008; Shanahan & Shanahan, 2013). The second type of technical vocabulary is words used in everyday language that have been given technical meanings (Fang & Schleppegrell, 2008). These words tend to be familiar, but have specialized meanings that can make them confusing, such as *fault*, *force*, *matter*, *medium, sponge* and *volume* (Fang & Schleppegrell, 2008). For example, *medium* in every day language refers to something average, not small or large, but when used in the science context can refer to the substance through which something is carried as in, *In which medium does sound travel the fastest?* (Fang & Schleppegrell, 2008, p. 22). Despite the familiarity of the word, its unfamiliar meaning in the science context can make it as

challenging as those in the first category. However, the complexity of the text is not only found in the technical terminology, but also in the syntax used, as "it is the total effect of the wording – words and structures – that the reader is responding to" (Halliday & Martin, 1993, p. 71). Thus, the common vocabulary support offered is insufficient to truly empower students as science readers; it must also include explicit instruction of the language forms and functions necessary for understanding and interacting with the content.

It is no wonder that students struggle to navigate this academic language. As Wellington and Osborne put it, "One of the major difficulties in learning science is learning the language of science" (2001, p. 1). Due to the demand of the language of science, students would benefit from explicit language instruction with focus on the language features such as cohesion within the text. As was demonstrated previously, one aspect of cohesion in written science texts is that complex noun groups tend to be used more than shorter nouns or pronouns, which is contrary to everyday speech (Fang & Schleppegrell, 2008; Fang & Schleppegrell, 2010). Example (7) shows a complex noun group from *Modern Biology* (as cited by Fang & Schleppegrell)

> (7) Most bony fishes have external fertilization and development. *This type of external reproduction in fishes and some other animals* is called spawning. (2008, p. 30)

The 11-word noun group (*This type of external reproduction in fishes and some other animals*) serves as the subject of the second sentence and allows the author to continue what was stated in the previous sentence and develop it further through the use of the demonstrative *this*, signaling that the reference is to something that the reader has just

encountered. This long, complex noun group is an example of how science texts facilitate the presentation and development of information in a cohesive chain of reasoning. This chain of reasoning is expressed through cohesion, or the relationships of meaning within the text.

Cohesion

Reading comprehension is complex and goes much deeper than understanding the vocabulary within the text, as noted in example 7 with the 11-word noun group that developed the idea from the previous sentence with the demonstrative *this*. Reading expository texts at the secondary level is challenging, with historical documents, technical scientific explanations and complex mathematical problems requiring strategies for understanding the functions of language structures in content area text (Fang, 2008). Understanding the way the information is written can facilitate the understanding of the text. One feature within the system of a text is its cohesion (Halliday & Hasan, 1976). This is a semantic concept, referring to the relationship of meaning within a text that makes it a text (Halliday & Hasan, 1976). Cohesion is expressed through the organization of language, partly by way of its vocabulary and partly through its grammar (Halliday & Hasan, 1976). Thus there is lexical cohesion and grammatical cohesion, including reference, substitution and ellipsis, while conjunction is a combination of both. Example (8) from Alice in Wonderland (as cited by Halliday & Hasan, 1976, p. 30) displays the various types of cohesion.

(8) The Cat only grinned when it saw Alice.

‘Come, it’s pleased so far,’ thought Alice, and she went on.

‘Would you tell me, please, which way I ought to go from here?’

'That depends a good deal on where you want to get to,' said the Cat.

'I don't much care where –' said Alice.

'Then it doesn't matter which way you go,' said the Cat.

'–so long as I get somewhere,' Alice added as an explanation.

'Oh, you're sure to do that,' said the Cat, 'if you only walk long enough.'

In this passage we see examples of lexical cohesion between *which way I ought to go* and *where you want to get to*, just as *care* of *I don't much care* is lexically connected to *want*. Reference is demonstrated in *that* of *that depends* and *it* refers to *the Cat* in Alice's first thought. *Do that* is a verbal substitution for *get somewhere*. *Where* shows ellipsis, presupposing *(I) get to*. The Cat's interruption with the conjunction *then* is related to Alice's *I don't much care*. Since the focus of this study is reference with demonstratives, this aspect of cohesion will be examined more in depth. The other areas that create cohesion, substitution, ellipsis, conjunction and lexical cohesion, are beyond the scope of the current study.

Reference

Reference words do not hold semantic meaning within themselves, but rather refer to something else (Halliday & Hasan, 1976). The three kinds of reference found in English are demonstratives, personals and comparatives (Halliday & Hasan, 1976). The focus of this study will be demonstratives. In its basic meaning, demonstrative reference has to do with location or a scale of proximity, although in written text it may also establish contextual ties between ideas or even refer to something beyond the text. Personal reference has to do with the category of person. Comparative reference is indirect reference through identity or similarity.

Table 1 shows examples of referring words.

Table 1

Reference Words

Demonstratives	definite article	*the*
	pronouns	*this, these, that, those, other, another*
	adverbs	*here, now, there, then*
Personal pronouns	I/me/mine/my we/us/ours/our he/him/his it/its	*you/yours/your* *they/them/theirs/their* *she/her/hers*
Comparatives	*same/different, other, bigger/est, more/less*	

(adapted from Humphrey et al., 2012, p. 148)

Example (9) from *The Human Body* shows examples of reference with demonstratives (*this, these* and *the*) and personal pronouns (*it* and *they*).

(9) The oesophagus lies beneath the trachea inside the chest. *It* runs behind the lungs and heart. *This* is the view down the inside of the oesophagus. Beneath its mucus-covered lining there are muscles that run down the length of the oesophagus and in a circular pattern around *it*. *These* muscles take over from the throat muscles after food is swallowed. *They* work together to squeeze the softened food down towards *the* stomach. (as cited by Humphrey et al., 2012, p. 149)

In this text, pronouns refer back to participants within the text; for example, the personal pronoun *it* refers back to *oesophagus*, the demonstrative determiner *these* refers back to the *muscles that run down the length of the oesophagus and in a circular pattern around it* and the personal pronoun *they* refers back to said *muscles* as well. The definite article *the* refers to ideas that are assumed to be within the reader's general knowledge on the topic. The demonstrative pronoun *this* refers to a diagram that accompanies the text.

Example (10) from *Physical, Earth and Space Science* shows reference with comparison

> (10) Ions are atoms that have a *different number* of protons than electrons and so have a net electric charge. Positively charged ions have *more protons* than electrons. Negatively charged ions have *more electrons* than protons. (2010, p. 282)

Comparison is a form of reference, because something is unable to just be 'like'; it must be 'like something' (Halliday & Hasan, 1976). Something may be said to be superior, equal, or inferior, either in its quality or quantity in comparison with something else (Halliday & Hasan, 1976). In the example given above, the comparison is one of quantity. The comparative *different number* points back to the referent *ion*. In the sentences that follow, the comparatives *more protons* and *more electrons* point back to *positively charge ions* and *negatively charged ions* respectively.

Reference can be particularly confusing for ELs, who do not always make the connection between the participants and the reference words that are used to refer to them (Scarcella, 2003). If that connection is not made, it can be very hard to follow what *it*, *these* and *they* actually refer to or to recognize what is being compared to what. The

procedure to carry out a scientific experiment shown in example (11) from Rothery illustrates the importance of understanding reference.

(11) Seed experiment

- Collect 2 petri dishes.
- Place a thin layer of soil in one dish and some cotton wool in the other dish.
- Label the dish with soil 'soil' and the other dish 'no soil'.
- Next, place about 20 seeds in each petri dish.
- Spray each dish with water until it is damp to touch.
- Finally, put the dishes in a warm sunny spot in the classroom. (1996, p. 116)

Rothery (1996) found that students struggled to correctly follow the procedure due to confusion about the reference used in regard to the petri dishes. She noticed that some students were treating both dishes the same way, rather than following which dish was referred to in each directive. Initially the dishes are introduced as *2 petri dishes*. In the next two directives the two dishes become *one dish*/*the dish* and *the other dish*. They are then referred to as *each petri dish*. The final direction brings them together again, referring to them as *the dishes*. The students had not been taught the crucial language feature of reference and were thus unable to keep track of the dishes with the different word choices were used for identifying them.

Demonstratives

The focus of this study will be examining reference with demonstratives within the physical science text. As formerly mentioned, in its most basic sense, demonstrative

reference is a form of verbal pointing and depending which demonstrative word is chosen identifies where the referent is on a scale of proximity (Halliday & Hasan, 1976). This system is shown in Table 2.

