University of Alberta

A Cross-Cultural Comparison of Scientific Language Use: Indigenous and Eurocentric Discourse on Issues Regarding Caribou in the North

by

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A thesis submitted to the Faculty of Graduate Studies and Research

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Secondary Education

Fall 2011

Edmonton, Alberta

ABSRACT

This work is an attempt to understand and lessen the borders that exist between Indigenous knowledge and Eurocentric science. I contend that the two groups represent distinct cultures and that it is important to look at the differences and similarities that occur in language use as the two communicate on issues of mutual concern. I argue that discourse can shape knowledge in two very distinct ways within two different modes of thought; a narrative mode that is used primarily by the Aboriginal community and a scientific mode that is utilized primarily by the scientists. The research involves discourse analysis as a means of studying a unique opportunity to compare and contrast two cultures speaking on the topic of preservation of caribou in the Northwest Territories of northern Canada. Although the intention of both the Aboriginal community members and the Eurocentric scientists are the same; to preserve the caribou numbers that exist in the North, the differences in language use can create turbulence between the borders of the two cultures. I argue that this analysis will assist in comprehending and mitigating the borders that have been created that now impact life in the North. In addition, this work represents an autobiographical journey that proposes curriculum theory as a reconceptualization of the current mindset of Eurocentric scientists and science educators. While governments, government agencies, and resource management boards continue to try and bridge the borders between Aboriginal peoples and Eurocentric agents, they may find that they are better served by reconceptualizing how they view and share knowledge. Curriculum theory provides an option to not only imagine a different future but also provides

strategies for looking inwards and evaluating one's own method of knowledge sharing. Aboriginal people and Eurocentric scientists both have a vested interest in protecting and maintaining caribou populations in northern Canada, but how they communicate those intentions to each other is critical if collaboration is to be possible and understanding how each other uses language can be a valuable aid in mitigating those borders.

ACKNOWLEDGMENT

First and foremost, I would like to thank my beautiful wife Shirley for all of her support and understanding throughout the years. She is the inspiration not only behind this research but for everything I do in life. One could not ask for a better partner to journey through life with and this thesis is as much her achievement as mine.

I would also like to thank my supervisor Dr. Norma Nocente for her incredible guidance throughout my program. She was flexible, patient, and most of all, supportive. I truly believe the quality of this work is a direct result of her direction and attention to detail. She is the consummate professional and it was a pleasure working with her.

I could not have asked for better supervisory committee members than Dr. Marie-Claire Shanahan and Dr. Brenda Parlee. Their enthusiasm for my work and their genuine interest in what I was proposing to accomplish provided me with great motivation to achieve this thesis. More importantly, their combined expertise provided me with the essential background knowledge that is required for a thesis of this scope. I look forward to our continued collaborations in the future.

A special thank you to Dr. David Pimm who put so much time and effort into my work that I felt like I had another committee member at my side. His passion for science and research is infectious and he helped guide my research in ways that I never dreamed of when I began my program. His sharing of knowledge was vital and this thesis would not have been possible without his input.

Dr. David Smith was more influential to this thesis than he probably ever realized and I would like to thank him for his teachings. He opened my eyes to ideas and ways of thinking that I had never before realized and I can say, without a doubt, that his course was the most rewarding educational experience I have ever received.

Although he was not involved in my research I would also like to thank Dean David Percy, Faculty of Law, who was so flexible and supportive my program. He sacrificed what was in his best interest to allow me to pursue my dreams and I would sincerely like to thank him for helping me achieve this goal.

And finally I would like to acknowledge the support of my dear friend Kristina Schultz. Kristina was also with me every step of the way and provided me the confidence and motivation to succeed. Her personal achievements are inspiring and her friendship is and will always be truly appreciated.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

Chapter One: Introduction

How My Journey Started

As a child I can recall having a strong connection to nature. I don't mean simply an appreciation for a walk in an outdoor area, but a deep-rooted bond to the Earth and all its living things. I thank my family for this connection as my childhood experiences were all formulated in the north-western part of North America and are inextricably tied to a positive family environment. As we travelled I spent hours looking down toward the Earth observing all the creatures and plants that lived there. Although I am sure I experienced envy of those classmates that flew in planes and traveled to exotic places, my memories of experiencing the Rocky Mountains, the Saskatchewan prairie, and the Oregon coast were vivid and life forming experiences that constructed the person that I am today. My unbelievably accommodating parents allowed me to pursue my love for nature at home as my small bedroom became my own little zoo and my walls consisted of aquaria, terrariums, and cages which contained dozens of species of fish, reptiles, amphibians, birds, and small mammals.

There was no doubt in my mind that I wanted to one day become a biologist or zoologist. Not only did I love animals but I was scientifically curious and was continually experimenting, tinkering, and exploring. But an interesting thing happened when I was finally able to take science courses within the K-12 school system; I performed quite poorly in them and did not enjoy them at all. I found the experience to be little more than memorization of terminology and found that they contained very little scientific inquiry of things that were of

interest to me. As a result, my own science education and experiences had very little to do with my K-12 school experience. My involvement and best memories tended to be external to what was being taught in school and had far more to do with informal learning.

My ancestry is an interesting combination of both informal learning from Indigenous knowledge and formal education from Eurocentric culture as well. My fifth great grandmother was Mary Maskegon, a Cree woman born in Manitoba in 1761. She married my fifth great grandfather, Peter Fidler, who was born in England in 1769 and spent his life as an explorer in Canada's North, around the same time that David Thompson was exploring more southern parts of Canada. My fifth great grandfather is credited as the first white man to have seen coal in the prairies, the Athabasca Tar Sands, and was the first white person to make contact with many of the Aboriginal tribes in northern Alberta, Saskatchewan, and Manitoba (MacGregor, 1966). Thus, my heritage has become symbolic of the border that exists between Eurocentric knowledge and Indigenous knowledge. As a Métis I find myself caught in the turbulence of two distinct borders. On the one side are my ancestors who literally brought the Eurocentric, Western world to North America. On the other, are my ancestors who are Indigenous to this land. Similarly, my scientific background and lifestyle place me squarely within a typically Eurocentric context, but my connection to the Earth and to its creatures cannot be quantified within those terms. And finally, my own formal education and my experience as an educator within a Eurocentric school system contrasts greatly with my interests in Indigenous knowledge.

