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Adverbial Clauses in 4th Grade Science Textbooks: A Structural and Functional Analysis

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ADVERBIAL CLAUSES IN 4th GRADE SCIENCE TEXTBOOKS: A

STRUCTURAL AND FUNCTIONAL ANALYSIS

By

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

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DEDICATION

To my sons John and Jack, in whom I hope to inspire a lifelong love of learning.

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CHAPTER 1: INTRODUCTION

A few years ago as I began my first year teaching English learners (ELs) at an elementary school, one of the most challenging aspects for me was deciding what features of language were most important to teach my students. At the time I was working in an inner city charter school in which the majority of students (89%) were Latino. About 78% of the students at the school were classified as ELs, which at this school meant that they came from homes in which English was not the only language spoken. Because the majority of students at this charter school were considered EL, every student received 30-40 minutes of English language development (ELD) time every day. Each class was divided into three groups based on their English language proficiency, as determined by their teachers using a combination of their W-APT scores, which is a language proficiency assessment tool, their classroom performance, and teacher observation. My primary job was to work with the least proficient ELs from each class in Kindergarten through grade two, teaching language through science and social studies content. I also collaborated with mainstream classroom teachers to help write language objectives that supported the content they were teaching in science, social studies, and language arts. I had limited time with my students, seeing each group between 30-40 minutes per day, and I wanted to make sure that I was maximizing my time with them by giving them the skills they needed to improve their English

proficiency and be successful in their mainstream classrooms. I also knew that I was setting the foundation for their future learning.

My students came to class each day bringing with them their own diverse cultures, languages, traditions and perspectives. They also often came to school having some proficiency in social English, the English that is typically used in everyday conversations. In general, these students were eager to learn; I saw so much potential in each of them that I did not want to let them down. I knew that I was one member of the team that could help these students experience academic success. Along with their many strengths, ELs also come to school every day with a unique set of challenges. Many of these challenges, which can affect students academically as early as Kindergarten, become more noticeable around 4th grade, which is the grade at which I will be focusing this study.

Perhaps one of the biggest challenges for ELs is making the leap from their current social language to a more academic register that is expected at school. While social language is highly contextualized, academic registers tend to be more abstract, lexically dense, and structured than the language they most likely use in their day to day interactions (Gibbons, 2006). In particular, the academic texts, such as textbooks, that students are expected to read at school convey meaning in a very different way than they are used to (Schleppegrell, 2004). The academic language that these texts use, that students are expected to use in their speaking and writing in the classroom, is often not explicitly taught by content area teachers. Without linguistic support, students may not make that leap to becoming proficient in a more academic register, even after several years in the mainstream classroom (Gibbons, 2006). Students may be judged as having

learning difficulties because teachers assume that their apparently fluent ELs' problems expressing themselves is a result of their cognitive abilities rather than their linguistic abilities; in reality, those students are only fluent in their social language in English but not yet in their academic language (Gibbons, 2006; Schleppegrell, 2004). It is therefore important that teachers are aware of the linguistic needs of their students and the areas in which they many need extra support.

One area that many ELs do need extra linguistic support in is reading comprehension. This is exemplified by the Minnesota Department of Education's yearly Minnesota Report Card (2015) which showed that there was a significant gap in reading achievement of ELs compared to all students and that the gap continued to increase as students progressed through school from the 4th to the 8th grade as shown in Table 1.

Table 1

Percentage of EL and All Students' Proficiency in Reading in 4th and 8th Grade

Grade Level	ELs	All Students
4th Grade	19.1	57.9
8th Grade	12.2	56.2

Since approximately 10% of all students enrolled in schools across the United States are currently classified as EL (NCES, 2010), mainstream teachers as well as language teachers will be educating this diverse group of students. Because only 19.1% of 4th grade EL students are considered proficient in reading, it is easy to conclude that current teaching methods are not meeting the needs of these diverse learners. Considering these numbers, it is imperative educators know best practices for teaching, especially in the area of academic reading instruction.

This leads me back to my original challenge when teaching ELs, which is deciding *what* to teach. In other words, which aspects of language are most important, relevant, and appropriate to focus on, especially when considering the vast amount of linguistic knowledge necessary for students to be able to speak, listen, read, and write in English in order to access academic content and to be able to express themselves appropriately in an academic setting? One effective way of determining what should be taught is to analyze what students will either need to produce or comprehend in order to express or access the content they are learning (Schleppegrell & Fang, 2010). With that knowledge, teachers can explicitly teach the specific structures and vocabulary needed in each case. Schleppegrell and Fang (2010) refer to the analysis of how language is used in different academic contexts as *functional language analysis*. In this approach, language and content are taught together by analyzing how grammatical forms are used to create meaning differently in each content area. Therefore, instruction is determined by how language functions within the context of what students are studying.

Often teachers are not aware of the complex linguistic features that are used within their content areas. Thus, Schleppegrell (2004) contends that teachers need to be better prepared to teach the language of their content areas. Once teachers understand how meaning is expressed through the grammar of their content, they can make it explicitly known to their students. By focusing on language as a way to comprehend content, teachers can give their students the linguistic tools they need and help them understand how and why certain linguistic choices are made as they read and write in different content areas in school. In order to do this, researchers and teacher educators need a better understanding of the linguistic challenges students face in school,

considering that this type of language differs significantly from the everyday language many students are used to (Schleppegrell, 2004).

Within different subject areas are different genres or types of text (Schleppegrell, 2004). Each genre can be analyzed to find grammatical and lexical patterns of how it is constructed. Although there are many ways to categorize genres, Schleppegrell (2004) classifies them as recounts, narratives, procedures, reports, accounts, explanations, or exposition. Each of these genres exhibits certain linguistic features; for example, a teacher could teach regular and irregular past tense verbs so students could recount a story in language arts, teach the imperative mood so students could write the instructions for a scientific procedure, or teach nominalization so students could better comprehend an account in a history text (Schleppegrell, 2004). By highlighting the features of each genre for students and explicitly teaching specific forms to convey specific meanings, teachers are giving their students the linguistic tools they need to succeed in an academic setting.

From the number of students not reading proficiently at grade level, it appears traditional academic reading instruction has not been as effective as it needs to be with all students. Typically 4th grade is when students begin to make the switch from learning to read to reading to learn (Chall, Jacobs, & Baldwin, 1990) and they are expected to be able to comprehend not only fictional stories but more difficult expository texts, often in the form of textbooks, as they begin reading for information in different subject areas. The problem is that many ELs at this point may have reached the level of their peers on attaining word level skills like decoding and word recognition, but have not yet developed the text level skills that will lead to reading comprehension (August &

Shanahan, 2006). Simply being able to decode and read fluently does not guarantee that a student will comprehend what they are reading (Williams, 2005) especially when the EL population is often lacking experience with and knowledge of academic language. The National Reading Panel (NICHD, 2000) identifies five areas that should be focused on in reading instruction, including phonemic awareness, phonics, fluency, vocabulary, and comprehension strategies and emphasizes vocabulary and comprehension strategies as the two essential components for comprehension. However, Fang (2008) argues that although this type of reading instruction is adequate in the early grades, by fourth grade and on when students are beginning to encounter more expository texts, educators need to go beyond just teaching these five areas as the language of expository texts is markedly different from the language found in the storybooks most often read in the early grades. After doing a thorough comparison of the language found in a typical primary-grade storybook to the language found in a typical intermediate-grade science text, he concludes that it is crucial that instruction go beyond the five typical areas of reading instruction and also focus on the unique forms and functions of language found in expository texts; otherwise students, especially ELs and other struggling readers, will be left behind.

Because text comprehension is especially challenging in difficult subject areas like science (Snow, 2002), and 4th grade is when reading achievement can decline for some students, most likely due to the distinct move towards more expository text reading, (Chall, Jacobs, & Baldwin, 1990); I wanted to learn more about the language that is used in science texts at this level. In order to do this, I looked at a chapter on the food web from a 4th grade science text called *Real Science* (William, Rubinstein, & Vega, 2000).

After reading through the text and paying close attention to the language used, I was surprised at the complexity of the majority of the sentences in the text. One feature I found prevalent throughout the text that contributed to sentence complexity was the use of subordinating conjunctions used to show how different ideas are connected within sentences. Subordinating conjunctions, also called adverbial subordinators, are words that connect an adverbial clause to the main clause of a sentence, conveying some type of relationship between the two clauses (Celce-Murcia & Larsen-Freeman, 1999). Example (1) from a 4th grade science text (William et al., 2000) shows this:

1. Even though they can be very tiny, decomposers are important.

The subordinating conjunction *even though* introduces the adverbial clause "Even though they can be very tiny." This connects to the main, or independent, clause, "decomposers are important," and forms a relationship between them showing contrast or unexpected results.

I believe these types of conjunctions can be problematic for ELs for a number of reasons. First of all, if students do not know the meaning of the subordinating conjunction being used, they may draw incorrect conclusions about the relationships between the two clauses being connected. This could lead to misinterpretation, especially when the conjunction could have more than one meaning, or could show more than one type of relationship (Fang, 2006). Also, subordinating conjunctions may be used differently in social conversation as compared to how they are used in academic writing (Celce-Murcia & Larsen-Freeman, 1999; Schleppegrell, 1992), so students may be unfamiliar with the more formal uses of these words. Lastly, in sentences with multiple

clauses, it may be difficult for students to identify which is the main clause of the sentence.

Because I believe that understanding subordinating conjunctions is an important piece of comprehension, their prevalence and use in science texts is worthy of further study. This paper is focused on how ideas are connected through subordinating conjunctions in 4th grade science texts. Since subordinating conjunctions connect adverbial clauses to the main clause in a sentence, I am going to be looking specifically at the frequency and positioning of adverbial clauses used in those texts as well as the meaning of the subordinating conjunctions used to introduce those clauses. I believe that an in-depth study of how adverbial clauses are used within 4th grade science texts will help inform my future teaching as well as hopefully give other language and mainstream teachers insight into this important language feature.

<div align="center">Guiding Questions</div>

In order to gain understanding of the nature of adverbial clauses in 4th grade science texts, I will do a structural and functional analysis of lessons on similar topics in four different texts in order to address the following questions and subquestions:

1. How are adverbial clauses, including subordinating conjunctions, used throughout the texts?

   - How frequently do adverbial clauses occur in science texts at this grade level?

   - Where in the sentence are these adverbial clauses found?

2. What relationships are created between the main clause and the subordinate clause in the sentence by the subordinating conjunctions?

3. How do the frequency and location of adverbial clauses, as well as the meanings of subordinating conjunctions, vary from textbook to textbook?

Role of the Researcher

As a language teacher I want to be able to teach students the language features they will need to know in order to access academic content in different subject areas. My role in this research project is to look specifically at one language feature, adverbial clauses in 4th grade science texts, in order to better understand how often, where, and why they are used. I will choose the texts to be analyzed, conduct my analysis based on the questions I identified above, and then draw conclusions based on my findings.

Summary and Chapter Overviews

In summary, ELs face challenges in the classroom, including a lack of linguistic skills necessary to communicate in an academic register, which can inhibit their reading comprehension of academic texts. However, ELs can be facilitated in learning academic language within the content areas through the functional grammar approach by teaching the specific language structures and vocabulary found in different disciplines and genres. Through my role as the researcher conducting a structural and functional analysis, and the preceding research questions, I plan to explore the use of adverbial clauses, including their frequency and positioning, as well as the relationships that the subordinating conjunctions used create between the main and subordinate clauses in 4th grade science texts.