Table 2

Demonstratives

		near	far (not near)
participant	singular	*this*	*that*
	plural	*these*	*those*
circumstance	place	*here*	*there*
	time	*now*	*then*

(adapted from Halliday & Hasan, 1976, p. 57)

The demonstratives *this*, *these*, *that* and *those* tend to refer to the location of something, usually a person or object that is participating in the process, thus within the nominal group, or in other words, noun phrases (Halliday & Hasan, 1976). In contrast, the circumstantial (adverbial) demonstratives *here*, *there*, *now* and *then* refer to the location of a process in space or time, thus functioning as adjuncts in the clause and not part of the nominal group. As previously mentioned, Halliday and Hasan's (1976) definition of demonstratives is broader than that of most. This study will examine what are most typically defined as demonstratives: *this*, *that*, *these* and *those.*

According to Hacker and Lunsford, demonstratives identify or point to nouns and often have the function of adjectives, called determiners (as cited by Hinkel, 2001). Biber and Myers suggested that demonstrative pronouns appear frequently in written academic discourse, due to their ability to make contextual ties between ideas (as cited by Hinkel,

2001). However, McCarthy (1994) and the American Psychological Association (APA) (2010) style manual warn against the use of demonstrative pronouns in writing due to the ambiguous referents that are at risk of being created. Rather, the recommendation is given to use demonstratives as determiners, for example, *this exam*, *that report*, *these liquids* and *those students*, to make the referent clear.

In Himmelmann's (1996) research of demonstratives, he arrived at four types of demonstrative uses. The first is situational use, which refers to the physical context of the event. Example (12) from *Physical, Earth and Space Science* demonstrates situational use.

> (12) In *this* chapter, you will make measurements and learn how to convert from one unit of measurement to another. (2010, p. 5)

In the example given, *this* very clearly refers to the chapter, which is the context of the information. Himmelmann's second use is discourse deixis, referring back to ideas or events that have been previously mentioned. The length of the text pointed to can vary, though is typically stated by clauses or longer chunks of text and is always adjacent to the referent (Himmelmann, 1996). Since it refers to prior text, it can also be called anaphoric. Example (13) from *Physical, Earth and Space Science* demonstrates discourse deictic use.

> (13) Galileo's sketches describe in detail what he actually saw through the telescope. *That* means that the sketches are objective. Others who looked through his telescope saw the same thing. *That* makes the sketches repeatable. (2010, p. 35)

In both cases, *that* refers back to the adjacent previous sentence. The first *that* refers back to *Galileo's sketches describe in detail what he actually saw through the telescope* and in the second instance *that* refers back to *others who looked through his telescope saw the same thing*. Example (13) shows the very use that McCarthy (1994) and the APA (2010) style guide warned against, as there are noun phrases in the previous sentence that that could potentially be the referent, rather than the entire sentence, creating some ambiguity around what *that* is referring to.

Tracking is the third use and is so named because it is used to keep track of what is happening to the participants, which are typically stated by nouns or noun phrases, and also can be called anaphoric, as it refers to something mentioned in a preceding section. Previously noted example (9) from *The Human Body* shows tracking.

> (9) The oesophagus lies beneath the trachea inside the chest. *It* runs behind the lungs and heart. This is the view down the inside of the oesophagus. Beneath its mucus-covered lining there are muscles that run down the length of the oesophagus and in a circular pattern around *it*. *These* muscles take over from the throat muscles after food is swallowed. *They* work together to squeeze the softened food down towards *the* stomach. (as cited by Humphrey et al., 2012, p. 149)

This example shows two different examples of tracking. The first being the *oesophagus*, which is referred back to, showing anaphora, with the personal pronoun *it* in *it runs* and later *a circular pattern around it*. Woven throughout the same section of text is another example of tracking with *muscles* referred back to by the demonstrative modifier *these muscles* and yet again with the personal pronoun *they*.

The fourth use is recognitional, also known as the 'reminder *that*' (Gundel et al., 1993, p. 302), which refers to shared knowledge (Himmelmann, 1996). Example (14) (as cited by Gundel et al., 1993, p. 302) demonstrates recognitional use.

> (14) Exxon Oil claims it will take several million dollars to clean up *that* oil spill off the coast of Alaska. [beginning of radio newscast]

That refers to a particular oil spill that is familiar to the audience and thus does not need to be further clarified.

This and *these* are unique in that they may also be cataphoric, referring to information that is yet to come in the text (Halliday & Hasan, 1976). Example (15) from Alice in Wonderland (as cited by Halliday & Hasan, 1976, p. 69) shows cataphora.

> (15) *These* were the verses the White Rabbit read: - [followed by the verses]

These creates cohesion by anticipating the verses that are to follow.

In written discourse, demonstratives can refer to a noun phrase, clause or chunk of text and they may require the reader to infer what the referent is. Example (16) from Swales and Feak exemplifies the need for the reader to make an inference.

> (16) Nowadays, laptop computers are lighter, more powerful, and easier to use than they were five years ago. *These* improvements have led to an increase in the sales of these machines. (2009, p. 44)

These improvements refers back to *lighter, more powerful, and easier* requiring the reader to infer that *lighter, more powerful, and easier* are positive qualities that should be considered improvements.

Demonstratives in Text

Many researchers have explored demonstratives in oral language (Gundel et al., 1993; Himmelmann, 1996; Swierzbin, 2010); however, very few studies have been done on how reference with demonstratives is used in text. Gray and Cortes (2010) have performed one of the few, examining *this* and *these* as pronouns (taking the place of a noun) versus determiners (modifying a noun) in a corpus of research articles in the disciplines of Applied Linguistics and Materials and Civil Engineering. They found that *this*/*these* was more frequent in Applied Linguistics, while within both disciplines there was similar percentage of usage with pronominal uses making up one-fifth of the occurrences, while the other occurrences were as determiners, concurring with Himmelmann's (1996) finding that determiner use is more frequent than pronominal use. As a result of their findings, they advocate for considering pronominal *this*/*these* as integral to academic writing and the need for instruction around this/these as a cohesive structure (Gray & Cortes, 2010).

Cohesion is just one component of language, and reference with demonstratives is only one piece of cohesion. The language features that would be found in science, social studies, math, or literature textbooks are distinct from each other and require the reader to approach them as such in order to build discipline-specific literacies (Fang & Schleppegrell, 2008). For this reason Fang and Schleppegrell argue that

> Functional language analysis provides the means for deconstructing texts, sentence by sentence, to help students process unfamiliar discourse patterns and talk about how meaning is constructed through language choices. This gives students the language analysis skills needed to

> effectively utilize other reading strategies, enabling them to engage with content more deeply and critically. (2008, pp. 8-9)

Not only do all students need to learn these skills in order to be successful in school, but also to be informed citizens; it is an issue of social justice (Fang & Schleppegrell, 2008) that brings students not only to the knowledge itself, but the knowing of how knowledge is produced (Moje, 2008). Access to and the ability to critically evaluate texts is necessary to fully participate in a democratic society.

The Gap

As I have shown through this literature review, academic language is in the forefront of education research today, not only as a general concept, but specifically in relation to the various disciplines. The work done around cohesion and its application to education has been developed since its origin in Halliday and Hasan's work of 1976. The gap that I have found is where these pieces intersect specifically with science. How is cohesion, particularly reference with demonstratives, used in a physical science textbook? What can a text analysis examining demonstratives offer in terms of helping teachers teach disciplinary literacy skills for a physical science text? My research seeks to connect these pieces in order to inform language instruction that incorporates disciplinary literacy in the physical science class.

Research Question

The primary question guiding this research is: *How are demonstratives used as reference in a 10th grade physical science textbook?* In order to answer this question, several sub-questions will be considered, including:

- Is the demonstrative used as a determiner or as a pronoun?

- In which direction does it point - is the referent anaphoric, cataphoric, a graphic beside the text or something within a graphic?
- How far is the referent from the demonstrative?
- Is the referent a noun phrase, a clause or an inference that the reader has to make?
- Is it clear what the demonstrative refers to or is there interference such as more than one noun phrase, clause or inference that could be potential referents in the sentence before or after the demonstrative, depending on if it is anaphoric or cataphoric?