Importance of Informal Learning

For myself, my location began as an inquisitive, "science-minded" youngster. I believe the bulk of my education, and certainly the components that I feel are most valuable, were learned through what I have subsequently understood to be "informal science" (Scribner & Cole, 1973). Evidence that informal science was of importance in my family is that my father had very little formal education. He, like many others growing up in rural Saskatchewan, completed grade 8 and then spent the rest of his time working on a farm. However, as youngsters, we saw him as the wisest person in the world. Although lacking higher education, he approached learning as a self-directed inquiry into the world and continues to do so in his eighties. This obviously had an effect on his children who also continue to inquire with scientific curiosity.

My scientific interests eventually led me to study within the Space Sciences. However, while many scientists in the field look outwards towards the cosmos I once again found myself looking down towards the Earth and its living creatures. My research consisted of using satellite imagery to observe woodland caribou habitat in northern Alberta (Bechtel, Sanchez-Azofeifa, Rivard, Hamilton, Martin, & Dzus, 2004). As exciting as it was to work on projects that involved the Canadian Aeronautics and Space Institute, the Canadian Space Agency (CSA) and the National Aeronautics and Space Administration (NASA), it wasn't long before I began to see that the results of all of the scientific knowledge and technology were not going to make much of a difference for the quiet, and soon to be endangered, woodland caribou in Alberta.

Concerns for the separation between the need for scientific knowledge and the needs of the caribou have brought me back to education, but from a far different perspective than what I had as a K-12 teacher. Having doubts that a Eurocentric based curriculum would benefit anything other than a Eurocentric view of science, I began to investigate the differences that occur in language use when those with a scientific background speak amongst themselves compared to the language used within Aboriginal cultures when they speak of issues important to them[1]. With this interest in mind, I sought out a data source that would contain evidence of both Eurocentric language use and Aboriginal language use.

How the Journey Led to the Research

Knowing that I had an Aboriginal heritage and being fully aware of the influence that informal learning had played in my own journey through life I decided to pursue research with the intent of melding the two topics together. However, the more I read the more I realized that much of the knowledge shared in Indigenous cultures occurs through informal learning. Furthermore, the more I studied regarding the history and philosophy of science the more I realized how those histories and philosophies are dominated by a Eurocentric perspective. As a result, it became evident to me that what was of interest are the differences (and commonalities) between Indigenous science shared primarily through informal

[1] The terms "Aboriginal" and "Indigenous" are often used interchangeably. For this research I will use the term *Aboriginal* when referring to the culture or people within the Sahtu region or other North American lands inhabited by Aboriginal people. This choice is made primarily on the fact that that is how they refer to themselves within the data. I will use the term *Indigenous* when referring to knowledge systems as the primary research sources used for this research utilize this term.

learning, and Eurocentric science taught primarily through Western traditions. Finding that divide and the border that tends to create turbulence between the two became the focal point of the research and what was needed was a data set and a methodology that would allow me to investigate the issue more deeply.

I soon came across transcripts from a public hearing that would serve these purposes quite well. The public hearing allowed both Eurocentric scientists and Aboriginal community members to speak on the issue of caribou hunting within a northern community. This was a unique opportunity to compare and contrast two distinct cultures speaking on a common topic of interest at the same event. Often, the divide between Eurocentric science and Indigenous science is revealed at times when the differences in beliefs create discontent or even animosity between the two cultures. But at this public hearing the intention of both the Aboriginal community members and the Eurocentric scientists are the same, which is to preserve the caribou numbers that exist in the North. Even though their *reasons* for wanting to preserve caribou numbers may be different, the end goal remains similar. Therefore, an opportunity is presented to allow us to observe how two different scientific cultures share knowledge at a time when they also share the same goal to preserve caribou.

How the Research Topic will be Addressed

What was needed then is a theoretical and methodological approach that would be structured enough to recognize differences and similarities but also flexible enough to accommodate other ways of knowing. Admittedly, there are times when the two may not seem congruent, however, this thesis is an attempt to

accommodate both approaches to knowledge sharing and as a result some discussion is required to explain the approach. Following the introductory chapter (Chapter One), is a chapter entitled "Where the Journey Began" (Chapter Two) that provides the inspiration behind the research and recognizes the borders that exist between Aboriginal and scientific cultures, again focused on the discussion of caribou sustainability. In this section the cross-cultural language comparison is described and a full explanation of how the academic investigation evolved into an analytical journey is shared so that the reader may follow the significance of the theory, methods and findings. Chapter Two also describes the Sahtu settlement area and the cultural importance of caribou in North American culture. It concludes by highlighting the research topic and as the starting point for how the journey began.

Chapter Three provides the theoretical framework for the thesis. It begins with an overview of the chapter and provides the background understanding required to investigate other ways of knowing. In this research Eurocentric science represents knowledge shared by scientists in a manner that is familiar to members within that cultural group, while the knowledge shared through the Aboriginal community represents an 'other' way of knowing. The literature that supports these ideas is shared throughout this chapter and the two cultures are described using Bruner's two modes of thought, the paradigmatic and the narrative and are proposed to provide a backdrop upon which the two cultures can be evaluated. I propose that the Eurocentric scientists are representative of the paradigmatic mode of thought and that their language is influenced and guided by

their Eurocentric scientific culture. Conversely, I propose that the Aboriginal speakers are influenced the narrative mode of thought. The distinct characteristics of both needs to be understood if we, as educators, hope to fulfill any realistic attempts of reducing the turbulence between two cultures. Recognition of the histories that have created this turbulence is critical in trying to assist in border crossings. Motivation for this research is to reduce the turbulence that can be created between two cultural borders. The term turbulence is suggested to represent the tension between the borders because there isn't necessarily any *intentional* desire to create conflict between the two groups, rather, their cultural practices inadvertently can create difficulties that need to be navigated. The results will, hopefully, help minimize the effect of perceived borders and offer a means to help cross them in a way that maintains the integrity of both cultures. To do so requires an honest and realistic evaluation of the current state of affairs in Aboriginal and Euroscientific collaborations. Although attempts for integrating scientific and Indigenous knowledge have been underway for many years, many will agree that "there has been little actual progress towards achieving such an integration" (Nadasdy, 2003, p. 114) and although government agencies, educators, resource management boards, and scientific research groups advocate for the use of Indigenous knowledge within their interest group there has been limited success showing how this can actually be achieved in a way that satisfies them as well as the Aboriginal communities (p. 115). The chapter also distinguishes what both Indigenous knowledge and Eurocentric science represents and provides the rationale of how these two modes of thought properly represent

the data set. Chapter Three concludes with an explanation of the language of science and explains how Eurocentric science itself has become a distinct culture.