In chapter two I summarize the research related to this topic including discussions on scientific literacy and the specialized language of science that contributes to its difficulty for ELs. I also define and give an in-depth explanation of adverbial clauses and

subordinating conjunctions, as well as discuss the purpose and use of text analysis. In chapter three I outline my methodology including my data collection techniques and procedure. In chapter four I explain the results of my analysis and how it connects with current research. Finally, in chapter five I reflect on major findings and discuss implications for language and mainstream teachers while considering the limitations of the study and need for further research.

CHAPTER TWO: LITERATURE REVIEW

The purpose of this study is to identify and analyze one feature that may make reading science texts difficult for ELs. I will do this through a structural and functional analysis of sections of four different 4th grade science texts in order to look at the frequency and position of adverbial clauses, focusing on the relationships created by the subordinating conjunctions used to introduce these clauses. By looking closer at this particular language feature and gaining a better understanding of how it functions in the academic context of science, what I discover will inform my future teaching as I help ELs construct meaning when they read these complex texts.

In this chapter I draw on previous research in order to make the connection between language and science learning, explain the functional grammar approach to analyzing texts, and outline some of the difficulties that ELs encounter when reading within the context of expository science texts. I also review previous research in order to define and give a more in-depth look at adverbial clauses and the subordinating conjunctions that introduce them as well as define and discuss the uses of text analysis. Finally, I outline current research on the uses of adverbial clauses and identify where a gap in research lies.

Language and Science

Science, in its many facets, is one of the disciplines that is required for study by students in the K-12 curriculum. When looking at the history of science teaching and learning in the United States, Yore, Bisanz, and Hand (2003) claim that the role of language- the skills of reading, writing, speaking, and listening- was largely ignored before the 1970s. However, since the late 1970s there has been much progress in the area of curriculum, teacher education, and instruction that have put a greater emphasis on the role that language plays in the learning of science; the ability for students to be able to read and write science has become more important (Yore et al., 2003). In Minnesota, the English Language Arts standards in grades 6-12 now include standards for literacy in the content areas of history/social studies, science, and technical subjects as a way to help meet the demands of reading, writing, speaking, and listening in each of those content areas (Minnesota Department of Education, 2010). Including this strand in the standards exemplifies the increased awareness of the important relationship between science and literacy.

Yore, et al. (2003) identifies two main components of science literacy: the *fundamental sense,* which involves being able to read, write, and speak about science, and the *derived sense*, which involves being knowledgeable about scientific concepts, the nature of science, and its procedures and application. Although language has been identified as playing an important role in the learning and understanding of science, there is still a lack of research on how the content of science dictates the structures of oral and written discourse, how scientists use language to communicate their findings to different audiences, and how educators can use that information to promote science learning in the

classroom (Yore, et al., 2003). Halliday (1996a) claims that the learning of language and the learning of science are inseparable and that the very nature of what scientists convey cannot be communicated using everyday language, but must be communicated using technical wording and certain linguistic structures that can make comprehension difficult for both native and non-native speakers of English alike. A number of these specific structures will be further discussed in a later section. In order for students to learn science, they must learn the language that science is communicated in. One way of becoming more aware of the language used in scientific writing is through a structural and functional analysis of scientific texts. A functional language approach to looking at scientific writing will be further discussed in the next section.

A Functional Language Approach

The functional part of a structural and functional analysis, which is based off of a functional grammar framework developed by Halliday (1985), is one way of looking at a text, any written or spoken discourse, to see how meaning is conveyed through language (Fang & Schleppegrell, 2010). Functional grammar shows us how language is used in different genres. For instance, scientific expository writing uses language differently than historical expository writing, or than the speech used between parent and child. Halliday (1985) claims that language structure is based on the purpose for which it is being used in any given context and that language is organized based on its purpose. The meaning of the text is conveyed through its grammatical configurations, meaning the choices in syntax and vocabulary used, as well as in the overall organization of the text. When considering that different genres use grammar in different ways to convey meaning, it is important to ask *how* grammar is used in each genre. This is where a

structural and functional analysis of the grammar used in different contexts and for different functions can be a valuable tool.

There are three different aspects of meaning that a functional language analysis considers when looking at a text (Fang & Schleppegrell, 2010; Halliday, 1985). The first is the *experiential* meaning that is focused on what is going on in the text. This is realized by analyzing the *participant, process,* and *circumstance* of each clause. The participant is expressed by nouns or noun phrases and is the who or what of the clause. The process is expressed through verbs, which can be categorized in different ways, but Fang and Schleppegrell (2010) categorize them as either *doing, sensing, being,* or *saying* verbs. Finally, the circumstances of the clause are typically expressed through adverbs or prepositions that convey the time, location or condition of what is happening. The second type of meaning considered through a functional language analysis is the *interpersonal* meaning. This type of meaning helps the reader determine the author's point of view and is often expressed through mood and modality, so it looks at whether the declarative, interrogative or imperative mood is being used as well as which types of modals are used. The third type of meaning considered is the *textual* meaning. This meaning is concerned with how the text is organized. It is expressed by its use of theme (known information) and rheme (new information) as well as cohesive devices. Text cohesion is often shown by features such as pronouns, synonyms, antonyms, and conjunctions, and addresses how the whole text ties together. These three types of meaning all occur simultaneously and a text can be analyzed by looking at the features for any of the types of meaning, depending on the intended purpose of the analysis (Fang & Schleppegrell, 2010).

A structural and functional analysis can give teachers and students an abundance of information about the meaning of a text, including patterns of how each discipline expresses that meaning in different ways. This study is intended to add to this knowledge by contributing to a further understanding of how both the experiential meaning and the textual meaning of 4th grade science texts are created.   Analyzing the use of adverbial clauses and the subordinating conjunctions that begin them will give insight into the circumstance of what is happening in the texts as well as text cohesion at the sentence level.   There has already been some research done looking specifically at how different disciplines express meaning (Fang, 2006, 2008; Halliday, 1996a; Snow, 2010). In the next section, I will look more closely at scientific writing and how meaning is expressed in many scientific texts as well as why those language features may be problematic for students, especially ELs.

Scientific Language

It is well documented that the language used in expository texts is much different than the language used in social situations between peers (Schleppegrell, 2004). In the discipline of science, Fang (2006) calls these specialized language features the language of school science (LSS). This specialized language does not happen randomly, or by chance (Halliday, 1996a). The syntax, vocabulary, and text structures used are a result of what scientists need in order to communicate. By the very nature of science, scientists need to communicate links between claims to form new theories (Fang, 2006). It is also a "discipline aimed at describing, explaining, analyzing, classifying, comparing, generalizing, hypothesizing, theorizing, and arguing about the phenomena in the natural world" (Fang, 2006, pg. 501). In order to communicate those ideas, scientists need to use

grammar in a unique way. So although LSS is necessary, it does make comprehension of scientific texts very difficult for those not familiar with the type of language used, including ELs (Fang, 2006). Five common features found in scientific expository writing include concentration of technical vocabulary, nominalization, passive voice, lexical density, and sentence complexity.

Concentration of technical vocabulary. Technical vocabulary is words that have a specialized meaning within a certain discipline. Although teachers typically focus instruction on technical vocabulary, and the words are often highlighted and defined in the text, the high concentration of technical vocabulary found in scientific textbooks can contribute to comprehension difficulties (Fang, 2006). Additionally, words from students' everyday lives often have different meanings when found in science texts, which can also cause a lack of comprehension (Fang, 2006). For example, the word *matter* in everyday language means the importance of something while in the context of science refers to a physical substance that takes up space. Finally, the definitions of technical vocabulary are often taught using other academic words that students might not understand (Snow, 2010).

Nominalization. This linguistic feature occurs when a verb, adjective, or even an entire sentence is changed into a noun or noun phrase that can be embedded in another sentence (Fang, 2006, Snow, 2010). Example (2) from Fang (2006, p. 500) shows how the verbs *tumble* and *splash* are converted into a noun phrase which also includes a modifying prepositional phrase:

2. *The tumbling and splashing of swiftly flowing water* mixes in air from the atmosphere, increasing the oxygen content of the water.

In science, this is done to help express more abstract ideas and theories and also to condense information. The resulting abstract and condensed information is often difficult to comprehend (Fang, 2006). Another reason nominalization can be difficult for students is that they may expect that nouns are used for people and things and verbs are used for actions and events, but here they find almost anything can be turned into a noun (Halliday, 1996a).

Passive voice. When using passive voice, the writer avoids naming the actor in the sentence. In scientific writing, this type of sentence structure is sometimes necessary, but it can also be used intentionally by the author to make the text more objective by not having to name who is responsible for an action or discovery (Fang, 2006). Example (3) from Fang (2006) demonstrates how the passive voice is used to avoid naming the party responsible for deforestation and subsequent hike in firewood prices:

   3. As forests were cut down, firewood became more expensive.
The effect of using the passive voice is that it can make the text much more impersonal, authoritative, less involving, and more difficult to read as students often prefer to read science narratives that contain human characters they can relate to personally and emotionally (Fang, 2006).

Lexical density. Lexical density measures how much information is packed into a single clause (Halliday, 1996a). One basic way of measuring lexical density is to figure out the average number of content words (i.e., nouns, verbs, adjectives, and adverbs) in each clause (Fang, 2008). More content words per clause results in a higher density text. Lengthy, complex noun phrases that add to lexical density are used in scientific writing to compress information that normally would be expressed in several sentences (Fang,

2006). These long noun phrases require students to process more information as they read making comprehension difficult, especially when there are no functional words in between (Halliday, 1996a)

   Sentence complexity. Complex sentences are sentences with an independent clause as well as at least one dependent clause (Celce-Murcia & Larsen Freeman, 1999). Dependent clauses are either introduced with subordinating conjunctions or are conveyed through saying and thinking verbs (Fang, 2006). Example (4) from a 4th grade science text (William et al., 2000, p. A52) shows how the subordinating conjunction *because* introduces the dependent clause that follows it and example (5) demonstrates how the dependent clause is expressed with a thinking verb:

4. A pyramid is a good model to show the flow of energy because a pyramid gets smaller as it goes up.
5.   She thought those types of birds were endangered.

 Another type of dependent clause is called an embedded clause because it is found within the main clause of the sentence. Example (6) from Fang (2006, p. 498) demonstrates this, with the embedded clause in italics:

6. A diagram *that is called an energy pyramid* shows the amount of energy that moves from one feeding level to another in a food web.

When sentences contain multiple subordinate or embedded clauses, or both, the logical relationships and semantic links between clauses can be difficult to figure out (Fang, 2006). These types of complex sentences are necessary in scientific writing because they

allow the writer to better present information and show logical relationships

(Schleppegrell, 2004).

These five linguistic features are by no means the only features in scientific

writing, but they do represent some of the most common features found in the discipline.

They also are often found working simultaneously within one text, making

comprehension extremely difficult for ELs and other students who have not been

explicitly taught about them and how to gain meaning from this type of language (Fang,

2006, 2008). Understanding these features is a vital piece in gaining scientific literacy

(Fang, 2006), therefore, we must not merely simplify the language we expose our

students to, but instead provide direct instruction on understanding these difficult

language features in order to provide students access to scientific content. This paper

focuses on the final feature in this list, sentence complexity, as adverbial clauses are one

type of subordinate clause that increases sentence complexity. In the following sections I

give a more complete definition and explanation of adverbial clauses and how they are

used in texts as well as provide an in depth explanation of a structural and functional

analysis, including its purpose and use.

<div align="center">Adverbial Clauses</div>

Because this paper explores the use, including frequency and location of adverbial

clauses as well as the meaning relationships created by the subordinating conjunctions

used within 4th grade science texts, it is imperative to have a good understanding of what

adverbial clauses are. Adverbials can come in the form of single words (adverbs),

phrases, prepositional phrases, or clauses and are used to modify verbs, adjectives, other

adverbs or entire clauses (Celce-Murcia & Larsen-Freeman, 1999) as shown in Table 2.