Conclusion

Chapter Two examined existing research of academic language as a multidimensional skill set consisting of language structures with both academic and non-academic words creating academic discourse. It affirmed the importance of explicit instruction of academic language in each of the content areas. This was connected to disciplinary literacy and was examined specifically in regard to the discipline of science. The cohesive resources of reference, ellipsis and substitution, conjunction and lexical cohesion were introduced, with a deeper look at reference with demonstratives, which will be the focus for this text analysis. Finally, the gap of how reference with demonstratives is used in a physical science text that this research project seeks to fill was addressed.

Chapter Three Preview

Chapter Three will describe the methodological approach which I will use to identify how reference with demonstratives is used within the physical science text. It will also examine the process used for text selection and data analysis.

CHAPTER THREE: METHOLODOLOGY

This chapter describes the research methods I used to analyze the physical science text. The purpose and paradigm of this study is outlined, followed by an explanation of the methodology that will be used. The text selection and the data analysis process is then described. Finally, the pilot study that informed the methodology of this study is presented.

Purpose

Within the field of ESL there is a need for educators to understand which language structures, and the meanings they carry, make up a text ELs will read. My primary purpose in doing this research is to analyze how reference with demonstratives is used in a physical science text. The main objective is to determine how demonstratives build meaning through their relation to their referent. The following question and its subquestions will guide the text analysis:

How are demonstratives used as reference in a 10th grade physical science textbook?

- Is the demonstrative used as a determiner or as a pronoun?
- In which direction does it point - is the referent anaphoric, cataphoric, a graphic beside the text or something within a graphic?
- How far is the referent from the demonstrative?

- Is the referent a noun phrase, a clause or an inference that the reader has to make?
- Is it clear what the demonstrative refers to or is there interference such as more than one noun phrase, clause or inference that could be potential referents in the sentence before or after the demonstrative, depending on if it is anaphoric or cataphoric?

In order to accomplish this, I will look at cohesion, specifically reference with demonstratives, while analyzing the text selected from the physical science curriculum. Ultimately, the results of this text analysis will inform instruction for ELs' text comprehension in the content area of physical science

Paradigm and Methodologies

Quantitative Research

Within this paradigm, the text analysis in this study will be quantitative in nature, as the demonstratives used will be categorized, measured and counted. Quantitative research tends to arrive deductively at a specific research question (McKay, 2006). The research question requires defined categories that determine the data needed to be collected (Dörnyei, 2007; McKay, 2006). Quantitative research provides numerical data and its results are based on statistics (Mackey & Gass, 2005). As previously stated, the purpose of this study is to analyze how reference with demonstratives is used within a physical science text by seeking to describe how demonstratives relate to their referent.

Text Selection and Data Collection

The excerpts of text used in the text analysis will be taken from the physical science textbook *Physical, Earth and Space Science* (2010). This text was chosen based on the urgent need my school faces to support the literacy development in all content

areas for the students, many of whom have arrived recently in the country with gaps in their L1 literacy development, as students with limited or interrupted formal education (SLIFE). Indeed, some of these students are preliterate in their first language. They are faced with the challenge of learning the language, the content, and developing critical literacy skills in their L2 in a limited amount of time without an existing framework of background knowledge and literacy in their L1 (Freeman & Freeman, 2002). With this in mind, I selected the physical science text to analyze, leveraging the fact that all students need to take the physical science class to fulfill their graduation requirements.

The physical science textbook is the school district's selection for the 9th grade physical science curriculum. Although in my building most students are in 10th grade when they take physical science, as it is typically taken during students' second year, upon completion of a science concepts class, a class offered to beginning ELs who are in need of building vocabulary, language structures and background knowledge in the content area of science. Physical science is the first credit-bearing science class that most students take. After an average of one year in the program, most students are typically still in the early stages of English language acquisition and are not prepared to independently read a physical science textbook successfully for meaning. In my school it is currently being used in class about once every two weeks, with each topic that is covered. The topic is introduced with experiential learning through a lab and then a reading from the text is used to articulate the science learning from the lab. At this level it is typical for the students to be able to independently identify titles and look up answers, but to be unable to synthesize and apply meaning from the text.

In the interest of setting parameters for the scope of this project, eight sections of

the book were chosen for analysis as a sample of convenience. I selected two adjacent sections from each of four chapters spread throughout the book to create a clearer picture of how reference with demonstratives is likely to be encountered in a typical classroom unit. The first two sections make up two of three sections within *Chapter 5: Force*, and are *5.1 Forces* and *5.2 Friction*. The next two sections, taken from *Chapter 14: Changes in Matter*, are *14.1 Chemical Reactions* and *14.2 Types of Reactions*. The third chapter selected is *Chapter 19: Changing Earth*, and the sections are *19.2 Plate Tectonics* and *19.3 Plate Boundaries*. The final two sections chosen are from *Chapter 27: Stars*: *27.1 The Sun* and *27.2 Stars*. These sections are consistent with other sections in the book in terms of length. Within the eight sections, there are 44 sub-sections with headings. The entire textbook has 753 pages and the eight sections to be examined consist of 44 pages, slightly less than 6% of the entire text. To determine how many pages I would analyze, I looked at two other sections randomly selected in the text to count the occurrences of demonstratives. One section, with a length of five pages, has 15 instances of demonstratives, while the other section is six pages long and has 12 occurrences of demonstratives.

Procedure

The focus of the analysis is how text cohesion is built through the use of demonstratives by examining each occurrence of demonstratives within the sections of text chosen. The process is outlined below.

1. Each occurrence of a demonstrative will be identified in the text chosen.
2. Each demonstrative will be identified as a determiner or as a pronoun. Table (3) illustrates the distinction.

Table 3.

Determiner versus Pronoun

Demonstratives	
Determiner	Pronoun
that house seems older	*that* is an old house

That as a determiner modifies the noun *house*, while *that* as a pronoun acts more like a personal pronoun pointing to the *house*.

3. The direction the demonstrative is pointing will be determined, whether the referent is anaphoric (pointing back to previous text), cataphoric (pointing ahead in the text), to a graphic beside the text or to something within a graphic.
4. The proximity of the referent and the demonstrative will be identified according to whether it is within the same sentence, in an adjacent sentence or with one or more sentences in between.
5. It will be determined if the referent is a noun phrase, a clause or an inference for the reader to make.
6. The clarity of what the demonstrative refers to will be assessed based on if there is more than one noun phrase, clause or inference that are potential referents in the sentence before or after the demonstrative, depending on if it is anaphoric or cataphoric. If there are multiple potential referents, but the noun modified by the determiner is repeated as the referent, then the referent is clear.

This data will be collected through annotated copies of the text and then compiled into charts in order to be quantified. A template of the spreadsheet used to compile the data can be found in Appendix A. Throughout this process, I will take note of my observations and the possible implications for EL instruction.

Procedure Example

Example (17) illustrates the entire process of the analysis that will be done for each of the 116 instances of demonstratives found in the text corpus.

> (17) Even the energy we get from coal, natural gas, petroleum, and wood comes from the Sun. *That* is because *these* fuels are created from photosynthesis. (p. 692)

The first step is to identify the demonstratives within the text. This text example has two demonstratives: *that* and *these*. Step two is to determine the part of speech of the demonstrative. In this example, *that* is a pronoun, taking the place of a noun, and *these* is a determiner, modifying the noun *fuels*. The next step is to identify the direction the demonstratives are pointing. *That* is anaphoric, referring back to *Even the energy we get from coal, natural gas, petroleum, and wood comes from the Sun*. *These* is also anaphoric, but refers only to *coal, natural gas, petroleum, and wood*. Then the proximity between the demonstrative and its referent is determined. In this example, both are in the adjacent sentence. The fifth step is to identify if the referent is a noun phrase, clause or inference. *That* refers to a clause, as its referent is the entire previous sentence, while *these* refers to a noun phrase that is part of the previous sentence. The final step is to determine if the referent is clear or unclear, dependent on if there is more than one noun phrase, clause or inference that could potentially be what the demonstrative is referring

to. In this example, both of the demonstratives could be referring to more than one noun phrase or clause, categorizing the referent for both of them as unclear. That six step process will be used for each of the 116 occurrences of demonstratives found in this text corpus to ultimately determine how demonstratives are used as reference in a 10th grade physical science textbook.

Reliability

In order to ensure that my analysis is reliable, my peer reviewer will follow the same methodology to complete a text analysis of ten percent of my work. We will first analyze a portion of the text together. Then we will analyze a portion of the text separately and compare our results as a reliability measure.