Chapter Four explains the methodological framework used for the analysis and identifies discourse analysis as the tool that would best provide us with a way of researching the data and allowing the modes of thought to be revealed and allow for the identification of the key characteristics that distinguish Eurocentric science speakers and Aboriginal speakers. The chapter begins with a rationale for why discourse analysis is the method of choice and explains this under the discipline best described as the "sociology of language". The best intentions of working together can be greatly affected when a cultural group is not aware of its own oral narrative practices. What might be an acceptable and rational behaviour or habit within one cultural group may not be seen as so within another group. For example, "When two different systems of knowledge, ways of knowing, or epistemologies interact, it can be difficult to make sense of the resulting conflict" (Brayboy & Castagno, 2008, p. 738). Therefore, the hope is that this research will help all educators, whether that be Eurocentric science educators, Indigenous science educators, or scientists hoping to educate the public at large, in understanding that cultural differences in narratives are reflected in not only the words and experiences shared, but in the thoughts and mental models held by individuals within those cultures.

Next, Fairclough's categorizations are used to distinguish three types of internal relations of text analysis: semantic relations; grammatical relations; and vocabulary relations. The methodological approach was clearly inductive in

nature as it began with observations looking for patterns and regularities, which once found, were derived into tentative hypotheses that were explored more deeply. As the approach matured, themes began to emerge from the research. These themes are influenced by the culture of communication and an explanation of its importance is also provided. The chapter concludes with an explanation of the data set.

Chapter Five provides the findings from the methodological approach taken. As mentioned, several themes emerged as the research progressed. First, there was recognition of the pronouns used and patterns of repetition appeared. Next, applying the language of science theory described above, grammatical problems in scientific English are identified in the language of the scientists. The use of scientific language also led to the identification of a power structure that was witnessed within the data, which is discussed in the section that follows. Next, the use of metaphors by both the scientists and the Aboriginal speakers are explored. Those metaphors become very important as they help build the modes of thought (Bruner's idea of mental models) that define the important relationship between people and animals. The final theme that emerged from the data was related to the narrative sequence and how both the scientists and Aboriginal speakers structure their narratives in order to share their respective knowledge.

Chapter Six brings the research into full circle as it was both of the starting point of my personal journey and a conclusion. I began my PhD with a critical eye on curriculum and teaching. As mentioned, my interest in informal science is what initiated my personal and academic curiosity. During my graduate

coursework I became very interested in aspect of curriculum theory that utilizes autobiography. Initially, I believed that my interest in autobiography was unrelated to my research and represented more of an "out of scope" curiosity. However, the more I read of the Aboriginal speakers' narratives, the more I came to learn and understand their perspective and point of view. I found myself beginning to identify with each speaker and even start to picture them in my head as I read their words that were spoken at the public hearing. As you will see, their discourse is open, honest, and heartfelt, but more importantly, is educational. I found myself learning from the wisdom and began to question some of the Eurocentric ideas and values that I myself held. Their autobiographical narratives *taught* me things I never expected to learn from a transcript, but those transcripts, because they were taken verbatim and accurately, are merely a written record of the oral wisdom that was shared at the meeting. And that wisdom was passed on to me through this research project. I then began to try and think of how I could in turn share that wisdom with those who reside within a Eurocentric perspective. It was the realization of a connection between curriculum theory and the autobiographies of the Aboriginal people that was the inspiration for Chapter Six, a chapter that reviews the necessity for a curriculum reconceptualization that is sensitive to the borders that have been created between Eurocentric science cultures and Aboriginal cultures in the North. Utilizing the work of curriculum theorists I propose the use of autobiography as a means to assist the crossing of borders between the two cultures and evaluate the autobiographical nature of the oral presentations of Aboriginal Elders as evidence.

Chapter Seven contains conclusions for the entire thesis by examining the implications for science education and for scientists. My hope is that this research will highlight the necessity for understanding and respecting differences in language use amongst varying scientific cultures. From a scientist's perspective it might be thought of as a guidebook to helping work with other World views of science. It offers not only an explanation of some important differences but provides specific examples of how language can mitigate cultural borders. For science educators, it provides an awareness of how the modes of thought are revealed through language and the need for cultural awareness of differing views.

Chapter Two: Where the Journey Began

Overview

The previous chapter outlined how my heritage, background, and upbringing all contributed to constructing the person that I am today. In this chapter, I will detail how those experiences motivated the research topic developed in this thesis. I use the metaphor of a journey for my research because I feel it is an aspect of my Aboriginal heritage that was revealed to me throughout my program. I, like many other well-intentioned researchers, had hoped to uncover ways that would help communicate Eurocentric science towards Indigenous science, all the while trying to avoid the pitfalls that can actually expand borders between cultures rather than lessen them. For example, often when Eurocentric scientists collaborate with Aboriginal cultures compartmentalization occurs in order to adhere to the categorizations of disciplines and subdisciplines that are utilized during Eurocentric scientific

processes. Compartmentalizm occurs as (primarily Eurocentric) scientists begin to classify everything into categories of knowledge. The natural sciences are divided into biology, physical sciences, chemistry, etc. and then further divided into biochemistry, geology, genetics, etc. Each discipline and subdiscipline is thought to be socially and intellectually distinct and influences how people think. Nadasdy (2003) believes that "Historians of science and sociologists have argued that this compartmentalization has more to do with the politics of institutionalized knowledge production in the West than it does with any corresponding divisions in the "real" world" (Nadasdy, 2003, p. 123). When an Aboriginal person is concerned with feeding his or her family, they are concerned for all the animals, the land, and the people living on the land. A compartmentalized approach would result in caribou experts who may ignore all factors other than caribou related variables.