Derewianka (2011) defines a phrase as a group of words that acts in a certain way, such as acting as a noun, verb, or adverb, while a clause is a unit of meaning that typically contains a verb. Some clauses, known as independent clauses, can stand alone as a complete sentence, while others cannot. Adverbial clauses are dependent clauses and cannot stand alone (Schrampfer Azar, 2000).

Table 2

Forms of Adverbials

The girl jumped *suddenly*.	Adverbial as a single word
The girl jumped *very high*.	Adverbial as a phrase
The girl jumped *into the air*.	Adverbial as a prepositional phrase
The girl jumped *because she was frightened*.	Adverbial as a dependent clause

Note. Adverbials are shown in italics.

In the previous examples, it was demonstrated that adverbials can take several different forms, as single words, phrases, prepositional phrases, or clauses. Adverbials can also modify more than one word (Celce-Murcia & Larsen-Freeman, 1999). We can see in the final example above that the adverbial clause "because she was frightened" modifies the entire independent clause "The girl jumped." Another attribute of an adverbial clause as opposed to other types of adverbials is that they typically begin with a subordinating conjunction which conveys some type of meaning relationship between the main clause and the adverbial clause (Biber, Johansson, Leech, Conrad, & Finegan, 1999). Subordinators and their meanings will be further discussed in a subsequent section.

In each of the cases in Table 2, the adverbial occurs at the end of the sentence. It is important to note that all adverbials, including adverbial clauses, can occur in different

positions within the sentence, including initial, medial, and final positions as

demonstrated in Table 3:

Table 3

Positions of Adverbial Clauses

When the sky is clear, you can see as far as Orcas Island.	Sentence-initial position
You can, *when the sky is clear*, see as far as Orcas Island.	Sentence-medial position
You can see as far as Orcas Island *when the sky is clear.*	Sentence-final position

Note. Table adapted from *The Grammar Book* (Celce-Murcia & Larsen-Freeman, 1999, p. 522)

Although adverbial clauses are rather free to occur in different positions within the

sentence, there can be some differences in the effect they have depending on their

position. Ramsey (1987) found that adverbial clauses in the sentence-initial position tend

to link previous content to the main clause of the sentence. They often reiterate known

information that has already been discussed in the previous discourse, while the main

clause introduces new information (Biber et al., 1999). When adverbial clauses fall into

the sentence-final position, the main clause at the beginning of the sentence often

contains the given information, while the adverbial clause presents new information

(Biber et al., 1999).

Biber et al. (1999) claims that sentence-initial adverbial clauses that present given

information can help provide text cohesion. One example is that sentence-initial

adverbial clauses can be used to show reason. These clauses can use previously given

information as a reason for the new information in the main clause. As a result, the

reason clause creates a bridge between the known information in the text and the new

information in the main clause of the sentence, creating cohesion (Biber et al., 1999).

Along with showing reason, sentence-initial adverbial clauses can be used to show

contrast with previous discourse as well. Sentence-initial clauses can also set up a

framework for what is to come (Biber et al, 1999), and are especially used in written

registers to set up hypothetical conditions in which the consequences are then discussed

in the main clause (Biber et al., 1999) as in example (7):

    7.   If the white rhino is not protected, it could easily go extinct.

Although her work was not specifically focused on scientific writing, Ramsey (1987)

supported this idea with her findings that generally within a paragraph, sentences towards

the beginning of the paragraph tended to have more sentence-initial adverbial clauses,

while those coming later in the paragraph tended to have more sentence-final adverbial

clauses. She notes that the sentence-initial adverbial clauses at the beginning of a

paragraph could act as a sort of preview to readers of what is to come later in the

paragraph. Finally, sentence-medial adverbial clauses are very rare in written discourse

(Biber, et al., 1999), but in spoken discourse, they are often separated from the rest of the

clause by long pauses (Celce-Murcia & Larsen-Freeman, 1999).

    There has been little research done on the frequency of adverbial clauses found in

academic texts; however, in a report looking at features of academic language in 5th grade

science, social studies, and math text books, it was found that science texts had far more

adverbial clauses than either math or social studies, with 17.84 per 100 sentences, or

about one every five to six sentences. It also found that there was a variety of fifteen

different subordinating conjunctions used to introduce the adverbial clauses and the most

frequently found were *when* (27%), *as* (27%), *because* (15%), and *if* (10%) (Butler et al.,

2004). In another study of the frequency of different adverbial types across four registers (spoken, fiction, published news, and academic prose), it was found that adverbials in the form of finite and non-finite clauses were found about 15,000 times per million words (Biber et al., 1999). Non-finite clauses, or reduced forms of adverbial clauses, are those in which the subject and sometimes the auxiliary verb of the subordinate clause has been deleted (Celce-Murcia & Larsen-Freeman, 1999). Examples (8) and (9) demonstrate how a finite clause can become non-finite.

8.   I lost my purse while I was shopping for shoes.

9.   I lost my purse while shopping for shoes.

Biber's work did not look specifically at the frequency of adverbial clauses within each register separately, so it is impossible to tell what the frequency is specifically in the academic texts that he analyzed. The current study will further look at frequency of adverbial clauses, including both finite and non-finite, in the specific genre of 4th grade science texts.

This section showed that adverbials can come in many forms including single words, phrases, prepositional phrases and dependent clauses. It also demonstrated that adverbials can appear in either the sentence-initial, medial, or final positions and that the position of the adverbial clause can have an effect on its meaning within the sentence. Finally, this section took a closer look at current research on the frequency of adverbial clauses. The following sections look at the subordinating conjunctions that introduce adverbial clauses and what they mean, as well as discuss why sentences containing adverbial clauses may be difficult for ELs to comprehend.

Subordinating Conjunctions

One identifying feature of an adverbial clause is that it is most often introduced by

a subordinating conjunction (Schrampfer Azar, 2000). However, in some cases, as

shown later, an adverbial clause can occur in a reduced form in which the subject and

possibly the subordinating conjunction are omitted. The non-exhaustive list in Table 4

shows some examples of simple and complex subordinating conjunctions:

Table 4

Simple and Complex Subordinating Conjunctions

Simple subordinating conjunctions		Complex subordinating Conjunctions	
after	since	so/as long as	insofar as
although	though	as soon as	in that
as	until	even if	now that
because	unless	even though	provided that
before	when (ever)	given that	so that
if	where (ever)	inasmuch as	
lest	whereas	in case (that)	
once	while	in order that	

Note. Table adapted from *The Grammar Book* (Celce-Murcia & Larsen-Freeman, 1999, p. 520).

Subordinating conjunctions are one type of logical connector that "allow a

listener/reader to infer connections between two segments of discourse" (Celce-Murcia &

Larsen-Freeman, 1999, p. 519). These cohesive devices help identify the connections

between clauses, thereby helping the reader make sense of the sentence. They are called

subordinating because once added to a clause, they cause the clause to become a

subordinate, or dependent clause. In summary, an adverbial clause is made up of a

subordinating conjunction plus an independent clause. The addition of the subordinating

conjunction makes what would be an independent clause dependent on the main clause of

the sentence, and also indicates some type of relationship between the two clauses. Example (10) from a 4th grade science text (William et al., 2000, pg. A49) demonstrates this:

    10. If you had a salad for lunch, the energy you received came from the lettuce, tomatoes, and other things in your salad.

The addition of the subordinating conjunction *if* makes the first clause a dependent clause. *If* also conveys a conditional meaning, telling us that if the adverbial clause is true, then the main clause is also true. The explicit meanings conveyed by subordinating conjunctions can aid in the comprehension of a text (Best, Rowe, Ozuru, & McNamara, 2005), as discussed in the next section.

    <u>Meanings of subordinating conjunctions.</u> In order to comprehend a text, students must be able to utilize a number of skills including decoding, accessing word meaning, and putting multiple word meanings together to make sense at the sentence level (Best et al., 2005). They must also be able to construct meaning across sentences and paragraphs to make meaning of the entire text (Kintsch, 1988). While reading a textbook, students must make many inferences about how different sentences and clauses are connected, or how their meanings go together. When these connections are made explicit through linguistic cues such as subordinating conjunctions, students do not have to make as many inferences on their own (Kintsch, 1988), which can increase their comprehension. Grammatically, sentences can often be written side by side without the use of a subordinating conjunction; however, by using these connectors, the author can help the reader make correct inferences about their intentions (Celce-Murcia & Larsen-Freeman, 1999)) as in examples (11) and (12).

    11. I planted a vegetable garden. I'm not fond of vegetables.

    12. I planted a vegetable garden *even though* I'm not fond of vegetables.

While in example (11) it is difficult to infer how these two clauses are related, example

(12) uses the subordinating conjunction *even though* to create a meaningful relationship,

signifying contrast, between the two clauses. This relationship remains unclear in

example (11).

    The use of subordinating conjunctions can signal many different meanings.

Different authors have categorized their meanings in different ways. For example, Biber

et al. (1999) puts subordinators into five meaning categories including time, manner,

reason, concessive, and condition. Celce-Murcia and Larsen-Freeman (1999) categorize

their meanings into time, location, manner, purpose, reason, simultaneous, conditional,

and concessive, while Givón (1993) puts them into the categories of temporal,

conditional, concessive, substitutive, additive, cause and reason, and purpose. Celce-

Murcia and Larsen-Freeman (1999) do not believe that subordinating conjunctions can

fall into the categories of substitutive or additive, perhaps because their definitions of

what qualifies as a subordinating conjunction differ slightly. For the purpose of this

paper, I am going to use the categories of time, location, manner, purpose, cause and

reason, conditional, and concessive. See Table 5 for examples of subordinating

conjunctions that fall into each meaning category:

Table 5

Meaning Categories of Subordinating Conjunctions with Examples

---

Time: *after, as long as, before, since, while, when, until*

Location: *where, wherever*

Manner: *as, in that, as if, as though*

Purpose: *so that, in order that, to, in order to*

Cause/ Reason: *since, because, as, now that*

Conditional: *if, even if, as long as, in case, provided that, unless*

Concessive: *although, even though, though, while*

Note. Table adapted from *The Grammar Book* (Celce-Murcia & Larsen-Freeman, 1999, p. 529)

Although some of these meaning categories seem straightforward, others require a little more discussion. Subordinating conjunctions of *time* and *location* can tell when and where something happened. *Manner* expresses the way in which something is said or done and *purpose* tells why it was done (Perez Amaro, n.d.). For the *cause* and *reason* category, Givón (1993) gives a slight semantic distinction between the two, explaining that cause shows some external relationship between an event and a result while reason attaches an evaluative perspective to it. When talking about a cause, the result is bound to happen (due to the cause). When talking about a reason, the subject has a choice, or decides to act a certain way (due to the reason). The following sentences (11 and 12) from Givón (1993, p. 300) exemplify the semantic differences:

11. External cause

    "Because it was freezing, the pipes burst."

12. Reason

"Because it was cold, I put on my coat."

In the first example, the freezing weather caused the pipes to burst. The effect was necessary due to the cause. In the second example, however, the effect of putting on the coat was not necessary, but a choice made by the subject. Although there is a slight semantic difference between these two, I have decided to put them into the same category to represent cause and effect. Next, *conditional* adverbial clauses express the possibility or impossibility of something happening (Perez Amaro, n.d.). Finally, the last semantic category of meaning for subordinating conjunctions is *concessive*. These types of clauses show "**contrast** or **counter-expectancy** with the [adverbial clause] supplying the grounds for the expectation, and the main clause showing the unexpected or less-likely event or state" (Givón, 1993, p. 297). Example (13) demonstrates this type of relationship.