Pilot Study

Prior to the actual text analysis, I ran a pilot study with a sample text from *Physical, Earth and Space Science* (2010) to solidify my methodology. I selected two sections from *Chapter 4 Motion*: *4.2 Graphs of Motion* and *4.3 Acceleration*. There are 11 pages in these two sections and throughout these 11 pages there are 11 occurrences of demonstratives.

The pilot was formative for my methodology. I realized there was a need to add the additional category of *Multiple Possibilities* when looking at the direction the demonstrative is pointing. I had originally planned to determine if the direction was anaphoric, cataphoric, to a graphic beside the text or to something within the graphic, but while doing the pilot I found an instance where the demonstrative could potentially be both anaphoric, pointing back to the referent, and also pointing to a graphic beside the text. This is shown in example (18).

(18) The data for your experiment is shown in Figure 4.4. *This* is position vs. time data because it tells you the runner's position in different points in time. (2010, p. 81)

The demonstrative *this* could refer back to *the data for your experiment is shown in Figure 4.4*, while also possibly referring to Figure 4.4, which is beside the text, thus the need for adding the category *Multiple Possibilities* for occurrences that may not simply fall into one category.

When identifying if the demonstrative refers to a noun phrase, a clause or to an inference that the reader has to make, it became clear that this could be more than one of the categories as well. Example (19) shows the referent is a noun phrase and an inference.

(19) The red runner's line on the position vs. time graph has a less steep slope. *That* means her speed is slower.

That refers back to *a less steep slope* and requires the reader to infer that the slope is less steep than the other runner's, as it is not explicitly stated.

There were two instances in which *that* was not used as a demonstrative, but it appeared deceivingly like the 'reminder *that*' (Gundel et al., 1993, p. 302), as shown in example (20).

(20) Recall *that* in a graph, the dependent variable is usually plotted on the vertical (or y) axis and the independent variable is usually on the horizontal (or x) axis.

The same phrase *recall that* could be used with the demonstrative *that* to draw students' attention to shared knowledge; for example, *Do you recall that graph we made yesterday?* However, in example (20) *that* acts as a conjunction.

The pilot study was useful to see the process and potential difficulties that might arise with classification within the categories in the actual study. It also became a starting place to begin norming with my peer advisor for the sake of reliability.

Conclusion

This chapter described the methodological approach that will be used to identify how reference with demonstratives is used within a physical science textbook. It defined this study as a quantitative study. Then the text selection was discussed. Next the process that will be used for data analysis was explained. Finally, a short overview of the pilot study was given.

Chapter Four Preview

Chapter Four will present the results of the analysis of the physical science text. The outcomes will be explained in light of the research question.

CHAPTER FOUR: RESULTS

This chapter presents the results of the text analysis of the *Physical, Earth and Space Science* (2010) physical science textbook. The research questions are reviewed, looking at how many demonstratives were found in the text analysis, whether the demonstrative is used as a determiner or pronoun, what direction it is pointing, its proximity to the referent, whether it refers to a noun phrase, clause or inference, and how clear the referent is. Data from the analysis is presented in response to each of the questions. The reliability results are also reviewed.

Text Analysis

The overarching question of the study is *How are demonstratives used as reference in a 10th grade physical science textbook?* The text *Physical, Earth and Space Science* (2010) was intentionally chosen as it is used in physical science, a class required for graduation that is typically taught after students have been learning English for one year. The level of the language used in the textbook makes it difficult for the students to apply meaning from the content and synthesize the ideas. Eight sections, with an average of 5-6 pages in each, were chosen from throughout the textbook as a sample of convenience with the intent of giving an overall view of how demonstratives are used as reference within the textbook. Data was collected from each text selection and was totaled for the whole text corpus through the process outlined in Chapter Three. The

purpose of the analysis was to determine how the demonstratives *this*, *that*, *these* and *those* are used as reference by answering the following questions:

- Is the demonstrative used as a determiner or as a pronoun?
- In which direction does it point - is the referent anaphoric, cataphoric, a graphic beside the text or something within a graphic?
- How far is the referent from the demonstrative?
- Is the referent a noun phrase, a clause or an inference that the reader has to make?
- Is it clear what the demonstrative refers to or is there interference such as more than one noun phrase, clause or inference that could be potential referents in the sentence before or after the demonstrative, depending on if it is anaphoric or cataphoric?

Demonstratives Results

Of the eight sections of text analyzed in this study, there were 116 demonstratives identified, averaging about 15 occurrences per section. Once the demonstratives were identified, it was noted which of the four demonstratives *this*, *that*, *these* and *those* were used with what frequency. Figure 1 shows the results of this analysis.

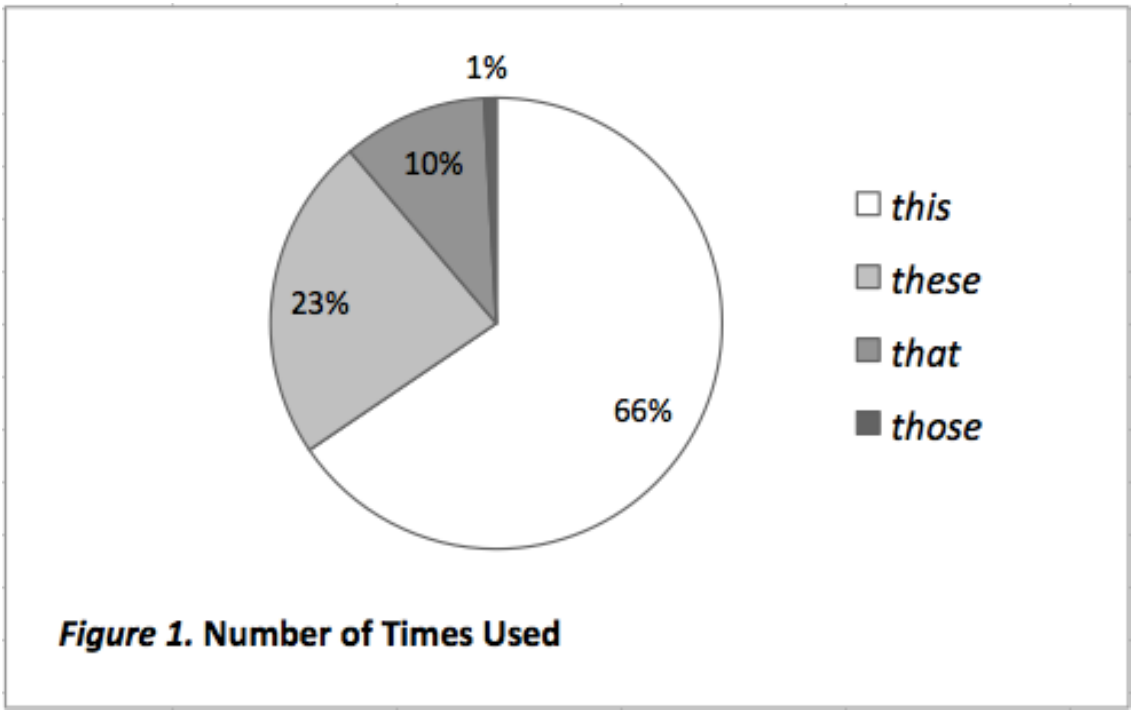

Figure 1. **Number of Times Used**

Figure 1 shows the number of times each demonstrative is used throughout the eight sections. *This* is used the most commonly with 76 occurrences; *these* has the second highest frequency, occurring 27 times. *That* is less common, occurring 12 times. The least commonly used demonstrative is *those*, occurring only one time within the eight sections of text analyzed.

Determiner or Pronoun Results

Of the 116 occurrences of a demonstrative within the eight sections, demonstratives are used as a determiner 82 times and as a pronoun 34 times. For each of the four demonstratives analyzed, all are most commonly used as determiners except the demonstrative *that,* which is used equally as a determiner and as a pronoun – six times each. The number of occurrences as determiner and pronoun for each demonstrative is shown in Table 4.

Table 4:

Determiner or Pronoun for all Text Selections

	Determiner	Pronoun
this	51	25
that	6	6
these	24	3
those	1	0
Total	82	34

Anaphoric, Cataphoric or Graphic Results

The majority of the demonstratives are anaphoric, with 75 instances in which the demonstrative points back in the text to the referent. Of the anaphoric referents, 27 of them are used as pronouns and 48 are used as determiners. One interesting example of anaphoric reference is shown in example (21).