Furthermore, Aboriginal perspectives can often be distilled in order to be useful for Eurocentric scientific purposes, but this limits the importance of Aboriginal people's beliefs, values, and experiences because researchers are forced to distill knowledge "according to external criteria of relevance, seriously distorting them in the process" (p. 141). With this knowledge in mind I had hoped to contribute research that would help mitigate these types of issues. But what I soon realized is that some of the truly important aspects of the research required me to reconceptualize my own Eurocentric biases. The journey for me then became not merely to uncover ways to integrate Eurocentric *into* Indigenous

science; rather, it became a realization that both are distinct cultures with much to offer one another.

Inspiration for this Research

The driving force behind this research is a desire to work within two distinct cultures; an Aboriginal culture that relies on caribou as a way of life and a scientific culture that is interested in the ecological and biological importance of caribou. At first glance the two cultural views may not seem that far apart, and in fact that may be true, however, how these two cultures communicate to one another may make them seem like they are much further apart than they actually are. Therefore, we need to first look at the differences and similarities that occur in language use when two cultures communicate in the same forum on a topic of mutual concern. From those differences we might find ways to better communicate with one another if attention is paid to the relations amongst the semantic, grammatical, and vocabulary use of each other's language (Fairclough, 2003). Therefore, this research became an opportunity to perform a cross-cultural comparison with the intention of unveiling two potentially disparate scientific views.

But there is a challenge for a researcher when analyzing two distinct cultures when his personal background consists of both. It requires an ability to objectively investigate and evaluate language use in a way that looks beyond the sentence, but rather incorporates all of the knowledge that people draw upon as they construct their language (Johnstone, 2008). The conversations that occurred between Aboriginal speakers and scientists when they discussed the importance of

caribou and the implications of hunting provided an ideal opportunity to investigate both Indigenous and Eurocentric scientific discourse in detail.

In addition, as an educator, I wanted to not only quantify and qualify the discourse between two cultures, but I also hoped to find a means to influence how educators and scientists share knowledge amongst themselves and to each other. This research, which began as an academic investigation, evolved over time into an analytical journey that not only gave me a deeper understanding of how language use occurs in scientific discourse, but afforded me the opportunity for deep reflection of Indigenous knowledge and how it is communicated. Therefore, the combining of Aboriginal narratives and discourse analysis provides what I believe is a bona fide opportunity for a Eurocentric dominated education system to be influenced by an *other*[2] way of knowing and this research will provide an example of how that can be incorporated. This other way of knowing was shared to me through the autobiographical narratives of the Aboriginal speakers present at the public hearing, and it was through them that I realized the power that autobiography can offer as a means to an alternative way of knowing. Curriculum theorists identified autobiography as a means of reconceptualization many years ago, but it wasn't until I truly witnessed it in action that I began to understand the importance it can play in sharing of knowledge. As a result, this particular journey really began when I was introduced, albeit through transcribed text, to the Sahtu Dene in Northern Canada.

[2] The term "other" is intended here to be used in the sense that it represents an alternative view to Eurocentric science. It is not meant to imply that one type of science is marginalizing or discriminating the other. On the contrary, it is meant to broaden the understanding of a view of science by allowing the influence of an *other* point of view.

The Sahtu Settlement Area and Caribou

The Sahtu Dene and Metis Comprehensive Land Claim Agreement established the Sahtu Settlement Area in the Northwest Territories, Canada in 1993 (Indian and Northern Affairs Canada, 1993). The Sahtu Settlement Area includes approximately 283,000 square km of land and includes the communities of Colville Lake, Deline, Fort Good Hope, Norman Wells, and Tulita. The Sahtu Renewable Resources Board (SRRB) was established through the Land Claim Agreement (13.8) and the Sahtu Dene and Metis Land Claim Settlement Act and is the main instrument of wildlife and forestry management in the Sahtu Settlement Area (Sahtu Renewable Resources Board, 2010). Of particular interest to this study are discussions that occurred on the topic of introducing a caribou hunting quota. Because of an apparent decline in caribou numbers, wildlife managers working for the Government of the Northwest Territories proposed to the Sahtu Renewable Resources Board that a quota on hunting caribou be established in an attempt to maintain caribou numbers. Not surprisingly, local Aboriginal hunters and community members are strongly opposed to a government enforced quota system and would rather maintain the caribou populations in traditional ways as has been done for many generations. The chairperson of the Sahtu Renewable Resources Board believes that "to the Dene people, you know, certain resources in our country have been a part of our lives and part of the lives of our grandfathers, their grandfathers and, certainly, many of the people here in -- in the Sahtu today" (Walter Bayha, November 21, page 7, line 12-16) and that the public hearing held to discuss caribou was a "milestone"

because it allowed everyone the opportunity to share their experience, concerns, and wisdom on caribou in the Sahtu Settlement Area.

Scientists too are concerned for the plight of the caribou in the North. The species of caribou relevant to this research project are the species *Rangifer tarandus,* and more specifically a subspecies that are referred to as barren-ground caribou or an ecotype known as migratory tundra caribou. It is well-known that caribou numbers tend to fluctuate and this appears to be a fairly natural trend with numbers decreasing to very low numbers only to rebound in future years. In fact, alarming statements have been made in the past of caribou herds completely disappearing "only to reappear out of nowhere after a few years" (Hummel & Ray, 2008, p. 86). Environment Canada has not identified barren-ground caribou as a species at risk, but because of their importance to northern communities there remains a large amount of awareness, and concern, for their well-being. They state "While barren-ground caribou herds are not currently listed as a species at risk, recent widespread declines in previously plentiful herds are causing significant alarm" (Environment Canada, 2011).

It is difficult to fully describe the importance that caribou play in North American culture because a remarkably small percentage of non-Aboriginal people have ever witnessed a caribou in the wild. Even though most Canadians rarely encounter caribou they certainly continue to identify with it. For example, the Canadian quarter has been emblazoned by a caribou image since 1937 and during a national CBC contest "the great migratory herds were repeatedly nominated as one of Canada's unique "wonders of the world"" (Hummel & Ray,

2008, p. 77). There is an unquestionable ecological importance that caribou play in the northern ecosystems that they inhabit. As a food source to other animals, caribou are preyed upon directly and indirectly by wolves, grizzly and black bears, and scavenged upon by wolverines, foxes, and ravens (Hummel & Ray, 2008). As a food source to Aboriginal people, "the migratory herds are valued at over $100 million per year in meat value alone" (Hummel & Ray, 2008, p. 59).