13. Even though I was tired, I stayed up late to watch the game.

In this sentence, the dependent clause, starting with the subordinating conjunction *even though,* gives the basis for the expectation. Based on this information, one would expect that the tired person would go to sleep; however, the main clause tells us that the tired person did the less likely act of continuing to stay up late. As demonstrated above, through the use of a variety of subordinating conjunctions, different meanings and relationships can be conveyed creating connections and cohesion between clauses. The next section will discuss some of the difficulties that subordinating conjunctions can cause ELs.

Challenges of Subordinating Conjunctions for ELs

Although the use of subordinating conjunctions helps create meaning, they can also cause comprehension difficulties for a number of reasons. First of all, when they are

used, they create complex sentences made up of numerous levels of semantic links and meaning relationships (Fang, 2008). These links and relationships can take time and effort for students to process, especially for struggling readers and ELs. Adding to this difficulty is that many simple subordinating conjunctions can be used as more than one part of speech (Celce-Murcia & Larsen-Freeman, 1999). *Where* and *when,* for example, are also *wh*-question words and can be used to begin relative clauses. Words like *before* and *after* can function as prepositions and *as* can be used as a comparative structure. Another difficulty is that the same word may signal different meanings, such as the word *when,* which is traditionally taught to signal time (Givón, 1993). The word *when*, however, can also be used to show a conditional relationship, which ELs may not be aware of. Example (14) by Givón (1993, p. 292) shows this:

14. *When* you bring it to me, I'll pay you.

    a. **Conditional interpretation**:

      …and if you don't bring it to me, I won't pay you. So it's up to you to decide which it shall be.

    b. **Temporal interpretation:**

      …So just go ahead and bring it to me, so that I can pay you."

Even though the second, temporal, interpretation has more certainty than the first, conditional, interpretation, they both give a sense of a conditional meaning, which may not be understood by ELs.

Finally, while adverbial clauses typically start with a subordinating conjunction added to a clause containing a subject and a verb, referred to as finite clauses, they can also appear in reduced forms (Biber et al., 1999), which can also cause difficulties with

comprehension. These reduced clauses, known as non-finite clauses, are typically

formed by omitting the subject of the adverbial clause and the 'be' form of the verb as in

example (14), or just omitting the subject and changing the verb to an *–ing* or *–ed* ending

as in example (15) (Schrampfer Azar, 2000). When an *–ing* ending is used, it implies the

active voice. When an *–ed* ending is used, the passive voice is implied (Fang, 1996).

These reduced clauses are typically adverbials of time and can appear in both the

sentence-initial and final positions (Celce-Murcia & Larsen-Freeman, 1999).

> 14: While I was driving to the store, I realized I forgot my wallet.
>
> While driving to the store, I realized I forgot my wallet.
>
> 15: After I drove to the store, I went and got lunch.
>
> After driving to the store, I went and got lunch.

Concessives such as *although*, *even though*, and *while* can be used in reduced

clauses as well (Celce-Murcia & Larsen-Freeman, 1999):

> 16: Although I was running late, I took my time at the store.
>
> Although running late, I took my time at the store.

In some reduced clauses, the subordinating conjunction as well as the subject can

also be omitted. This can be another source of confusion for ELs because it hides the

logical connection between the main clause and the subordinate (or adverbial) clause,

causing the student to have to make the connection on their own based on their

background knowledge or context clues (Fang, 2007) such as in the following example:

> 17. Because I was running late, I sped to the store.
>
> Running late, I sped to the store.

In most cases in order for the subject to be omitted, it must be the same as the subject in the main clause. Otherwise it creates what is called a dangling participle, which can lead to sentences that do not make sense (Biber et al., 1999), such as in example (18):

18. After driving to the store, my dog needed to be let out.

In this sentence, it seems as if the dog was the one driving to the store, which in most cases, except maybe in a fictional story, would not make sense. These types of sentences are typically seen as ungrammatical and are not very common in written language (Biber et al. 1999).

In this section it was shown that subordinating conjunctions can create a number of meaningful relationships between clauses, including time, location, manner, purpose, cause or reason, conditional, and concessive relationships. This section also outlined the numerous ways in which subordinating conjunctions might cause comprehension difficulties for ELs. Since this study is intending to look at the use of adverbial clauses in academic science texts through the means of a structural and functional text analysis, the following section will give a more in-depth look at what a text analysis is and how it can be used in the classroom.

Text Analysis

Although there are many different uses for a text analysis and they are used in a variety of fields, in the field of education one reason for a text analysis is to help teachers understand language use so that they can help students who are having trouble processing the language (Halliday, 1996b). In the broad sense, text, or discourse, analysis is the study of how language is organized in different contexts. More specifically, and for the

purpose of this study, a structural and functional analysis can be used to look at the ways that particular language features contribute to the meaning and interpretation of a text (Barton, 2004).

Barton (2004) explains that linguists have used text analysis for a variety of purposes from studying structural rules at the sentence level, to looking more broadly at the connections between language features and their functions in different contexts and registers (formal versus informal, for example) and how language can function differently among different cultures and genders, for example. In the classroom, structural and functional analysis has implications both for teachers and students.

As pointed out by Fang (2008) and Schleppegrell (2004), ELs need new ways of learning and understanding the language used in difficult school subjects such as science. Analyzing both the language that students use in their own writing as well as the language they encounter in their reading of academic texts is a way for teachers and students alike to focus on language in systematic ways (Achugar, Schleppegrell, & Oteiza, 2007). Through such analysis, teachers can better understand the language demands of their content areas in order to support their students' language and literacy development and help them approach the texts they read (Achugar et al., 2007). Students can participate in analysis as well, to help them recognize patterns of language use in texts and help them see how meaning is affected by different language choices. This allows them to participate more fully by supporting their reading comprehension and writing in difficult content areas (Schleppegrell, 2013). In a time where many teachers are looking for ways to better support their ELs, a structural and functional analysis is one way of integrating the learning of language with the learning of content so that both

language and curricular goals can be met. In the next section, I look at what research on the use of adverbial clauses has already been done, and where there may be a lack of research as well.

<div align="center">Gap in Research</div>

There has been some research done on the use of adverbials in written and oral discourse. For example, Biber et al. (1999) created an inventory of a variety of linguistic features, including different types of adverbials, looking at their patterns of use and frequency in different registers in a corpus of over 40 million words. His corpus included four different registers including published news, spoken English, fiction, and academic prose; however, he did not look specifically at the frequency of adverbial clauses within academic prose. Butler et al. (2004) conducted a study on 5th grade text books looking at some features of academic English including vocabulary, organization, and grammar in math, science, and social studies texts. Within the grammar section they included an analysis of different types of clauses, specifically counting the number of coordinating conjunctions and the number of subordinating conjunctions found. They also identified the most commonly used conjunctions in those texts. Chafe (1984) did a comparative study with 20 people to compare the use of adverbial clauses in their informal speech versus their academic writing. He focused mostly on position of the adverbial clause within the sentence and on what type of information, known or unknown, that the clause held. To my knowledge, there have not been any studies looking specifically at 4th grade science texts, analyzing the frequency and position of adverbial clauses as well as the meaning of subordinating conjunctions. This study is intended to help fill the gap in this

area, giving a more complete look at the use of adverbial clauses in 4th grade texts by exploring the following questions and sub questions:

1. How are adverbial clauses, including subordinating conjunctions used throughout the texts?

    *   How frequently do adverbial clauses occur in science texts at this grade level?

    *   Where in the sentence are these adverbial clauses found?

2. What relationships are created between the main clause and the subordinate clause in the sentence by the subordinating conjunctions?

3. How do the frequency, and location of adverbial clauses, as well as the meaning of subordinating conjunctions, vary from textbook to textbook?

Summary

In summary, science and scientific language are closely connected in that learning the language of science is a necessary part of learning the content of science. The language of school science uses various features that make reading expository science texts difficult for ELs including a concentration of technical vocabulary, nominalization, passive voice, lexical density, and sentence complexity. A structural and functional analysis can be used to analyze texts in order to see how grammatical features, such as adverbial clauses, are used in different contexts to create meaning. Adverbial clauses are dependent clauses that modify the independent clause of the sentence. They are typically introduced by a subordinating conjunction which creates some type of meaningful relationship between the main clause and the subordinate clause in the sentence. These types of conjunctions can cause comprehension difficulties for ELs. A structural and

functional analysis can help teachers and students see patterns in language and realize how meaning is affected by language choices. However, the current research on uses of adverbial clauses leaves a distinct gap in the research in that no studies have addressed the use of subordinating conjunctions specifically in 4th grade science texts. Therefore in chapter three I outline my methodology including the data collection techniques and procedure for the current study that hopes to help fill this gap.

CHAPTER THREE: METHODOLOGY

The purpose of this study is to investigate the use of adverbial clauses and the subordinating conjunctions that introduce them in 4th grade science texts in order to better understand how their use creates meaning within the context of academic scientific writing. I did this through conducting a structural and functional analysis of four different 4th grade science textbooks and attempted to give insight into the following research questions and subquestions:

1. How are adverbial clauses, including subordinating conjunctions used throughout the texts?

   - How frequently do adverbial clauses occur in science texts at this grade level?

   - Where in the sentence are these adverbial clauses found?

2. What relationships are created between the main clause and the subordinate clause in the sentence by the subordinating conjunctions?

3. How do the frequency and location of adverbial clauses, as well as the meaning of subordinating conjunctions, vary from textbook to textbook?

In chapter two I looked at previous research related to this topic including the connection between language and science learning, a structural and functional approach to analyzing language, definitions and examples of the use of adverbial clauses, as well as

a look at how text analysis can be used. In this chapter I outline the methodologies that were used to conduct the current study. First, I explain the research paradigm. Next, I describe the data collection sources and techniques, and finally I outline the procedure and analysis techniques as well as discuss the validity and reliability of the study.

<div align="center">Research Paradigm</div>

This study was conducted through a quantitative research paradigm. McKay (2006) lays out the characteristics of this type of research including the role of the researcher, the purpose of the research, the research questions, the research design, and data analysis.   Quantitative research assumes that the researcher's role is to observe and measure. The researcher also tries to minimize the number of variables and has much control over any variables that are present (McKay, 2006). In the current study, lessons from four 4th grade science texts were analyzed. As the researcher, after choosing the texts, I counted the number of adverbial clauses, determined where in the sentence the adverbial clauses were located, categorized the subordinating conjunctions based on their meanings within the text, and compared the use of adverbial clauses across texts. There were minimal variables as the texts were all 4th grade science textbooks on a similar topic; matter. The number of sentences from each sample were also be accounted for.

Within the quantitative paradigm, the purpose of the research is to generalize and predict (McKay, 2006). Although the generalizability of any study should be carefully considered, the more controlled the study, the more generalizable the study becomes (McKay, 2006). In this study, my sample size was quite small, so although the results may give insights into how adverbial clauses in 4th grade science texts are used, its generalizability is still limited. Deductively inferred research questions as well as a set

methodology are also features of quantitative research (McKay, 2006). For this project,

my research questions and methods were both laid out before conducting my research.

Finally, with quantitative research, data is analyzed statistically (McKay, 2006). In the

current study, I analyzed data using descriptive statistics. The frequency and position of

adverbial clauses were calculated using percentages, and the variety of subordinating

conjunctions as well as their meaning categories were determined and counted. The

frequency and meaning category of each subordinating conjunction used were also

reported in percentages.