> (21) The density at the Sun's core is about 158.0 g/cm^3. This is about 18 times the density of solid copper. In order to reach *this* high density, a star must have a mass much larger than a planet. (p. 688)

The second time the demonstrative *this* is used in (21), as a determiner in *this high density*, there is a chain of reference in which *this high density* refers back to *about 18 times the density of solid copper*, which in turn refers back to *about 158.0 g/cm^3*. This is an example of Himmelmann's (1996) tracking use, used to keep track of what is happening to the participants, which are typically stated by nouns or noun phrases.

The second most common occurrence is the referent potentially being both somewhere in the text (anaphoric or cataphoric) and a graphic beside the text. This occurred 21 times, 6 of which are pronouns and 15 are determiners. Example (22) illustrates this.

> (22) Albert Einstein's famous equation shows how huge amounts of energy can be created from a smaller mass (Figure 27.8). *This* helps explain why such a huge amount of energy is produced by nuclear fusion. (p. 692)

The demonstrative pronoun *this* could refer back to *Albert Einstein's famous equation shows how huge amounts of energy can be created from a smaller mass*, as well as to Figure 27.8, a graphic beside the text, which depicts Einstein's equation for energy. Included in this category of direction is when the demonstrative potentially refers to referents that occur in more than one direction as shown in example (23).

> (23) For the decomposition of water into hydrogen and oxygen, the energy source is electricity. In fact, *this* particular reaction, illustrated in Figure 14.13, is called electrolysis. $2H_2O \rightarrow 2H_2 + O_2$. (p. 344)

This potentially refers back (anaphoric) to *the decomposition of water into hydrogen and oxygen* and ahead (cataphoric) to the equation of the reaction $2H_2O \rightarrow 2H_2 + O_2$ as well as Figure 14.13, which is a diagram beside the text of the experimental setup for electrolysis of water. In example (23), there is a chain of reference that refers to the same idea, but not all necessarily refer to each other, making it difficult to conclude exactly what the demonstrative refers to.

In six instances, the referent is cataphoric, meaning in the text following the demonstrative, each of which is used as a determiner. Example (24) demonstrates this.

(24) In *this* reaction, chalcocite (a mineral) reacts with oxygen in the presence of heat. The products are a type of copper oxide and sulfur dioxide. (p. 341)

This reaction could refer to both of the following clauses *chalcocite (a mineral) reacts with oxygen in the presence of heat* and *The products are a type of copper oxide and sulfur dioxide*, creating a cataphoric referent. The first sentence in example (24) is the first sentence in that section of the text, so it is clear that the referent is not anaphoric, as there is nothing for it to refer back to.

It was also noted when the demonstrative referred only to a graphic beside the text. Such instances refer to the context of the information, classifying the demonstrative as situational use (Himmelmann, 1996). This occurred twice in the text, both instances as determiners. Example (25) shows this.

(25) Figure 14.7 *This* graphic illustrates that the number of oxygen and hydrogen atoms are not balanced for the methane reaction. (p. 338)

Above this text caption is the graphic as described. Here *this graphic* refers to the graphic itself.

In 11 instances, the demonstrative referred to something within the graphic, rather than the whole graphic itself. Example (26) illustrates this.

(26) *This* box is moving. (p. 108)

This sentence is part of the graphic, written on top of an image of a box being moved and the demonstrative *this* refers to the image of the box itself within the graphic. There is another image and more writing in the same graphic.

The results of the analysis of the direction the referent is pointing for each demonstrative are shown in Table 5 and the direction of the referent as a pronoun or a determiner is shown in Table 6.

Table 5

Direction

	Anaphoric	Cataphoric	Graphic	Within Graphic	Multiple Possibilities
this	45	7	2	10	12
that	8	0	0	0	4
these	21	0	0	1	5
those	1	0	0	0	0
Total	75	7	2	11	21

Table 6

Direction as Pronouns and Determiners

	Pronoun	Determiner
Anaphoric	27	48
Cataphoric	0	7
Graphic	0	2
Within Graphic	1	10
Multiple Possibilities	6	15
Total	34	82

After analyzing the direction the demonstrative was pointing, I looked at the proximity of the demonstrative and its referent.

Proximity of Demonstrative and Referent Results

In the analysis of the proximity of demonstrative and referent it was found that it is most common for the referent to be in an adjacent sentence to the demonstrative, with 95 occurrences of this. Example (27) demonstrates the demonstrative referring back to a clause in the adjacent sentence.

(27) The pound is based on the Roman unit libra, which means "balance." *This* is why the abbreviation for pound is lb (p. 99).

This refers back to the clause *The pound is based on the Roman unit libra*.

There are a few instances in which the referent is in an adjacent sentence as well as in a sentence apart from the demonstrative. While the referent is in multiple places, it was counted as the referent falling in the adjacent sentence. Example (28) demonstrates this.

> (28) For example, your muscles create force when you swing a baseball bat. On a windy day, the movement of air can create forces. Earth's gravity creates a force called weight that pulls on everything around you. Each of *these* actions creates forces and through those forces, each can change an object's motion. (p. 98)

These actions refers back to the actions listed in the previous adjacent sentence as well as the two sentences prior to that. *You swing a baseball bat*, *the movement of air can create forces* and *Earth's gravity creates a force* are all referents of *these actions*.

The demonstrative being in the same sentence as its referent occurred only five times. One example of this is the one instance in which the demonstrative *those* was used. This is shown in example (29).

> (29) Each of these actions creates forces and through *those* forces, each can change an object's motion. (p. 98)

Those forces refers back to *forces* in the clause *each of these actions creates forces*. This is one of the rare instances found in this analysis in which both the referent and demonstrative are in the same sentence.

There are only three instances of one or more sentences between the demonstrative and the referent in the text corpus that was analyzed. One of these instances is demonstrated in example (30).

> (30) Harry Hess wondered if it was possible that new ocean floor was created at the site of mid-ocean ridges. Hess knew about continental drift and thought that Wegener was partly right. The continents had separated from a supercontinent, but not by plowing through the sea floor. Instead, Hess realized that if new ocean floor formed at *these* undersea mountains, then continents on either side would get separated apart during the process (Figure 19.8). (p. 480)

These undersea mountains refers back to *mid-ocean ridges*, which are separated with two sentences between them. This agrees with Himmelmann's (1996) statement that tracking use can refer back more than one statement. However, example (31) also has one or more sentences between the demonstrative and the referent, but falls into Himmelmann's (1996) category of discourse deixis, since it is an idea stated by a clause. Yet it refutes his claim that discourse deixis always refers to the adjacent sentence. However, Himmelmann is generally correct, since most of the data shown in Table 8 supports his claim.

> (31) The friction force between two smooth, hard surfaces is approximately proportional to the force squeezing the surfaces against each other. Consider sliding a heavy box across a floor. The force between the bottom of the box and the floor is the weight of the box. Therefore, the force of friction is proportional to the weight of the box. If the weight doubles, the force of friction also doubles. *This* rule is NOT true if one or both surfaces are wet, or if they are soft (p. 109).

This rule refers back to *the friction force between two smooth, hard surfaces is approximately proportional to the force squeezing the surfaces against each other*, with 3 sentences in between demonstrative and referent.

The distance between the demonstrative and its referent was determined in each case by whether the determiner and referent were in the same sentence, adjacent sentence or with one or more sentences in between. The 13 instances of the demonstrative referring to a graphic beside the text or something within the graphic were counted separately. Table 7 illustrates the results of proximity and Table 8 shows the results of proximity in relation with Himmelmann's (1996) four categories of the major usage types of demonstratives of situational use, which refers to the physical context of the event; discourse deixis, referring back to ideas or events that have been previously mentioned; tracking, used to keep track of what is happening to the participants; and recognitional, which refers to shared knowledge.

Table 7

Proximity

	Same Sentence	Adjacent Sentence	One or More Sentences Between	Graphic
this	3	60	1	12
that	1	10	1	0
these	0	25	1	1
those	1	0	0	0
Total	5	95	3	13

Table 8

Proximity in Regard to Himmelmann's Types of Demonstratives

	Same Sentence	Adjacent Sentence	One or More Sentences Between	Graphic
Situational Use	5	4	0	12
Discourse Deictic Use	0	61	1	1
Tracking Use	0	30	2	0
Recognitional Use	0	0	0	0
Total	5	95	3	13

Noun Phrase, Clause or Inference Results

The referent is most commonly a clause, or larger chunk of text, with 68 occurrences. Of the 68 clauses or chunks of text, 61 of them are, in Himmelmann's (1996) terms, discourse deixis, while the other seven fall into Himmelmann's situational use. Example (32) demonstrates a clause referent with discourse deictic use.