But there is a cultural significance to caribou that is impossible to put a number value on. The caribou have become a symbol of resiliency and life in the North and their cultural importance is unquantifiable. Larry Innes, believes "the caribou are the drum, the song, and the heartbeat of the people" (Hummel & Ray, 2008, p. 70) and notes how the Innu people in Goose Bay, Labrador emphasize the need for respect and proper treatment of caribou that are willing to be "given" to the people. When asked about how Government imposed hunting regulations would affect his people, Fred Sangris, a chief of the Yellowknives Dene, states

> It's going to be kind of difficult. In our region there are many families who depend on caribou for ceremonies, for sharing, for community, for gatherings. Caribou is the centre of our life. To ask our people to go on regulation to regulate themselves, to maybe even look at quotas so that the numbers will come back strongly, it's going to affect them. We know that there will be some strong words exchanged, but we have to be understanding, we all have to try to do our part. If the herd is going to be there for the next generation, we have to think about that. Otherwise the next generation may not see caribou at all, so we have to do our part, and

ask all people to work with us as well (Canadian Arctic Resources Committee, 2007, p. 26).

As a result, caribou and Northern people not only share the same land, but also share a history and culture that resides deeply within them. Discussion of the caribou's importance provides a unique opportunity to observe how scientific knowledge derived from vastly different cultures comes together when discussing a topic of scientific and cultural significance.

Research Topic

My research topic thus came together in two very important and distinct ways. First of all, by basing my research around the relationship between caribou and Northern cultures I am able to explore an issue of deep interest to me. Secondly, framing the research as an exploration of discourse used in both Eurocentric science cultures and in other ways of knowing offers insights into how differences and similarities in science communications can affect understanding and agreement amongst peoples of distinct cultures. Therefore, this research uses discourse analysis to compare and contrast how language in Aboriginal, traditional knowledge-based cultures and in Eurocentric, scientific-based cultures is used during a decision making processes involving caribou harvesting in northern Canada. Aboriginal cultures maintain many beliefs, values, social relationships, and practices that distinguish them from mainstream Euro-Canadian cultures (Aikenhead & Ogawa, 2007). These differences can lead to the creation of borders that make it difficult to navigate between when communicating on scientific topics of mutual interest. The results of this analysis

will assist in comprehending and mitigating those borders that have been created through capitalism and colonialism that now impact life in the North. Aboriginal people and Eurocentric scientists both have a vested interest in protecting and maintaining caribou populations in northern Canada, but how they communicate those intentions to each other is critical if collaboration is to be possible and understanding how each other uses language can be a valuable aid in mitigating those borders.

Chapter Three: Theoretical Framework

Overview

In the previous chapter I discussed the journey that led to the creation of the research topic for this thesis. In this chapter, I will lay out the theoretical components upon which the analysis is built. The reader may notice that there is not a distinct literature review section of this thesis, rather, because of the diversity of themes that emerged during the research process the appropriate literary references are made throughout. References that are explicit to the theoretical background are emphasized in this chapter, those that are explicit to methodological framework are emphasized in chapter four, and references that are explicit to particular themes in the findings appear throughout chapter five. In chapter six, a theoretical framework of a different type is introduced, one from a curriculum theory perspective. Although the ideas and findings from the previous chapters still influence the conclusions in chapter six, a theoretical framework of curriculum reconceptualization is introduced and thus the appropriate framework and literature references are described in more detail within that chapter.

In this chapter (Chapter Three), I will first describe Jerome Bruner's (1986) two modes of thought which lay the groundwork for the entire thesis. These two modes of thought highlight how discourse can shape knowledge in two very distinct ways. The two modes become representative of the two different cultures; a narrative mode that is used primarily by the Aboriginal community and a scientific mode that is utilized primarily by the scientists. Bruner also introduces his concept of mental models and how those mental models shape and construct the discourse of the speakers in this research is an important function to be understood. Next, a background on Indigenous knowledge and Eurocentric science is provided. Through this research I hope to lessen the turbulence created between the borders of two cultures and in order to do so we must first understand where the differences lie. And lastly, I propose that the language of science falls within a distinct culture all its own. Therefore, the concept of the language of science being a distinct register of the English language is proposed to allow for a deeper investigation into the similarities and differences between Indigenous knowledge and Eurocentric science.

Other Ways of Knowing and the Language of Science

Bruner's two modes of thought.

Two distinct cultures are examined in this research and can be divided into two different modes of thought (Bruner, 1986). This includes our knowledge of both Eurocentric science culture and our knowledge of Indigenous science cultures. The theoretical framework underpinning this research is built upon this concept and represents two ways of knowing applicable to the discourse analyzed

here. The first mode, the paradigmatic, is utilized primarily through the sciences and follows functions of mathematics, explanation, categorization, and hypothesis testing. The paradigmatic mode of thought "employs categorization or conceptualization and the operations by which categories are established, instantiated, idealized, and related one to the other to form a system" (p. 12). Conversely, the narrative mode of thought represents storytelling, often through historical accounts and "strives to put its timeless miracles into the particulars of experience, and to locate the experience in time and place" (p. 13). The two modes of thought are useful distinctions in highlighting the similarities and differences between scientific discourse of the scientists and the Indigenous knowledge of the Elders as they interact in a common forum.

The distinction between the paradigmatic and narrative modes of thought is important in this research because of the nature of a public hearing. The goal of this public hearing is to allow a decision-making body (in this case the Sahtu Renewable Resources Board) to listen to and possibly be influenced by various stakeholders. The narratives of the Elders, which are presented primarily as stories are contrasted to the scientific arguments of the scientists' narratives. Bruner believes that "A good story and a well-formed argument are different natural kinds. Both can be used as means for convincing another. Yet what they convince *of* is fundamentally different: arguments convince one of their truth, stories of their lifelikeness" (Bruner, 1986, p. 11). This analysis will attempt to determine if the distinction between the two is evident in the narratives presented at the public hearing. For example, Bruner believes that in the case of a scientific mode of

thought “It is probably the case that scientific or logical writing – or, rather, writing governed by requirements of a scientific argument – tends to choose words with the object of assuring clear and definite reference and literal sense” (Bruner, 1986, p. 22). If this is true then even though both the scientists and Aboriginal speakers are speaking on a common topic, their language selection must differ. Conversely, the narrative mode of thought utilizes language that “deals in human or human-like intention and action and the vicissitudes and consequences that mark their course” (Bruner, 1986, p. 13). This will resonate with Aboriginal speakers who have shared “narratives that have been passed on orally for generations [and] continue to provide a foundation for evaluating contemporary choices and for clarifying decisions” (Cruikshank, 1998, p. xii). In other words, their language choice is not governed by rules or requirements, but by the particulars of experience which help “to locate the experience in time and place” (Bruner, 1986, p. 13). As a result, the narrative mode of thought is well represented through the oral presentations made by the Aboriginal speakers in this analysis, and as you will see in later sections, time and place play a particularly important role in the Aboriginal narratives.