<div align="center">Data Collection</div>

Data Sources

For this study, the use of adverbial clauses from lessons in four different 4th grade

science texts was analyzed. Each text was published by a major publisher for elementary

science texts and included *Science* (Moyer et al., 2002), published by

Macmillan/McGraw-Hill; *Scott Foresman Science* (Cooney, 2003), published by Scott

Foresman; *Science* (Badders et al., 2007), published by Houghton Mifflin; and *Science*

(Slavick Frank et al., 2002), published by Harcourt. Each text was written specifically

for 4th grade readers and each text contained lessons on the states of matter and

measuring matter that contained a similar number of sentences, ranging from 100 to 167

that were analyzed. The texts were chosen based on meeting criteria set by the researcher

including being written for 4th grade students, including the chosen topic, and being

written by a well-known publishing company.

<u>Data Collection and Analysis</u>

   The first step in my analysis was to count the number of sentences in each of the chosen lessons, which included two lessons from each text. Because this study was looking only at full sentences, only text from the main body was included in the analysis. Next, all adverbial clauses were identified and recorded. The subordinating conjunction that introduced each adverbial clause was then identified and classified based on its meaning. Reduced clauses were also counted and classified based on whether the subject and/or subordinating conjunction had been removed and if the verb form had been changed. Example (19) shows a reduced form in which the subject has been deleted and the verb form has been changed:

   19. Carlos studied every day before he took his final exam.

     Carlos studied every day before taking his final exam.

Example (20) shows how the subordinating conjunction can also be deleted. Note that the subject has been deleted and the verb form has been changed as well:

   20. Because I forgot to set my alarm, I woke up late.

     Having forgotten to set my alarm, I woke up late.

Next, the adverbial clauses were categorized based on their position in the sentence, in either the initial, medial, or final position. I tracked my data using the worksheet in Appendix A. I then did a statistical analysis based on my findings by calculating the percentage of sentences that contained adverbial clauses and the percentage of adverbial clauses that fell into the sentence-initial, sentence-medial, and sentence-final positions. I then documented the number of different subordinating conjunctions used as well as the frequency with which each one was found. Then I looked at the function of each of these

subordinating conjunctions and what types of meaning relationships were created between clauses by their use. Finally, the similarities and differences across texts were discussed. The analysis was done in part using the data analysis tool found in Appendix B.

<u>Pilot Study</u>

The data collection procedures from the previous section were used in a pilot study using a lesson on life cycles from the 4th grade science text *Real Science* (William et al., 2000). Of the 64 sentences within the main body of the lesson, 17 contained adverbial clauses, which was 26.6% of all sentences. In 58.8% of cases, the adverbial clause was found at the beginning of the sentence, while 41.2% of cases were sentence-final. There were no cases of sentence-medial adverbial clauses found. Six different subordinating conjunctions were identified with *when* (35.3%), *because* (29.4%), and *if* (17.6%) being the most common. The meaning relationships between clauses that were most often conveyed by the use of subordinating conjunctions were a conditional relationship (52.9%) and a cause or reason relationship (29.4%). The pilot study also revealed that the subordinating conjunction *when* conveyed a conditional relationship 100% of the time, as opposed to a time relationship. The pilot study demonstrates that adverbial clauses in 4th grade science texts are a worthy topic for further study and also that the data collection and data analysis tools do measure what they set out to measure. The following section will give a more in depth look at the validity and reliability of this study.

Verification of Data

This study strives for high validity and reliability. It has high validity because the data collection tool provided data that measures what it has set out to measure (McKay, 2006). It was developed specifically to measure the frequency and position of adverbial clauses, as well as the meaning relationships conveyed through the use of subordinating conjunctions. Although the generalizability of the study may be limited due to the small sample size, it can be used as a guideline for teachers, especially when the results are taken into consideration with any other similar studies conducted. All measures were taken to increase internal validity including controlling variables that could influence the results (McKay, 2006) such as using the same grade level texts, similar number of sentences between samples, and analyzing samples on similar topics.

This study has high internal reliability because the results were analyzed and counted several times by the researcher to increase accuracy. A colleague also analyzed 13% of the data in order to achieve complete agreement on the data analysis. The study also has high external reliability because the study could be easily replicated using the data collection and analysis tools developed for this study (McKay, 2006).

Summary

In summary, a quantitative research paradigm was used to conduct this study. Four 4th grade science textbooks were analyzed by recording all adverbial clauses and noting their frequency and position within the texts. Subordinating conjunctions were also identified and classified by the meaning relationships they created between clauses. The pilot study ascertained that conditional and cause or reason relationships were the most commonly used within that text. The current study is validated in part due to the

pilot study conducted by the researcher and is reliable because a portion of the data was reviewed by a colleague of the researcher. In chapter four I outline the results of the study.

CHAPTER FOUR: RESULTS

For this study, chapters from four 4th grade science texts were analyzed in order to discover how adverbial clauses and the subordinating conjunctions that introduce them are used in that context. Data was collected and analyzed in order to answer the following questions and subquestions:

1. How are adverbial clauses, including subordinating conjunctions used throughout the texts?

    - How frequently do adverbial clauses occur in science texts at this grade level?

    - Where in the sentence are these adverbial clauses found?

2. What relationships are created between the main clause and the subordinate clause in the sentence by the subordinating conjunctions?

3. How do the frequency and location of adverbial clauses, as well as the meaning of subordinating conjunctions, vary from textbook to textbook?

In this chapter I give a general description of the texts analyzed and present the results of the analysis based on the research questions above.

General Descriptors

Two lessons each from four different 4th grade science texts were analyzed for this study. The texts were from four major publishers in education including *Science*

(Moyer et al., 2002), published by Macmillan/McGraw-Hill; *Scott Foresman Science* (Cooney, 2003), published by Scott Foresman; *Science* (Badders et al., 2007), published by Houghton Mifflin; and *Science* (Slavick Frank et al., 2002), published by Harcourt. Each of these texts contained lessons on the states of matter and measuring matter, which were the two lessons analyzed. The word count from each text ranged from 100 to 167 sentences with a total of 494 sentences for all texts. Because the number of sentences varied between texts, the percentage for the frequency and position of adverbial clauses as well as the percentage for subordinating conjunctions used and their meanings were calculated in order to account for those differences. Analyzed text included all sentences from the main body of each lesson but did not include titles, headings or subheadings, labels or captions, or charts/diagrams. A colleague checked 13% of the data and our initial agreement for both frequency and meaning categories was approximately 84%. These differences were resolved through much discussion and ultimately 100% agreement was attained.

<div style="text-align:center">Results</div>

Frequency and Position of Adverbial Clauses

Of the 494 total sentences analyzed for this study, 9.3% contained adverbial clauses, meaning almost one out of every ten sentences. I found this number to be slightly lower than expected considering a study conducted by Butler et al. (2004) found that 17.8% of the sentences in the 5th grade science texts they analyzed contained adverbial clauses and my small pilot study of a 4th grade science text found 26.6% of all sentences contained adverbial clauses. As shown in Table 6, there was a wide range in the percentage of adverbial clauses found between publishers, from 4.8% in the McGraw-

Hill text to 17% in the Harcourt text. The percentages were calculated by dividing the

total number of adverbial clauses by the total number of sentences for each text. Among

all texts, there were no instances of sentences containing more than one adverbial clause

and all of the adverbial clauses were finite, containing a subordinating conjunction and an

overt subject.

Table 6

Percentage of Adverbial Clauses by Publisher

Publisher	Number of Sentences	Number of Adverbial Clauses	Percentage of sentences containing adverbial clauses
McGraw-Hill	167	8	4.8
Scott Foresman	115	12	10.4
Houghton Mifflin	100	7	7.0
Harcourt	112	19	17.0
All Texts	494	46	9.3

Of the 46 total adverbial clauses found in all texts, 63% were sentence-initial

while the remaining 37% were sentence-final. No adverbial clauses were found in the

medial position, which is consistent with current research that states that sentence-medial

adverbial clauses are rare in written language (Biber et al., 1999). The percentages of

sentence-initial and sentence-final adverbial clauses varied amongst the different

publishers as shown in Table 7.

53

Table 7

Position of Adverbial Clauses by Publisher

Publisher	Percentage of Adverbial Clauses in the Sentence-Initial Position	Percentage of Adverbial Clauses in the Sentence-Final Position
McGraw-Hill	62.5	37.5
Scott Foresman	41.7	58.3
Houghton Mifflin	85.7	14.3
Harcourt	68.4	31.6
All texts	63.0	37.0

Each of the texts, with the exception of the Scott Foresman text, had more sentence-initial adverbial clauses which ranged from 85.7% in the Houghton Mifflin text to 41.7% in the Scott Foresman text. Because adverbial clauses in the sentence-initial position are more common in these texts, they are possibly being used to help form cohesion between sentences because adverbial clauses in the sentence-initial position often reiterate known information and attempt to connect that information to the main clause in the sentence (Biber et al., 1999; Ramsey, 1987). Examples (20) from the Harcourt text (Slavick Frank et al., 2002, p. E6) and (21) from the McGraw-Hill text (Moyer et al., 2002, p. E21) demonstrate this (italics added to emphasize adverbial clauses):

20. A large, heavy object such as an elephant has a lot of mass. A small, light maple leaf has much less mass. *Even though an elephant and a leaf are very different*, each is an example of matter.

21. In space there are stars known as red supergiants. *When a red supergiant becomes very massive*, it can lose its outer layers in a huge explosion.

In each of these examples, the sentence-initial adverbial clause references something from the sentence(s) that precede it. The main clause of the sentence then introduces some new information about that referent.

Subordinating Conjunctions and their Meanings

Throughout all of the texts, a total of 10 different subordinating conjunctions were found, with *when* (37%), *if* (21.7%), and *as* (17.4%) being the most commonly used. This varies from findings by Butler et al. (2004) in which *when* (27%), *as* (27%), *because* (15%), and *if* (10%) were the most commonly used in the 5th grade science texts analyzed for that study. Lesser used subordinating conjunctions found in the current study include *because, until, after, before, even if, even though,* and *whenever.* Table 8 shows the total use of each subordinating conjunctions in all texts while Table 9 shows how the use of subordinating conjunctions varies from text to text.

Table 8

Use of Subordinating Conjunctions for All Texts

Subordinating conjunction	Number of Times Used	Percentage of use
When	17	37.0
If	10	21.7
As	8	17.4
Because	3	6.5
Until	3	6.5
After	1	2.2
Before	1	2.2
Even if	1	2.2
Even though	1	2.2
Whenever	1	2.2

Table 9

Percentage of Use of Subordinating Conjunctions by Publisher

Subordinating Conjunction	McGraw-Hill	Scott Foresman	Houghton Mifflin	Harcourt
When	25 (2)	33.3 (4)	57.1 (4)	36.8 (7)
If	12.5 (1)	25 (3)	28.6 (2)	21.1 (4)
As	25 (2)	16.7 (2)	0.0	21.1 (4)
Because	12.5 (1)	8.3 (1)	0.0	5.3 (1)
Until	12.5 (1)	8.3 (1)	0.0	5.3 (1)
After	12.5 (1)	0.0	0.0	0.0
Before	0.0	8.3 (1)	0.0	0.0
Even if	0.0	0.0	14.3 (1)	0.0
Even though	0.0	0.0	0.0	5.3 (1)
Whenever	0.0	0.0	0.0	5.3 (1)

Note. Initial numbers indicate percentages. Number of occurrences appears in parenthesis.

There was a wide variety of subordinating conjunctions used between texts. Only two subordinating conjunctions, *when* and *if,* were used in all four texts while *as, because,* and *until* were found in three out of four texts. The other subordinating conjunctions, *after, before, even if, even though, and whenever*, were each only found in one of the four texts. The Harcourt text had the greatest variety with a total of seven different subordinating conjunctions used. The McGraw-Hill and Scott Foresman texts each used six different subordinating conjunctions, while the Houghton Mifflin text only used three.