(32) The direction of a force makes a big difference in what the force can do. *That* means force is a vector, like velocity or position.

That refers back to the clause *The direction of a force makes a big difference in what the force can do*, which is the entire previous sentence, aligning with Himmelmann's description of discourse deixis as referring back to ideas or events that have been previously mentioned, stated by clauses or longer chunks of text and always being adjacent to the referent (Himmelmann, 1996).

It is less common that the demonstrative points to a noun or noun phrase. This occurred 34 times. Thirty-two of the noun or nouns phrases are Himmelmann's (1996) tracking use while the other two are situational use. Example (33) shows the demonstrative referring to a noun phrase with tracking use.

> (33) The East African Rift Valley is an example of rifting in progress that began about 20 million years ago, when Arabia split from Africa. *This* rift is marked by a series of long lakes that start near the southern end of the Red Sea and extend southward toward Mozambique. (p. 486)

This rift refers back to the noun phrase *the East African Rift Valley*.

There is one instance in which the reader has to make an inference, shown in example (34).

> (34) You cannot change the number of individual atoms in a compound. *That* would change its chemical formula and you would have a different compound. (p. 339)

That refers back to *change the number of individual atoms in a compound*, which requires the reader to infer that it is through changing the number of individual atoms in a compound that the chemical formula is changed, despite the negative verb phrase *cannot change*.

Again, the 13 instances in which the demonstrative points to a graphic or something within the graphic were counted separately as shown in the results of this analysis in Table 9.

Table 9

Noun Phrase, Clause or Inference

	Noun Phrase	Clause	Inference	Graphic
this	12	52	0	12
that	5	6	1	0
these	16	10	0	1
those	1	0	0	0
Total	34	68	1	13

Clear or Unclear Referent Results

This analysis found that it is more likely that the referent is unclear, with 82 of the 116 demonstratives showing a lack of clarity as to what is the referent. Example (35) demonstrates an unclear referent.

> (35) If you locate Orion in the night sky, you can see Betelgeuse, a red supergiant, and Rigel, a blue supergiant. It is easy to find *this* constellation because of the three stars that form its belt. (p. 697)

In (35), *this constellation* refers back to the noun *Orion*; however, there are a few other noun phrases that could be its referent, such as *night sky*, *Betelgeuse, a red supergiant*, or *Rigel, a blue supergiant*. The possibility of other referents and the fact that they are closer to *this constellation* than the actual referent cloud the clarity of the demonstrative's relationship with its actual referent and assumes that the reader knows or can figure out that Orion is a constellation while the other potential referents are not. This could be especially confusing for ELs and will be discussed further in Chapter Five.

On the other hand, there are several instances in which the referent is clear. Example (36) shows this.

(36) The Moon doesn't fly off because a force exists between Earth and Moon. *That* force is called gravity. (p. 101)

In this case, *that force* clearly refers to the clause *a force exists between Earth and Moon*. This referent is clear because the noun modified by the determiner *that* is *force*, and *force* is also used in the referent, making the connection between the two evident.

The referent was determined to be clear if there is one noun phrase, clause or inference that could be a potential referent. The referent was determined to be unclear in the case of more than one noun phrase, clause or inference that could be potential referents. If there are multiple potential referents, but the noun modified by the determiner is repeated as the referent, then the referent would be considered clear, as noted in (36).

In the cases where the referent is a graphic, what the demonstrative is referring to is also considered to be clear, except in the one instance that the demonstrative is a pronoun, as shown in example (37).

(37) Figure 14.2: *These* are all different kinds of evidence that a chemical reaction is occurring. (p. 335).

This sentence is a caption and *these* refers to four images within the graphic. This instance is less clear than the other demonstratives with a graphic because it is a pronoun and it is impossible to know if the reader will first read the visual text or the printed text, so depending on how the text is approached, the reference might not be clear.

Table 10 shows the results of the analysis of clear and unclear referents.

Table 10

Clear or Unclear Referent

	Clear Referent	Unclear Referent
this	24	52
that	5	7
these	4	23
those	1	0
Total	34	82

Reliability Results

As a reliability measure, I asked my peer reviewer to analyze ten percent of the text to ensure the reliability of my findings. First, I shared the process I had followed in my pilot study and discussed the changes I had made and what I had learned through the experience. We then went through the same process following the steps described in Chapter Three: Methodology. We analyzed a section of the text together. Then we analyzed the next section of the text separately and compared our results.

From our individual analysis, we found our results to be almost exactly the same. There was one discrepancy in which I classified a referent as a clause and my peer reviewer classified it as a noun phrase. After discussing it briefly, we agreed together that it was a clause. Except for this one initial difference, every other aspect of our separate analyses was consistent, so I feel confident in the reliability of the findings.

Chapter Five Preview

Chapter Five discusses the findings from this analysis and considers their implications for ELs with connections to the relevant research outlined in Chapter Two. The limitations of the study will be addressed, as well as the plan to disseminate the results. Suggestions for further research will be made. Finally, I will conclude with a personal reflection on the process of completing this capstone.

CHAPTER FIVE: DISCUSSION

This chapter discusses the findings of the text analysis of the physical science text *Physical, Earth and Space Science* (2010). The main question I sought to answer was *How are demonstratives used as reference in a 10th grade physical science textbook?* In order to answer that, the following questions served as a guide:

- Is the demonstrative used as a determiner or as a pronoun?
- In which direction does it point - is the referent anaphoric, cataphoric, a graphic beside the text or something within a graphic?
- How far is the referent from the demonstrative?
- Is the referent a noun phrase, a clause or an inference that the reader has to make?
- Is it clear what the demonstrative refers to or is there interference such as more than one noun phrase, clause or inference that could be potential referents in the sentence before or after the demonstrative, depending on if it is anaphoric or cataphoric?

The findings from these questions are discussed in connection with the research presented in Chapter Two in light of possible implications for ELs and their instruction. Additionally, the limitations of the study will be acknowledged, recommendations for further research will be made, implications for this study and dissemination of results will be shared and, in conclusion, a personal reflection will be made.

Discussion: Determiners vs. Pronouns

After identifying each demonstrative in the text, the next step was to categorize each demonstrative as a determiner or a pronoun. A determiner modifies a noun, while a pronoun takes the place of a noun. One important finding is that 82 of the 116 demonstratives are determiners and only 34 are pronouns. This confirms Himmelmann's (1996) finding that determiner use is more frequent than pronominal use and roughly concurs with Gray and Cortes's (2010) study in which determiners made up 80% of the demonstratives in the text they analyzed.

This finding of a majority of determiners also connects to McCarthy (1994) and the APA (2010) style manual's warning against the use of demonstrative pronouns in writing due to the ambiguity created around the referents. In contrast, their recommendation is to use demonstratives as determiners to clarify the referent (APA, 2010). Since the majority of demonstratives are determiners in this text corpus, the referent may be clearer in those instances, supporting an EL in making the connection between a demonstrative and its referent. Example (38) illustrates the difference between a demonstrative used as a determiner and as a pronoun.

> (38) To change the number of molecules of a compound, you can write a whole number coefficient in front of the chemical formula. When you do *this*, all of the types of atoms in *that* formula are multiplied by *that* number. (p. 339)

The two determiners offer more clarity on what they are referring to. *That formula* refers back to *the chemical formula* and *that number* refers back to *whole number coefficient*. The noun the determiner modifies creates more obvious cohesion with its referent, while

the pronoun *this* does not give the same clear connection to its referent, *you can write a whole number coefficient in front of the chemical formula*.

While a demonstrative determiner may be clearer than a demonstrative pronoun, according to my analysis, of the 82 determiners, only 34 of them have a clear referent. Of the 13 demonstratives referring to a graphic or something within a graphic that is next to the text, the 12 determiners were considered to be clear. Such instances are what Himmelmann (1996) considered to be situational use, referring to the physical context of the event. In the other cases of a clear referent, the demonstrative also acts as a determiner. However, the other 48 instances of determiners are considered less clear because there is more than one noun phrase, clause or referent to which the determiner could be referring.

Interestingly, not one pronoun is considered to have a clear referent, which affirms McCarthy (1994) and the APA (2010) style manual's warning against pronoun demonstratives in text. Even example (37) mentioned in Chapter Four that refers to something in a graphic is considered to be unclear.