Mental models.

It is important to understand the delineation of the two modes of thought because it represents more than just two styles of speaking, rather, they represent two different methods of thinking and Bruner identifies how “human mental activity depends for its full expression upon being linked to a cultural toolkit – a set of prosthetic devices, so to speak – then we're well advised when studying

mental activity to take into account the tools employed in the activity" (Bruner, 1986, p. 15). The linking of mental activity to cultural experience is critically important in this research because it provides the theoretical approach to help understand where the differences between two cultures truly lies. It suggests that the differences are far more complex than just an understanding of science. Deep understanding can only result if both language and cultural considerations are taken into account. Bruner thus introduces his idea of mental models, that is, "the models that we store in our heads that guide our perception, thought, and talk" (Bruner, 1986, p. 47). The concept of mental models is important in this research because they can be based on knowledge of the world as individuals have experienced it. Therefore, the life experiences that a person encounters builds their own mental models that they use as they move through life facing other experiences. Bruner believes that mental models "enable us to keep an enormous amount in mind while paying attention to a minimum of detail" (Bruner, 1986, p. 48) and this type of model creation is what we collectively call "science".

Bruner's framework is a useful starting point because he distinctly separates science and the humanities as two possible worlds. He claims the objective of the thought processes and mental models of scientists "is always to convert those dense metaphors into the transparent, frangible hypothesis of science – or into untestable axioms that will generate hypotheses that, with luck, may be tested" (p. 52). On the other hand, Aboriginal Elders would likely be representative of the humanities which seeks "to understand the world as it reflects the requirements of living in it" (p. 50). Therefore, the language used by

each culture reflects the mental models that they possess. Although both groups may be concerned for the quality of life of both the people and the animals of the area, how they frame their possible worlds varies greatly. As a result, although science and the humanities may have started at a similar origin they diverge because they have different goals. The objectivity of science "attempts to make a world that remains invariant across human intentions and human plights" (p. 50) whereas the humanist "deals principally with the world as it changes with the position and stance of the viewer" (p. 50).

Indigenous knowledge and Eurocentric science.

Aikenhead & Ogawa point out that colonial discourse categorises the terms *Indigenous knowledge* and *science* into two colloquial terms which they believe are insufficient in capturing the diversity and complexity of other ways of knowing (Aikenhead & Ogawa, 2007, p. 540). Thus, negotiating between Western, Eurocentric science and Indigenous sciences requires an ability to consider alternative ways of knowing and to recognize the importance and contribution that can be made by a variety of views. They present what they believe to be more authentic categories: indigenous ways of living in nature (which would include the Dene people in northern Canada used in this research), neo-indigenous ways of knowing nature (which includes Asian cultures such as Islam and Japanese), and Eurocentric sciences (which would include the USA, Australia, or UK) (Aikenhead & Ogawa, 2007, p. 540). This research includes the first and third of these categories and while I agree with the authors' rationale, for practicality I will continue to use the term Indigenous knowledge when referring

to the narratives of the Elders and use the term Eurocentric science when referring to the narratives of the scientists[3].

Eurocentric science presumes that our physical world is definable and knowable and that one can obtain knowledge through an impartial observer point of view. However, Indigenous knowledge tends not to generalize observations into universal laws and "does not separate the observer from the observed as is necessary for the presumed objectivity of Western science" (Brayboy & Castagno, 2008, p. 738). Because of this perspective, moving between Eurocentric and Indigenous knowledge requires a cross-cultural approach that recognizes Eurocentric science as its own cultural entity and understands that people's core cultural identities may be, at times, in conflict with Eurocentric science (Aikenhead G. , 2001). It should be noted that although the term Indigenous knowledge is being used for this research, this does not mean that Indigenous knowledge does not include science or a scientific method. On the contrary, there are many components of Indigenous knowledge that are clearly scientific in nature. However, for the purposes of this research I will not be referring to the Indigenous knowledge users as "scientists". That term will be used specifically for the Eurocentric science users. The role of the teacher then becomes a "culture

[3] It should be noted that different authors use different terminology when referring to the knowledge of Aboriginal people. Aboriginal science, Indigenous science, Native science traditional knowledge, traditional ecological knowledge, and others can be found in a wide variety of reference material. For the sake of clarity this research I will utilize the term Indigenous knowledge, except when an alternative term is directly quoted, in which case the terminology used by the original author will be utilized.

broker" who helps students move between the culture of science and the other cultures experienced by being one who:

> identifies the cultural borders to be crossed, who guides students back and forth across those borders, who gets students to make sense out of cultural conflicts that might arise, and who motivates students by drawing upon the impact Western science and technology have on the students' life-worlds (Aikenhead G. , 2001, p. 339).

According to Goulet, the Dene Tha, for example, offer us an opportunity to look at different models of thought and show how Euro-Canadians can gain by trying to learn from their "guiding principles in the transmission of knowledge" (Goulet, 1998, p. xxxvi). Goulet's work highlights the ability of Aboriginal people to work within Euro-Canadian patterns of behaviour in some contexts and to work according to Dene patterns of conduct in other contexts (Goulet, 1998). This Indigenous knowledge is recognised as a "kind of knowledge about the land and animals that is distinct from that for most Euro-North Americans" (Nadasdy, 2003, p. 9). Indigenous knowledge offers a perspective that reaches outside of the formal Eurocentric scientific model that is utilised in North American school systems. For example, the Dene's insight into Euro-Canadian values exists not only because of their experience with economic, religious, educational, and political Euro-Canadian institutions, but also because as a people they are willing to "accept cultural differences and willingly communicate with non-Dene according to non-Dene ways" (Goulet, 1998, p. 2). For example, during the

public hearing used for this research, Elder Timothy speaks of the Elders by saying:

> 21 They're not gonna tell you what to do, but
> 22 they're gonna tell you a story. That's the way they are.
> 23 They never really tell us what to do; they always tell us
> 24 a story and you find these thing -- little things in the
> 25 -- in the stories, and that's how you move forward.
> 1 But if you don't listen, you just keep
> 2 doing what you think is the best. But listen to the
> 3 Elders when they talk. There's -- there's a lot of them
> 4 behind me that are -- I feel -- I feel strong, because
> 5 they're behind me (Elder Timothy, November 22, page 63-64, lines 21-5).