The original meaning categories for these subordinating conjunctions included time, location, manner, purpose, cause or reason, conditional, and concessive. After completing the data collection phase, I added two additional categories which include *special cases* and *ambiguous for cause/reason or time.* These two additional categories will be further explained below. Table 10 shows the number and percentage of use for each meaning category for all texts.

Table 10

Meaning of Subordinating Conjunctions in All Texts

Meaning Category	Number of Times Used	Percentage of Use
Conditional	24	52.2
Time	13	21.7
Ambiguous for Cause/Reason or Time	3	6.5
Cause/Reason	3	6.5
Manner	3	6.5
Special Cases	2	4.3
Concessive	1	2.2
Location	0	0.0
Purpose	0	0.0

As seen in Table 10, the subordinating conjunctions found in this study most often conveyed a conditional relationship between the adverbial clause and the main clause in the sentence. The conditional meaning was conveyed 52.2% of the time while a time relationship was conveyed 21.7% of the time. Other meaning relationships expressed included ambiguous for cause/reason or time (6.5%), cause/reason (6.5%), manner

(6.5%), special cases (4.3%), and concessive (2.2%). There were no instances in which a location or purpose meaning relationship was conveyed.

As for the ambiguous meaning that could have either meant cause/reason or time, there were three clauses, all starting with *as,* in which the meaning was not clear as shown in examples (22), (23), and (24) from the Harcourt text (Slavick Frank et al., 2002) (italics added to emphasize adverbial clauses).

22. Water changes its shape *as you poke your finger into it.* (p. E6)

23. *As the particles in a liquid move,* they bump into the walls of their container. (p. E7)

24. *As the regular arrangement of particles breaks down,* the ice melts. (p. E8)

For each of these sentences, it could be inferred that either the actions in both clauses are occurring simultaneously or that the action in the adverbial clause is causing the action in the main clause to take place. Since the authors' intentions are not known, I have categorized these instances into their own separate category in which the meaning is ambiguous, or unclear. Concerning the special cases category, there were two instances in which the subordinating conjunction *as* began a clause that was acting as a reminder to the reader as exemplified in examples (25) and (26) from the McGraw-Hill text (Moyer et al., 2002, p. E8) (italics added to emphasize adverbial clause):

25. *As you learned on page E6,* all matter has mass.

26. *As you can see,* it looks a little like a seesaw.

Table 11 shows the meaning categories broken down by publisher. In all four texts, the conditional relationship was the most commonly expressed. Apart from that, there is a wide variety of meanings conveyed between the texts. In addition to a

conditional relationship, each of the texts did have subordinating conjunctions that

created time relationships and all but the Houghton Mifflin text had subordinating

conjunctions that conveyed cause or reason. Only one of the four texts had meanings that

fell into the categories of concessive, special cases, or ambiguous for cause/reason or

time. Again, none of the texts conveyed the meaning of location or purpose.

Table 11

Meaning of Subordinating Conjunctions by Publisher

Meaning Category	McGraw-Hill	Scott Foresman	Houghton Mifflin	Harcourt	All Texts
Conditional	37.5 (3)	41.7 (4)	71.4 (5)	63.2 (12)	52.2 (24)
Time	25.0 (2)	33.3 (5)	28.6 (2)	5.3 (1)	21.7 (10)
Ambiguous for Cause/Reason and Time	0.0	0.0	0.0	15.8 (3)	6.5 (3)
Cause/Reason	12.5 (1)	8.3 (1)	0.0	5.3 (1)	6.5 (3)
Manner	0.0	16.7 (2)	0.0	5.3 (1)	6.5 (3)
Special Cases	25.0 (2)	0.0	0.0	0.0	4.3 (2)
Concessive	0.0	0.0	0.0	5.3 (1)	2.2 (1)
Location	0.0	0.0	0.0	0.0	0.0
Purpose	0.0	0.0	0.0	0.0	0.0

Note. Initial numbers indicate percentages. Number of occurrences appears in
parenthesis.

In all of the texts, when comparing the specific subordinating conjunctions used

with the meaning categories, the subordinating conjunctions do not always fit into the

meaning category that would be expected. For example, the conjunctions *when, until,*

after, before, and whenever, which all appear to indicate a time relationship, are used

collectively just over 50% of the time. However, the data shows that a time relationship is only conveyed 21.7% of the time. This indicates that at least one or more of those conjunctions can also be used to convey other meaning relationships between clauses. This variance in form and meaning is discussed further in the next chapter.

Summary

In Chapter 4, I presented the results from the data collection procedure. The results showed that in the 4th grade science texts analyzed for this study, 9.3% of the sentences contained adverbial clauses. The majority of the adverbial clauses, 63%, were sentence-initial while the remaining 37% were sentence-final. A variety of 10 different adverbial clauses were found throughout the data with *when, if,* and *as* being the most common. The two most prevalent meaning categories were conditional (52.2%) and time (21.7%).

In Chapter 5, I reiterate the major findings of this study and how they connect with current research on this topic. I also discuss teaching implications as well as explain how the results of the study will be disseminated. Next, I identify the limitations of the study and the need for further research. Finally, I provide my own personal reflection on my participation in this study.

CHAPTER FIVE: CONCLUSION

This structural and functional analysis looked at lessons from four 4th grade science textbooks with the goal of answering the following questions and subquestions:

1. How are adverbial clauses, including subordinating conjunctions used throughout the texts?

   • How frequently do adverbial clauses occur in science texts at this grade level?

   • Where in the sentence are these adverbial clauses found?

2. What relationships are created between the main clause and the subordinate clause in the sentence by the subordinating conjunctions?

3. How do the frequency and location of adverbial clauses, as well as the meaning of subordinating conjunctions, vary from textbook to textbook?

Discussion of Major Findings

The first major finding of this research is that 9.3% of sentences contained adverbial clauses out of a sample of 494 sentences in the 4th grade science texts analyzed. This is consistent with prior research that states that one feature of the language of school science (LSS) is that it uses complex sentences which contain one or more subordinate clauses, such as adverbial clauses (Fang, 2006). It is interesting to note, though, that

although adverbial clauses were found in all texts, there seems to be very little consistency with the frequency in which they were found. In this study, texts ranged from having 4.8% to 17% of sentences containing adverbial clauses. Other studies add to the wide variation in frequency including a study of 5th grade science texts that found 17.8% of sentences contained adverbial clauses (Butler et al., 2004) and my pilot study of a 4th grade science text that found a frequency of 26.6%. Despite the inconsistency in frequency, research suggests that LSS, which includes the use of adverbial clauses, is a necessity in scientific writing because it is used to help establish clear links among claims, facts, and data so that scientific theories may be developed (Fang, 2006).

All of the adverbial clauses identified in this study were finite clauses containing a subordinating conjunction and an overt subject. This is consistent with research that states that finite clauses are the most common type of adverbial clause across all registers (conversation, written news, academic prose, and fiction), including expository writing (Biber et al., 1999).

Another finding of this study is that the majority of adverbial clauses, 63%, were sentence-initial. Research states that finite and non-finite adverbial clauses across all registers are found predominately in the sentence-final position (Biber et al., 1999). However, in this study, only finite adverbial clauses were found and of those, the majority (52.2%) had a conditional meaning. Research states that finite clauses with a conditional meaning occur in the sentence-initial position 55% of the time in written registers including written news, academic prose, and fiction (Biber, et al., 1999), which is consistent with the findings of this study. Research shows that other finite adverbial clauses of circumstance including time, concessive, and cause/reason, in written registers,

tend to be more common in the sentence-final position (Biber et al., 1999). This suggests that this study found more sentence-initial rather than sentence-final adverbial clauses because there were a high percentage of conditional clauses present in the texts.

There was a variety of 10 different subordinating conjunctions used throughout the 4th grade science texts analyzed. Research states that across all registers, only 15 subordinators occur more than 200 times per million words. In academic prose, the most common subordinators are *if, because,* and *when* (Biber et al., 1999). In this study, the most common subordinators used were *if, when,* and *as.* Although the top three most commonly used subordinators were not exactly the same, all of the subordinators found in this study were among, or a variation of, the top 15 most common subordinators found across registers. The two variations included the use of *even if* for *if* and *whenever* for *when.*

This study also found that there were a variety of meaning relationships created by the subordinating conjunctions used throughout the texts with the most common being conditional (52.2%) and time (21.7%). This differs from research that states that the most common semantic relationships created by adverbial clauses in academic prose include conditional and concessive meanings (Biber, et al., 1999). Conditional and concessive relationships are both common in presenting arguments, which are common in academic writing. However, research also states that conditional clauses have the additional role of "specifying the conditions under which facts hold" (Biber et al., 1999, p. 825) and furthermore that generic factual conditionals, those that express factual and unchanging relationships, are found frequently in scientific writing (Celce-Murcia & Larsen-Freeman, 1999). It could be that this study had a high number of conditionals and

not concessives because the texts that were analyzed were not a presentation of an argument, but rather an explanation of the states of matter and how to measure them, which contained conditionals that did express those factual, unchanging relationships. Perhaps if another genre within scientific writing were analyzed, or academic writing within another content area, there may be more concessive adverbial clauses found. Example (27) from the Harcourt (Slavick Frank et al., 2002, p.E7) text shows one instance of generic factual conditional use (italics added to emphasize adverbial clause):

27. *If you pour a liquid from one container into another,* the amount of matter in the liquid stays the same.

In addition to conditional and concessive meanings, research states that purpose adverbial clauses are also common in academic writing (Biber, et al., 1999). This differs from the findings in this study, in which no clauses were found that indicated a purpose meaning. The reason for this may be that purpose clauses tend to be found in procedures or in text that gives suggestions for improving conditions (Biber, et al., 1999) and neither of these types of content were present in the texts analyzed for this study. Instead, the texts in this study were explanations and within these explanations conditional and time adverbials were the most commonly found.

Another important finding from this study is that form and meanings of subordinating conjunctions did not always coincide. This implies that certain subordinating conjunctions can have multiple meanings, and also that some meaning relationships can be conveyed using a variety of different subordinating conjunctions. Prior research (Biber et al., 1999) and this study found that the subordinating conjunction *as* has the ability to convey multiple meanings, including manner, cause/reason, and time.

Research (Biber et al., 1999) states that the semantic breakdown for each of these meaning categories varies by register. In the written academic register *as* indicates manner 65% of the time, time 25% of the time, and cause/reason 10% of the time (Biber et al., 1999). Prior research (Biber et al., 1999) and the current study also found that at times the semantic roles of cause/reason and time overlap each other and the exact meaning may not be clear. The findings of the current study differed notably from prior research with *as* indicating manner 37.5% of the time, and being ambiguous for cause/reason or time 37.5% of the time. The other 25% of the time it was used as a special case in which it served as a reminder to the reader as to where or how they learned or knew something that was stated in the main clause of the sentence. This seems like a very high percentage of special cases considering that the vast corpus analyzed by Biber et al. (1999) did not result in *as* conveying meanings other than manner, time, and cause/reason when used as a subordinating conjunction. This causes me to wonder if perhaps Biber et al. (1999) included any special cases of *as* into the manner category, as that would make their and the current study's findings much more consistent.

When is another subordinating conjunction that has the ability to carry multiple meanings. Research states that *when* or *whenever,* which typically conveys time, can also indicate a conditional relationship (Givón, 1993). The current study corroborated this, finding that *when* indicated time 27.8% of the time and a conditional relationship 72.2% of the time.