> (37) Figure 14.2: *These* are all different kinds of evidence that a chemical reaction is occurring. (p. 335).

This caption, example (37), is printed below the graphic, which contains four images showing different kinds of evidence of a chemical reaction. While it is possible the reader will arrive at the graphic first, it is impossible to predict the reader's order of processing information, whether they first look at the visual text or at the printed text, which could affect the clarity of the demonstrative *these*.

Although the majority of the demonstratives are determiners in the text analyzed in this study, about 29% of the demonstratives are pronouns, affirming Gray and Cortes' (2010) assertion that pronominal demonstratives are integral to academic writing. They advocate for explicit instruction around demonstratives as a cohesive structure. For ELs reading these texts, the lack of clarity, especially in pronominal demonstratives, could lead to comprehension issues. If students are not receiving direct instruction on the cohesion that is created by demonstratives that when standing alone have no meaning attached to them, they may miss the connection between ideas, thus possibly misunderstanding the information in the text.

Discussion: Anaphoric, Cataphoric or Graphic

One of the research questions posed sought to determine if the referent is anaphoric, cataphoric or a graphic beside the text. An anaphoric demonstrative points back to previous text, while a cataphoric demonstrative points ahead in the text. It was also determined that a referent could have multiple possibilities, potentially pointing to more than one place, for example, both anaphoric and a graphic.

One important finding is that the majority of demonstratives are anaphoric, pointing back in the text to the referent. Of the 116 demonstratives, 75 are anaphoric. Of these 75 anaphoric demonstratives, 70 of them are discourse deictic, the second of Himmelmann's (1996) four types of demonstratives. Discourse deixis means the referent is an idea or event and is both anaphoric and adjacent. Of the other five anaphoric demonstratives, three referents are within the same sentence as the demonstrative and two referents have one or more sentences between them.

Of the anaphoric demonstratives that were determined to have a clear referent, all of them are discourse deictic, with the exception of two. Examples (39) and (40) demonstrate the two exceptions that are not discourse deictic.

(39) Each of these actions creates forces and through *those* forces, each can change an object's motion. (p. 98)

(40) The force of friction acting on a surface always points opposite the direction of the motion of *that* surface. (p. 108)

In both examples the demonstrative and the referent are in the same sentence. In (39) *those forces* refers back to *forces* and in (40) *that surface* refers back to *surface*. Example (27) from Chapter Four demonstrates a discourse deictic demonstrative.

(27) The pound is based on the Roman unit *libra*, which means "balance." *This* is why the abbreviation for pound is lb (p. 99).

This refers back to the previous adjacent sentence *The pound is based on the Roman unit libra*, making it discourse deictic.

Of the seven instances that are cataphoric, all of them fall into Himmelmann's (1996) first type of situational use, referring to the context of the information. Example (41) demonstrates cataphoric situational use.

(41) *This* section provides you with information on how to classify the different types of chemical reactions. (p. 343)

In the example given, *this* very clearly refers to the section, giving the context for the information that is to follow. Each instance of a cataphoric demonstrative in this text corpus utilized *this*, which fits the claim that cataphoric demonstratives can only be *this* or *these* (Halliday & Hasan, 1976).

There are 21 instances in which the referent is in potentially more than one direction from the demonstrative. 19 of those instances could be anaphoric and refer to a graphic. The other two instances are more ambiguous as to whether the referent is anaphoric or cataphoric in the chain of reference. Examples (42) and (43) demonstrate this ambiguity.

> (42) For example, if you place an iron nail into a beaker of copper (II) chloride, you will begin to see reddish copper forming on the iron nail. In *this* reaction, iron replaces copper in the solution and the copper falls out of the solution and onto the nail as a metal. $Fe + CuCl_2 \rightarrow FeCl_2 + Cu$. (p. 345)
>
> (43) For the decomposition of water into hydrogen and oxygen, the energy source is electricity. In fact, *this* particular reaction, illustrated in Figure 14.13, is called electrolysis. $2H_2O \rightarrow 2H_2 + O_2$. (p. 344)

In (42) *this reaction* could potentially refer back to the written description of the reaction *if you place an iron nail into a beaker of copper (II) chloride, you will begin to see reddish copper forming on the iron nail* or ahead to the equation $Fe + CuCl_2 \rightarrow FeCl_2 + Cu$. In (43) *this particular reaction* has three potential referents, as it could refer back to *for the decomposition of water into hydrogen and oxygen, the energy source is electricity*, ahead to the naming of the reaction, *electrolysis*, or to the equation $2H_2O \rightarrow 2H_2 + O_2$. It is impossible to know which referent the author intended, but both examples show a chain of reference in which one term refers back to another, which in turn refers back to the original. Regardless of the cohesion created by the chain of reference, identifying the correct referent in these examples is confusing and further evidence that direct instruction around demonstratives is important for the success of ELs. This also supports that the

content area teacher should implement this kind of instruction, as the content teacher would have a better idea of the meaning within the text than the ESL teacher might, as the ESL teacher does not necessarily have strong training in the content area.

One common feature of academic language is that there can be more than one clause within a sentence. The demonstrative could potentially refer to multiple referents in various directions. This could be particularly confusing for ELs, who may not make the connection between the referents within different clauses and the single demonstrative that is used to refer to them. If the connection is not made, it can be very challenging to follow the coherence of the text and create meaning from the information being presented (Freeman & Freeman, 2003).

Discussion: Proximity of Demonstrative and Referent

One important finding in terms of the proximity is that in 95 of the 116 occurrences the referent is found in the sentence adjacent to the demonstrative. There are only eight instances when the demonstrative and referent are either in the same sentence (5 times) or have one or more sentences between them (3 times). The other thirteen instances were not counted in this category, as they refer directly to a graphic or something in the graphic. In other words, 92% of the countable occurrences find the referent in the sentence adjacent to the demonstrative. This is a noteworthy finding that gives reason for explicit instruction on encountering a demonstrative in the text and knowing to look for its referent in the adjacent sentence.

There is one instance of proximity that contradicts Himmelmann's (1996) claim that discourse deixis always refers to the immediately adjacent sentence. This was noted

in Example (31) in Chapter Four with three sentences separating the demonstrative from its referent.

> (31) The friction force between two smooth, hard surfaces is approximately proportional to the force squeezing the surfaces against each other. Consider sliding a heavy box across a floor. The force between the bottom of the box and the floor is the weight of the box. Therefore, the force of friction is proportional to the weight of the box. If the weight doubles, the force of friction also doubles. *This* rule is NOT true if one or both surfaces are wet, or if they are soft (p. 109).

Every other demonstrative analyzed in this text corpus fit into Himmelmann's (1996) assertions, that the tracking use can be adjacent or refer back more than one sentence, while discourse deixis use must always refer to the adjacent sentence. Example (31) is a demonstration of the complexity of teaching rules or guidelines about language when they do not always hold up in real life application.

Discussion: Noun Phrase, Clause or Inference

This analysis found only one instance of a demonstrative referring to something that the reader would have to infer, which is beneficial for ELs, as such inferences can rely on background knowledge that may be assumed, but is not actually realistic that all students come to the text with. It did find that the majority of referents are clauses, with 68 clauses, over 34 noun phrases, again not counting the 13 graphic referents.

First of all, the fact that a demonstrative can refer to a short noun phrase, perhaps only one word in length, or an entire clause or even an entire section or chapter is confusing. A noun phrase referent can be just as difficult to identify as the referent as an entire clause might be. One illustration of this comes from Example (35) in Chapter Four.

> (35) If you locate Orion in the night sky, you can see Betelgeuse, a red supergiant, and Rigel, a blue supergiant. It is easy to find *this* constellation because of the three stars that form its belt. (p. 697)

Here *this constellation* has one referent, which is *Orion*. However, within the same sentence as *Orion* there are a few other noun phrases that could also be the referent of *this constellation*, including *night sky*, *Betelgeuse, a red supergiant*, or *Rigel, a blue supergiant*. Indeed, the possibility of other referents impedes the clarity of the demonstrative's relationship with its actual referent especially with three proper nouns in the sentence and one of them being the referent while the other two are not. Although the referent is a noun phrase, there is no obvious connection to this noun phrase over the others within the sentence.