Not only does Elder Timothy explain that the Elders are going to share their experiences through the use of story, but he also relays to the audience that it is not their way to tell people what to do, but to listen to stories and find within them meaningful direction. In a sense, he is trying to *teach* the non-Dene how to listen to the narratives and is laying out how they share their knowledge, in hopes that the audience will understand the critical aspects. The Aboriginal Elders of the Sahtu region use stories as a means of maintaining their oral heritage. Like other Aboriginal communities, the stories constitute a body of cultural knowledge that "has important practical applications in that it serves as a main charter guiding people with respect to behaviour and conduct in a very wide range of contexts"

(Klapproth, 2004, p. 382). As such, the sharing of oral narratives offers far more than just the passing over of content knowledge; it gives meaning to the individual, to the community, and to the land and animals that they share it with. Rather than just viewing the content knowledge as just another form of science (e.g., Indigenous science) we should view learning Indigenous knowledge as "a journey toward wisdom, not an accumulation of facts and concepts" (Aikenhead G. , 2006, p. 111).

Acceptance of other peoples is a lesson that would be beneficial for Eurocentric science as well. Barnhardt and Kawagley (Barnhardt & Kawagley, 2005) believe that the core values and beliefs of Indigenous worldviews have survived for thousands of years and are just as valid today as they have been in the past. Furthermore, because Indigenous cultures have such a long association and connection to particular places, Eurocentric scientists would be wise to learn from these alternative ways of knowing as they can offer "lessons that can benefit everyone, from educator to scientist, as we search for a more satisfying and sustainable way to live on this planet" (Barnhardt & Kawagley, 2005, p. 9).

Understanding the differences in Eurocentric science and Indigenous knowledge is important for the educational community for a number of reasons. Firstly, when speakers of oral narratives engage in a discourse, they create social meaning through text that is held against a background of all other texts that are recognized as having a relationship to them through a principle called intertextuality (Lemke, 2004). How language is used determines the social community that a speaker identifies with and understanding how members of

different communities make connections between some forms of texts and not others are of a "fundamental concern for text semantics, discourse analysis, and the study of social systems generally, as well as for educational research" (Lemke, 2004, p. 4). For example, many of the Elders that spoke at the public hearing were well-versed in both the Euroscientific views of climate change and the Canadian government's policies on the land claims agreements, and as a result their narratives make connections to more than just their own cultural heritage.

Second, crossing the borders of cultures is of importance for all educators so that they can consider other ways of knowing and, as a result, other ways of teaching, as they work with people from cultures different from their own. For example, the Dene:

> expect learning to occur through observation rather than instruction, an expectation consistent with the Dene view that true knowledge is personal knowledge. The Dene prefer this kind of knowledge since it is the form that has the most secure claim to being accepted as true and valid. Students of the Dene have often commented on the fact that this theme goes hand in hand with the premium Dene place on "noninterference" or "nonintervention" in the lives of others (Goulet, 1998, p. 27).

As a result, other ways of knowing may encompass a vast array of cultures and identities and it is important that any research that incorporates a cross-cultural approach is cognizant of the similarities and differences. The concept of border crossing should not be considered one directional; rather it should be conceived as a concept which allows for an open-minded approach that helps

mitigate understanding in all directions. It is hoped that the results of this research will not only promote border crossing between Indigenous knowledge and Eurocentric science, but engage discourse amongst all forms of science.

Language of science.

Scientists and science educators who have only known a Eurocentric environment may not realize that the language that they speak, that is, the language of science, is representative of a distinct cultural group. Following Bruner's ideas of mental models, scientists and science educators will have formed mental models that work within one particular framework. However when that framework is challenged or is unable to provide an explanation for an experience, the person may reject new information. Border crossing promotes an ability to move between mental models that are based in different frameworks. However, in order for that to be successful one has to realize that they are speaking a distinct language and possess a Eurocentric mental model. Recognition of the language of science is an important first step in assisting our goal of border crossing.

Historians and philosophers of science have produced extensive work on the history and importance of science for all of humanity. For an overview of the evolution of science and Eurocentric science see Aikenhead & Ogawa (2007). This research investigates the language of science and the impact that is made when speakers of Eurocentric scientific backgrounds engage with speakers that normally rely on Indigenous knowledge. Specifically, Eurocentric, English speaking scientists will utilize what Halliday refers to as “scientific English” as a

functional variety, or register, of the English language (Halliday M. A., 2004, p. 140). Although it is difficult to definitively define exactly what scientific English entails, it is important to investigate it because of the power that it possesses and even though an English speaker may not be able to identify it as a recognizable category he still "knows it when he sees it or hears it" (p. 141). One Arctic researcher jokingly states "I work with elders who speak no English, and it's quite similar to working with scientists, because they don't speak any English either" (Bielawski, 1996, p. 217). Therefore scientific English can be thought of as a register of the English language that contains its own grammar, syntax, and meaning. The ability to be scientificly literate requires being able to operate within this register. The question becomes then, can scientists, when dealing with people that are outside of the scientific English register, communicate in a way that allows others to be included in the sharing of knowledge or do they in fact create an exclusive social group that creates borders between them?

It is important to note that the use of scientific English cannot be identified simply through technical terminology or isolated phrases. Rather, interpretation requires researchers to understand that it is a combination of numerous related features throughout an entire narrative that identifies a piece as being a part of a scientific English discourse and is far more complex than mere terminology. Halliday describes it as "the language of science" which includes "the various forms of discourse in which the activities of 'doing science' are carried out - but seen as a systemic resource for creating meaning, not as a collection of instances of text" (Halliday M. A., 2004, p. 49). As a result, the language of science may

not include any technical terms at all and may have uses that go far beyond just scientific knowledge. For example, the writings of scientific researchers and academics "not only negotiate community knowledge and credibility, but help to produce and sustain status relationships, exercise exclusivity and reproduce interests which lead to an unequal distribution of influence and resources" (Hyland, 2004, p. 168). Therefore, the language of science needs to be investigated as an entity rather than individual passages and as a result this research investigates narratives presented by scientists as entire passages rather than individually selected words, as one might see in a corpus linguistics study.