The discrepancy of form and meaning in the results of this study also indicates that some meaning categories can be expressed in multiple ways. This study found that the meaning categories of time, cause/reason, and conditional were all conveyed using

more than one subordinating conjunction. With the conditional meaning, research states that *if* is the most common subordinating conjunction used to introduce these clauses (Biber et al., 1999); however, *when* or *whenever* may be substituted to convey the same meaning (Celce-Murcia & Larsen-Freeman, 1999). This may be confusing for ELs, as they may not realize that conditionals can be expressed using *when*. In this study, *if* (or *even if)* was only used 45.8% of the time to create a conditional meaning while *when/whenever* was used 54.2% of the time. This way of expressing conditionals is an important realization for students to make considering the current study shows *when* was used to introduce conditional clauses more than 50% of the time. Examples (28) and (29) from the Harcourt text (Slavick Frank et al., 2002) demonstrate conditional *when* clauses (italics added to emphasize adverbial clause):

28. *When matter is a liquid,* its particles slip and slide around each other. (p.E7)

29. *When ice is heated,* some particles begin to move fast enough to break away from their neighbors. (p.E8)

The final major finding of this study was the wide variation of the frequency of adverbial clauses found as well as the variety and number of subordinating conjunctions and the variety of their meanings used among the four different texts analyzed. Of interest is that while three of the texts used 6 to 8 different subordinating conjunctions, the Houghton Mifflin text only used three different subordinating conjunctions. One possible reason that the Houghton Mifflin text had less variety of subordinators could be that it was the shortest text analyzed with only 100 sentences compared to 112, 115, and 167 sentences analyzed in the other texts; however, it did not carry the least percentage of subordinating conjunctions, just the least variety. In fact, the McGraw-Hill text which

had the most sentences also had the lowest percentage of adverbial clauses with just 4.8%

of sentences containing them. It would be interesting to do a broader analysis within the

Houghton Mifflin text to see if the trend continued and if they generally do not use a

wide variety of subordinating conjunctions or if that was more specific to the topic of

matter that was analyzed for this study.

Another interesting variation between the texts was the differences in meanings

conveyed by the subordinators. Each of the texts had a substantial percentage of

adverbial clauses indicating condition and time. However, only three of the four texts

also had a percentage of clauses indicating a cause/reason relationship. This is interesting

considering that all of the texts were explanations on the same topic. Once again, though,

it is the Houghton Mifflin text that did not have any cause/reason clauses. In fact, while

they only used a variety of three different subordinators, those subordinators fell into only

two different meaning categories including conditional and time. This variation in the

meanings across texts is somewhat perplexing considering that Schleppegrell (2004)

contends that each genre uses language in unique ways to create meaning. Therefore, if

the four texts that were analyzed for this study are of the same genre, scientific

explanations, the language used to create meaning should be more similar than different.

Perhaps the authors of the Houghton Mifflin text were attempting to simplify the text,

and in turn changed the way in which meaning relationships were conveyed between

clauses. The implications of these and all results found in this study will be discussed in

the next section.

Teaching Implications

Implications for teaching can be drawn from the major findings of this study in the following areas; providing direct instruction on the forms and functions of adverbial clauses and conducting text analyses in the classroom.

<u>Implications for Direct Instruction of Adverbial Clauses</u>

A number of teaching implications can be drawn from the major findings of this study in regards to providing direct instruction of adverbial clauses. The first implication is that, although frequencies varied, sentences containing adverbial clauses are present in 4th grade level science texts. Because sentences containing multiple clauses, including adverbial clauses, can be difficult for ELs to comprehend (Fang, 2006), teachers should provide direct instruction on how to identify these types of sentences and unpack their meanings so that they become more comprehensible. To do this, the data analysis collection tool developed for this study, found in Appendix A, could be used. First, sentences containing adverbial clauses could be identified. Then, the subordinating conjunction that introduces each subordinate clause could be identified and classified based on its meaning in order to help determine how the two clauses relate to each other. Teachers can give direct instruction on which subordinators signal specific meanings. Because this study found that some subordinators can have multiple meanings, it would be helpful to ELs to learn when each meaning typically applies.

Teachers can help students identify subordinators with multiple meanings and give them clues to help determine which meaning is being conveyed. As mentioned in the previous section, one example of a subordinator with multiple meanings that may be difficult for ELs is *as*, which can indicate manner, cause/reason, or time. Additionally, it

has been established that, at times the semantic roles of cause/reason and time can overlap each other and it may be difficult for ELs to decipher which meaning applies. This overlap occurs because when two events are happening at the same time or one right after the other, it may imply that one event caused the other (Biber et al., 1999). This makes the meaning ambiguous as we do not know the author's intent and can only make an inference on the true meaning based on context clues. So while *as* clauses indicating manner may be quite clear as seen in example (30) from the Scott Foresman text (Cooney, 2003) (italics added to emphasize adverbial clause), *as* clauses indicating cause/reason or time are more difficult to decipher as seen in example (31) from the Harcourt text (Slavick Frank, 2002)(italics added to emphasize adverbial clause):

30. One way to measure the volume of a solid is by using a meter stick, *as the children in the picture are doing.*

31. *As the regular arrangement of particles breaks down,* the ice melts.

These distinctions will be important for the students to discover as they unpack the meaning relationships between clauses and a close reading of the text will hopefully inspire some rich conversations about which meanings could possibly apply.

The other subordinator that was found to fit into multiple meaning categories is *when.* In example (32) from the Houghton Mifflin text (Badders et al., 2007, p. E15) (italics added to emphasize adverbial clause), *when* indicates that the events in both clauses are happening concurrently. This signifies a time relationship.

32. *When scientists measure objects*, they use tools that measure in metric units.

In other instances, *when* can signify a conditional meaning. This is true when it has been substituted for the subordinating conjunction *if*. In these types of sentences, the

two clauses are often indicating a factual, unchanging relationship (Celce-Murcia &

Larsen-Freeman, 1999). Example (33) from the Harcourt text (Slavick Frank et al., 2002,

p.E13) demonstrates this (italics added to emphasize adverbial clause):

　33. However, the mass of a gas sample doesn't change *when the volume of the*

gas changes.

Therefore, if *if* can reasonably be substituted for *when,* it probably indicates a

conditional meaning rather than a time meaning, especially if it is showing an

unchanging, scientific relationship (Celce-Murcia & Larsen-Freeman, 1999). Because it

was found that conditional meanings are common in scientific writing, it will be

important for students to discover the different forms in which they are created.

Another teaching implication of this study is that when there are sentences with

multiple clauses, teachers should help students determine which clause is the main clause

of the sentences, containing the main verb, and which is the subordinate clause. Helping

students identify common subordinators is one way in which they can distinguish

subordinate clauses from the main clause in the sentence, because these subordinate

clauses cannot stand alone. Another way to help students identify the main clause from

the subordinate clause would be to focus on the location of the subordinate clause in the

sentence. This study found that 63% of adverbial clauses were found in the sentence-

initial position. Sentence-initial adverbial clauses may cause difficulty because the

student must read through the entire first clause before getting to the main clause of the

sentence. They may assume that the first verb they encounter is the main verb of the

sentence when that is not the case. However, teachers can help students identify these

sentence-initial adverbial clauses by focusing first on the subordinating conjunction that

begins the sentences, and secondly on punctuation, as the sentence-initial subordinate clause is separated from the main clause by comma. Teachers can also point out that these sentence-initial adverbial clauses sometimes contain given information and may help provide connections between previous information in the paragraph and the main clause of the sentence (Biber et al., 1999), although they don't always do so.

Finally, it is important to note that several words that can be used as subordinating conjunctions can also be used as other parts of speech. Some of the uses of these words may be difficult for ELs to distinguish from subordinating conjunctions such as the one seen in example (34) found in the McGraw-Hill text (Moyer et al., 2002, p.E6):

34. The photograph shows one way you can find out if air is matter.

In this example, the word *if* is used as part of an embedded question rather than as a subordinator. When identified, these types of constructs should be directly addressed and distinguished as different from subordinating conjunctions.

Implications for Conducting a Text Analysis in the Classroom

The final implication for teaching is that, because there was such a wide variety of the use of adverbial clauses as well as in the number, variety, and meaning of subordinating conjunctions used, it would be beneficial for teachers to understand how to conduct a structural and functional text analysis on the specific text used in their classrooms and design a language focused lesson based off of that analysis. Prior research states that when teachers are given the analysis tools to deconstruct a passage clause by clause with their students to look for specific grammatical features, such as the subordinating conjunctions used to connect clauses, it can reveal patterns of language use as well as help students gain greater understanding of the content (Achugar,

Schleppegrell, & Oteiza, 2007). Once teachers are aware of how to conduct a text analysis, they become more aware of the language features used in the context of science and are able to draw their students' attention to these features as well.

Different types of analysis can be done for different purposes. A participant, process, circumstance analysis (Fang & Schleppegrell, 2010) can be done focusing on how adverbial clauses add to the circumstance of the sentence, indicating the particular times or conditions in which different processes occur. This will aid students in understanding the experiential meaning of the text, which is what is actually occurring in the text. Teachers and students could also gain insight on the textual meaning of the text by analyzing how subordinating conjunctions are used as cohesive devices, making connections between known and new information in the text. Additionally, because it was shown that some texts have a very low frequency of adverbial clauses, teachers and students could attempt to discover other ways in which connections are made between ideas in the text. It may be that those texts require that students make more inferences as to how ideas relate to each other rather than explicitly stating the relationship through the use of subordinating conjunctions. If teachers are able to give input on which texts are used in the classroom, they may want to take this information into consideration when choosing a text.

Once students become comfortable identifying adverbial clauses and their uses within a text, they can begin expanding sentences in their own scientific writing, creating connections between ideas through the use of different subordinating conjunctions. It is also important to note that although I believe that teaching students the forms and meanings of adverbial clauses can help aid in their reading comprehension, more research

is still needed in order to identify the most effective methods and instructional strategies for doing so.

Dissemination of Results

I look forward to being able to share what I have learned from this study with others. It is important for both mainstream and other ELD teachers to understand that each content area may utilize different language features to express meaning and that these language features can be better understood by analyzing the texts used in the classroom. Informed by this study, I can now present the findings when taking part in informal conversations with other educators around this topic as well as in more formal settings. In the past, I have conducted trainings to the staff within my own building on writing language objectives. I feel confident adding some of the knowledge that I have gained through this research project to that training, or as a separate training at my future places of employment. Also, presenting information centered on my research at the Minnesota English Learner Education conference held each fall would be an opportunity to reach a larger audience. Because the use and meanings of adverbial clauses is just one grammatical feature that teachers can gain more knowledge in through a text analysis, my hope would be that once teachers are aware of other prominent features used in academic English and how to conduct a text analysis, they would be able to apply the technique to those other features as well.

Limitations

There are several limitations that should be considered when looking at the results of this study. First of all, the scope of this study was small. While books from four major publishers were used, only two lessons from each of those publishers were

included, limiting the number of sentences analyzed. Furthermore, to maintain

consistency, all text consisted of the same topic: matter. An analysis of a broader corpus

or of other topics other than matter could provide additional information about the use

and meaning of adverbial clauses. In addition to only one topic being analyzed, only one

genre, explanations, was analyzed. As noted above, research (Biber et al., 1999) has

suggested that some meaning categories of subordinating conjunctions are more common

in different types of genres within academic writing, such as purpose clauses being more

common in procedures. It would be interesting to see if that was the case within these

texts as well. Finally, all texts analyzed were written at a 4th grade reading level and were

from science textbooks. Other grade levels and content areas could be analyzed to

expand our understanding of the use and meaning of adverbial clauses as well.