Although the referent as a noun phrase may be confusing, of the referents that are considered to be clear, 19 refer to a noun phrase and only three are clauses, without the 12 clear graphic referents, suggesting that clauses can be even more difficult to identify as the referent. This is shown in example (44).

> (44) Gravity squeezes the density of a star so tightly in the core that the electrons are stripped away and the bare nuclei of atoms almost touch each other. At *this* high density, nuclear fusion occurs, releasing tremendous amounts of energy. (p. 688)

In this example, *this high density* seems specific to a very clear referent, when in fact it refers to the entire previous sentence: *Gravity squeezes the density of a star so tightly in the core that the electrons are stripped away and the bare nuclei of atoms almost touch each other.* This emphasizes that students need to be taught that a demonstrative needs to

have a referent and it can be in various forms from a noun phrase to an entire sentence or section or beyond.

Discussion: Clear or Unclear Referent

Notable findings on the clarity of the referent have been previously mentioned throughout this chapter. Here is a summary of the results. In order for a referent to be considered clear, there can be only one noun phrase, clause or inference that the demonstrative could be referring to or if there is more than one possible referent, the noun modified by the determiner has to be repeated as the referent. There are 34 instances in which that criterion is met, including the 12 determiner demonstratives that the referent is a graphic beside the text or something in the graphic. Of the 34 instances, all are determiners, modifying a noun. Thus, the referent is more likely to be clear if the demonstrative is a determiner.

All of the clear referents are anaphoric or only to a graphic except example (45), which is cataphoric and as well as pointing to a graphic.

(45) Balance *this* equation (Figure 14.11): $Cu_2S + O_2 \rightarrow Cu_2O + SO_2$. (p. 341)

This equation refers to the following equation $Cu_2S + O_2 \rightarrow Cu_2O + SO_2$ as well as Figure 14.11 alongside the text.

In terms of distance between the demonstrative and the referent, the clear referents are all either in the instances of a determiner pointing to a graphic or something in the graphic or with the referent in the adjacent sentence with the exception of two occurrences in which the referent is in the same sentence. These same sentences were shown in examples (39) and (40) as the two referents that are not deictic.

(39) Each of these actions creates forces and through *those* forces, each can change an object's motion. (p. 98)

(40) The force of friction acting on a surface always points opposite the direction of the motion of *that* surface. (p. 108)

The other consideration was whether the referent is a noun phrase, clause or an inference. In instances when the referent is classified as clear, 19 demonstratives refer to a noun phrase, three refer to clauses and 12 were not counted, due to referring to a graphic or something in a graphic. This suggests that a noun phrase referent is typically clearer than a clause referent.

In conclusion, a referent may be easier to identify when pointed to by a determiner, when it is a noun phrase, anaphoric and in an adjacent sentence to the demonstrative. More research is needed to verify this claim.

Limitations

This study has developed many important findings, yet it does have several limitations. The primary limitation is its small text sample size. Only eight sections, less than 6% of the entire book, were analyzed. Although there were some strong themes among the findings, additional sections from other chapters may have added other results that could alter the findings. The analysis of more sections could also validate the findings from this study with stronger certainty. This study is limited to only one physical science text. Every textbook is different, with a different writing style, so another physical science textbook with comparable content could contain an entirely different usage of demonstratives. Another limitation is this study's focus on *this*, *that*, *these* and

those, as it does not address other demonstratives and their use; however, an analysis of all demonstratives was beyond the scope of this project.

Further Research

The limitations of this study provide reason to continue the research to extend the findings. An analysis of a larger number of sections within the textbook would give more representative information of how demonstratives are used in this particular text. Another study could analyze multiple physical science textbooks to observe trends across texts or note differences between them. To expand the scope even further, research could be done across subjects and grade levels within the discipline of science. Additionally, a study could extend beyond demonstratives to focus on other aspects of reference or in even broader strokes, of cohesion within the discipline of science. Another study could look at references to visuals in texts, as this study found that the relationship between visual text and printed text and the clarity therein can be complicated.

Implications

The findings of this text analysis have several implications for instruction in the physical science classroom. One of the primary implications is that teacher awareness of pedagogical language of the various forms used in a physical science textbook should be raised. If teachers were aware of the language structures unique to their discipline and specifically the text they expect their students to be able to read, they would be able to anticipate where students may need additional support and ultimately empower students to tackle challenging text because they have the skills to understand the text structures. For example, a teacher may recognize that demonstratives are most commonly referring to an idea in the prior adjacent sentence. With this understanding, the teacher could

provide explicit teaching before expecting students to approach the text independently. Moving forward, students' own awareness of the complex language forms within the text is heightened (Fang & Schleppegrell, 2008), promoting skills that allow them to become stronger critical readers.

The use of demonstratives and the finding that there can be lack of clarity in determining the referent suggest that it is important to teach students, and especially ELs, how the meaning of the demonstratives *this*, *that*, *these* and *those*, is found through their referent, rather than having independent semantic meaning (Halliday & Hasan, 1976) and how they are used to create cohesion within a text by connecting ideas. It is important to emphasize that the demonstratives are not used interchangeably, but each has a specific role it can play based on whether the referent is singular or plural and its proximity to its referent. Additionally, students need to know that the referent can be in various forms from a noun phrase to an entire clause, sentence, section or beyond, as well as an inference the reader is expected to make.

A final implication of this study is the need for explicit instruction on the difference between demonstratives used as determiners and demonstratives used as pronouns. Findings suggest there is generally less clarity around pronominal demonstratives. If students are unable to follow the cohesive links between ideas, comprehension can be impeded. This can be especially challenging when there are multiple clauses that the demonstrative could be referring to. It is also important that ELs understand that a demonstrative can have multiple possible referents in various directions.

Dissemination of Results

Upon the completion of this capstone, I will share the results of my research with my colleagues to inform them of what I have learned with the hopes of expanding on these ideas in our practice and our continued study of effective disciplinary literacy instruction in an EL classroom. These findings are relevant for the physical science teachers as well as all science and other content area teachers, since demonstratives are a part of the language used in each discipline. Additionally, ESL teachers can benefit from this research as they seek to support what is happening in the content area classrooms through their own language instruction. I will share this research through meeting with teachers in the hopes of igniting a school wide dialogue on how we might use this information to design meaningful instructional practices that support disciplinary literacy in all our classes.

Personal Reflection

As I near the end of completing a capstone, I am struck with deep gratitude for the experience. When I started my Research Methodology class last summer, I had very little idea of what lay ahead. I began the class with only a small idea of what I wanted to research. Throughout these past months my ideas have morphed and been shaped into something I never would have envisioned from the beginning. One of the beauties of the process of a capstone is that there is not a prescribed outcome, but rather that the learning leads the process, making it unique for each individual. Indeed, this is one of my greatest lessons: the learning can guide me. This process of independent study (independent, yet well supported with the feedback and guidance of my wonderful capstone committee) has empowered me to continue learning even as the final curtain is dropping on my graduate

school experience. I have become fascinated by disciplinary literacy and language structures and the trends and exceptions that occur within text. Even as I write the last pages of this capstone, I know that my learning is far from complete.

Conclusion

The purpose of this research was to inform EL instruction using a physical science textbook to better understand how demonstratives are used within the text. Among the outcomes, I have increased my own understanding of language structures and how cohesion is created within text, as well as some potential barriers to comprehension because of the way in which language is used. One of my primary roles as literacy specialist is ensuring that students have access to the content through text and that they are able to independently make meaning from the text. One way to accomplish this is to be aware of the complexities within the text and support the teachers in identifying those complexities in order to anticipate student need as they approach the text. Teachers may benefit from pinpointing common language features or structures that may pose challenges for the students and teach strategies around those features. As students learn to track cohesion throughout a text they will be better equipped to make meaning from what they are reading. Independent meaning making allows students to examine text critically and not simply receive information, but evaluate it. Such skills can be extended across disciplines to build critical thinkers and readers empowered to access text independently.

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APPENDIX A: DATA SPREADSHEET

		Determiner vs. Pronoun		Direction					Proximity of the Referent				Noun Phrase, Clause or Inference				Clarity	
Demonstrative	Number of times used	Determiner	Pronoun	Anaphoric	Cataphoric	Graphic	Within a Graphic	Multiple Possibilities	Same Sentence	Adjacent Sentence	One or More Sentences Between	Graphic/Within a Graphic	Noun Phrase	Clause	Inference	Graphic/Within a Graphic	Clear Referent	Unclear Referent
this																		
that																		
these																		
those																		
Total																		