<div align="center">Further Research</div>

The need for further research directly reflects the limitations of this study. In

order to increase the validity of the study, a larger sample size should be analyzed. A

broader sample of topics and genres could give educators more information on how

adverbial clauses are used within scientific texts. Of interest to me would be to look

specifically at how the use of adverbials varies between different genres. Additionally, it

would be very informative to do a similar analysis across content areas to see how

adverbial clauses are used within other subjects. This study could also be expanded to

include multiple grade levels. It would be very informative to see if and by how much

the frequency of adverbial clauses increases as the reading level becomes more advanced.

It would also be interesting to see if the types of relationships created between clauses

stayed similar or varied depending on the grade level analyzed. Lastly, further research is

needed to identify how direct instruction of the use and meaning of adverbial clauses affects students' comprehension and which strategies could be most effective for teaching this language structure.

Personal Reflection and Conclusion

Through the process of conducting this research, I have learned many valuable lessons. I initially chose to conduct a text analysis because it was convenient in my current life situation to work with texts rather than with students. I am very grateful that I was led in this direction because I feel that by reviewing the literature and research of other language experts, and by conducting my own research on the language used in science textbooks, I have gained much knowledge. First of all, I have learned much about adverbial clauses and how they are used within science texts. I have also gained knowledge about other prominent language features found in scientific texts that may cause difficulty for ELs. Because I am a native English speaker, I did not have to have direct instruction of many of these grammatical constructs; however, it is imperative that as a language teacher, I am aware that these structures are common in academic texts, and that they can cause comprehension difficulties for non-native speakers.

Throughout this process, I have also learned much about conducting text analyses and feel more confident about doing them on my own as well as with students, in order to identify how different content areas and genres create meaning through the use of different grammatical structures. I feel this will greatly impact and improve my teaching in the classroom as I will be better prepared and more confident to teach reading in the content areas. Analyzing the texts that my students are required to read will help me create more language focused lessons that not only include vocabulary and grammar in

general, but on the specific structures of academic English used in those texts that makes comprehension difficult.   I believe this knowledge will also help me with writing instruction as I will be able to analyze my students' writing and instruct on structures that they can use to improve their writing by helping them discover and practice how language works in an academic register.

Overall, I believe this research project has greatly increased my knowledge of how to approach teaching reading in the content areas, especially in science, and therefore will better me as an ELD teacher. A sentiment expressed by J.R. Martin (1996) regarding the importance of teaching scientific literacy resonated with me after doing this research, which was that the scientific texts that we use with our students should be a model of scientific writing, not merely simplified versions that do not contain the technical language required to express scientific ideas. In his words, "diluting the scientific discourse necessarily involves diluting the science that is taught. As we have seen, science is unthinkable without the technical language science has developed to construct its alternative world view" (Martin, 1996, p. 202). We as educators must have technical knowledge of the structures involved in this writing so that we can purposefully develop ways to give students access to that scientific language in order to increase their scientific literacy. Many of these structures, including complex sentences comprised of multiple clauses, appear in the elementary grades. This is when we must begin introducing students to these structures in order to provide the building blocks for their future language development. By utilizing the teaching implications stated above, even with young learners, teachers can shed light on how adverbial clauses, as well as other language features common in LSS, are used in scientific texts so that they have the

opportunity to become proficient in the academic language of science and fully

participate in the learning of scientific knowledge.

APPENDIX A

Data Collection Tool   Key:

| Ambiguous meaning- AM |
| Subject deleted- S̶ |
| Subordinating conjunction deleted- S̶C̶ |
| Verb form changed- VFC |

Adverbial clause	Position	Subordinating conjunction	Meaning category	finite/ non-finite	Text Name

APPENDIX B

Data Analysis Tool

<u>Text # (1,2,3,4) (Circle One)</u>

Total # of sentences   _____

# of adverbial clauses   _____

% of sentences
containing adverbial clause   _____

Subordinating conjunction	# of times used	% of use

Adverbial clause position	# of times found	% of times found
Initial		
Medial		
Final		

Meaning/relationship	# of times found	% of times found
Time		
Location		
Manner		
Purpose		
Cause/reason		
Conditional		
Concessive		

Notes:

All Texts

Total # of sentences   _____

# of adverbial clauses   _____

% of sentences
containing adverbial clause   _____

Adverbial clause position	# of times found	% of times found
Initial		
Medial		
Final		

Subordinating conjunction	# of times used	% of use

Meaning/relationship	# of times found	% of times found
Time		
Location		
Manner		
Purpose		
Cause/reason		
Conditional		
Concessive		

Notes:

REFERENCES

Achugar, M., Schleppegrell, M.J., & Oteiza, T. (2007). Engaging teachers in

language analysis: A functional linguistics approach to reflective literacy.

English Teaching: Practice and Critique, 6(2), 8-24.

August, D., & Shanahan, T. (2006). *Developing Literacy in Second-Language Learners:*

Report of the National Literacy Panel on Language-Minority Children and Youth.

Routledge, Taylor & Francis Group. (ERIC Document Reproduction Service No.

ED556105).

Badders, W., Carnine, D., Fleiciani, J., Jeanpeirre, B., Sumners, C., & Valentino, C.

(2007). *Science.* Boston, MA: Houghton Mifflin Company.

Barton, B. (2004). Linguistics discourse analysis: How the language in texts works. In C.

Bazerman & P.A. Prior (Eds.), *What writing does and how it does it: An*

introduction to analyzing texts and textual practices. (pp. 57-82). Mahwah, NJ:

Routledge.

Best, R. M., Rowe, MS., Ozuru, Y., & McNamara, D.S., (2005). Deep level

comprehension of science texts: The role of the reader and the text. *Topics in*

Language Disorders, 25(1), 65-83.

Biber, D., Johansson, S., Leech, G., Conrad, S., & Finegan, E. (1999). *Longman grammar of spoken and written English.* Essex, England: Pearson Education Limited.

Butler, F. A., Bailey, A. L., Stevens, R., Huang, B., Lord, C., & California Univ., L. E. (2004). Academic English in Fifth-Grade Mathematics, Science, and Social Studies Textbooks. CSE Report 642. *Center For Research On Evaluation Standards And Student Testing CRESST.* (ERIC Document Reproduction Service No. ED483409).

Celce-Murcia, M., & Larsen-Freeman, D. (1999). *The grammar book: An ESL/EFL teacher's course* (2nd ed.). Boston, MA: Heinle.

Chafe, W. (1984). How people use adverbial clauses. In C. Brugman & M. Macaulay (Eds.), *Proceedings of the tenth annual meeting of the Berkeley Linguistics Society* (pp. 437-449). Berkeley: University of California. Retrieved from http://journals.linguisticsociety.org/proceedings/index.php/BLS/article/view/1936/1708 (control K to Kill URLs)

Chall, J.S., Jacobs, V.A., & Baldwin, L.E. (1990). The reading crisis: Why poor children fall behind. Cambridge, MA: Harvard University Press.

Cooney, T. M. (2003). *Scott Foresman science*. Glenview, Ill: Scott, Foresman.

Derewianka, B. (2011). *A new grammar companion for teachers*. Marrickville Metro, N.S.W: e:lit - Primary English Teaching Association.

Fang, Z. (2006). The language demands of science reading in middle school. *International Journal of Science Education*, *28*(5), 491-520. doi: 10.1080/09500690500339092

Fang, Z. (2008). Going beyond the fab five: Helping students cope with the unique

    linguistic challenges of expository reading in intermediate grades. *Journal of*

    Adolescent & Adult Literacy, 57(6), 476-487. doi: 10.1598/JAAL.51.6.4

Fang, Z., & Schleppegrell, M. J. (2010). Disciplinary literacies across content areas:

    Supporting secondary reading through functional language analysis. *Journal of*

    Adolescent & Adult Literacy, 53(7), 587-597. doi: 10.1598/JAAL.53.7.6

Gibbons, P. (2006). Bridging discourses in the ESL classroom: students, teachers and

    researchers. London: Continuum.

Givón, T. (1993). *English grammar: A function-based introduction* (Vol. 2). Amsterdam:

    John Benjamins Pub. Co.

Halliday, M. A. K. (1985). *An introduction to functional grammar*. Baltimore, MD:

    Edward Arnold.

Halliday, M. A. K. (1996a). Some grammatical problems in scientific English. In M.A.K.

    Halliday & J.R. Martin (Eds.), *Writing science: Literacy and discursive power* (pp.

    69-85). London: Falmer Press.

Halliday, M. A. K. (1996b). The analysis of scientific texts in English and Chinese. In

    M.A.K. Halliday & J.R. Martin (Eds.), *Writing science: Literacy and discursive*

    power (pp. 124-132). London: Falmer Press.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-

    integration model. *Psychological Review, 95*(2), 163-182.

Martin, J.R. (1996). Literacy in science: Learning to handle text as technology. In

    M.A.K. Halliday & J.R. Marin (Eds.), *Writing science: Literacy and discursive*

    power (pp. 166-202). London: Falmer Press.

McKay, S.L. (2006). *Researching second language classrooms.* Mahwah, NJ: Lawrence Erlbaum Associates.

Minnesota Department of Education. (2010). Minnesota Academic Standards English Language Art K-12.

Minnesota Department of Education. (2015). [Graphs illustrating the percentage of students who met proficiency in achievement standards set by Minnesota educators]. *Minnesota Report Card.* Retrieved from http://rc.education.state.mn.us/

Moyer, R., Daneil, L., Hackett, J., Prentice Baptiste, H., Stryker, P., & Vasquez, J. (2002). *Science.* Farmington, NY: Macmillan/McGraw-Hill.

National Center for Statistics in Education (2010). *The condition of education 2010.* Retrieved from http://nces.ed.gov/pubs2010/2010028.pdf

National Institute of Child Health and Human Development (NICHD). (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature of reading and its implications for reading instruction.* Washington, DC: US. Department of Health and Human Services. Retrieved from http://www.nichd.nih.gov/publications/pubs/nrp/documents/report.pdf

Perez Amaro, C.L. (n.d.). *Carmen Luisa's ESL site.* Retrieved from http://www.carmenlu.com/third/grammar/third_year_grammar.html

Ramsey, V. (1987). The functional distribution of preposed and postposed 'if' and "when' clauses in written discourse. In R. Tomlin (ed.), *Coherence and Grounding in Discourse* (pp. 383-408)*.* Amsterdam: John Benjamins.

Schleppegrell, M. J. (2004). *The language of schooling: A functional linguistics perspective.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Schleppegrell, M.J. (2013). The role of metalanguage in supporting academic language development. *Language Learning 63*, 153-170. doi: 10.1111/j.1467-9922.2012.00742.x

Schrampfer Azar, B. (2000). *Understanding and using English grammar* (3rd ed.). White Plains, NY: Pearson Education.

Slavick Frank, M., Jones, R.M., Krockover, G.H., Lang M.P., McLeod, J.C., Valenta, C.J., & Van Deman, B.A. (2002). *Science.* Orlando, FL: Harcourt School Publishers.

Snow, C. (2002). Reading for understanding: Toward an R & D program in reading comprehension. Santa Monica, CA: RAND

Snow, C.E. (2010). Academic language and the challenge of reading for learning about science. *Science 328,* 450-452.

William, C.K., Rubinstein, J.H., & Vega, C.J. (2000). *Real Science.* Columbus, OH: SRA/McGraw-Hill.

Williams, J.P. (2005). Instruction in reading comprehension for primary-grade students: a focus on text structure. *The Journal of Special Education, 39* (1), 6-18.

Yore, L., Bisanz, G.L., & Hand, B.M. (2003). Examining the literacy component of science literacy: 25 years of language arts and science research. *International Journal of Science Education, 25*(6), 689- 725. doi: 10.1080/09500690305018