Halliday (2004) emphasizes that many science teachers believe that the difficulty that students face when dealing with the language of science has more to do with difficulties in the vocabulary or jargon that is selected, and that "scientific concepts and scientific reasoning – could just as well be expressed in everyday common non-technical terms" (Halliday M. A., 2004, p. 160). He compares the 'jargon' view of science to another view of science which is "totally dependent on scientific language: that you cannot separate science from how it is written, or rewrite scientific discourse in any other way" (p. 160).

From a theoretical perspective then, this research is approached in an exploratory manner that will help determine if one, both, or neither of these views are representative of the discourse analyzed here. In this situation, the scientists do possess a Eurocentric background, however, they have also been immersed in a culture that embraces an other way of knowing and are well aware that their audience at the time of the public hearing was a non-Euroscientific one. How the

scientists respond to this situation and how they utilize the language of science will tell us much about how Eurocentric science is presented and perceived by a non-Eurocentric audience.

Theoretical Framework Summary

In summary, Bruner provides us with a way of understanding how language and thought are interwoven and how two distinct modes of thought, the paradigmatic and the narrative, represent two alternative ways of knowing. This research will determine whether those two modes of thought can be witnessed in the discourse of Eurocentric scientists and Aboriginal community members. I will show that the narrative mode will be representative of Indigenous knowledge and that the paradigmatic mode will dominate the discourse of the scientists, even though they are in a non-scientific setting at the time of the hearing. The rationale for believing that the scientists will preserve their paradigmatic mode of thought is that their mental activity, and thus their language use, is formed by the mental models that they possess. Whether or not they are aware of these mental models cannot be determined from this data, however, their choice of language should indicate how deeply embedded those mental models are. Likewise, I would expect the Aboriginal speakers to also exhibit a narrative mode of thought, as the public hearing is an environment that encourages them to share their experiences. Although they are aware of the presence of the scientists, it is unlikely that they will adapt their mental models either. This leads us once again to the importance of border crossing. Border crossing is an ability to comfortably move past cultural barriers, without having to jeopardize one's own beliefs. Knowing that both

cultural groups possess their respective mode of thought requires us to look for opportunities that either promote dialogue between the two or highlight opportunities for border crossing that may have been missed. And finally, knowing that the language of science is a distinct register of the English language and that it is formed within a Eurocentric scientific mode of thought, we would expect the scientists to display examples of that language. However, this is an unusual situation because the presentation of the scientists is in a non-Euroscientific environment. They are presenting in front of what they know are not Eurocentric scientists. From an educational perspective, this is of immense interest to us because it is one of the opportunities for a Eurocentric scientific community to make connections with others. How they utilize the language of science a large they determine its effect on the audience and in the long run could determine their perception of Eurocentric science and scientists.

Chapter Four: Methodological Framework

Discourse Analysis

Overview: Why discourse analysis?

With the theoretical framework established, I next had to investigate the best method of analyzing the data that would be structured enough to endure a rigorous evaluation but also flexible enough to accommodate two widely different cultural perspectives. The theoretical ideas mentioned in the previous chapter provide a general knowledge of the cultural environment and the methodologies subsequently emerged. Methods were drawn from the theoretical research and

were applied to the data set. In some cases, methods were not applicable or the results could not be seen within the data, however, the methods utilized in this research strongly support each case. In other words, a wide variety of approaches are used in order to support the conclusions. That said, the overall methodological approach broadly incorporates discourse analysis, and as you will see, discourse analysis includes an extremely wide range of techniques, some of which are useful to this research and others that may not be applicable. In this chapter, I will provide the rationale for which components of discourse analysis are most useful in supporting both the data and the proposed theoretical framework.

Discourse analysis, primarily considered a subdiscipline of linguistics, is not in itself a theoretical perspective or methodological framework. This is because it does not entail a single theory or set of theories rather, "it simply describes the object of study: language beyond the sentence" (Tannen, 2007, p. 5) or in other words "the study of language, in the everyday sense in which most people use the term" (Johnstone, 2008, p. 2). Others have described it as referring "both to the study of language above the sentence (more accurately, above the clause), and also to the study of naturally occurring language" (Stubbs, 1983, p. 10). Therefore, what constitutes discourse requires some clarification. Discourse is usually used as a mass noun (for example, how we use *music* or *information*) in "actual instances of communicative action in the medium of language" (Johnstone, 2008, p. 2). The reason it is referred to as *discourse analysis* instead of *language analysis* is that it is not focused solely on language, but also on "what happens when people draw on the knowledge they have about language,

knowledge based upon their memories of things they have said, heard, seen, or written before, to do things in the world: exchange information, express feelings, make things happen, create beauty, entertain themselves and others, and so on" (Johnstone, 2008, p. 3). In other words, "we continually and actively build and rebuild our worlds not just through language, but through language used in tandem with actions, interactions, non-linguistic symbol systems, objects, tools, technologies, and distinctive ways of thinking, valuing, feeling, and believing" (Gee, 2005, p. 11). It is these characteristics that make discourse analysis appropriate for the data being studied here.

Tannen (2007) believes discourse analysis embraces at least nine disciplines: linguistics, anthropology, sociology, psychology, literature, rhetoric, philology, speech communication, and philosophy (p. 6), so defining the methodology of discourse analysis can be a complex and difficult task. In fact, consensus on the word *discourse* itself can be equally involved. From a broad perspective, this research will follow Gee's concept of discourse as "Discourse" (that is, discourse with a capital "D" as opposed to discourse with a lower-case "d") (Gee, 2005). Gee's view of Discourse is that it encapsulates not only the language-in-use (lower-case "d"), but also all of the aspects of one's "body, clothes, gestures, actions, interactions, symbols, tools, technologies (be they guns or graphs), values, attitudes, beliefs, and emotions..." (Gee, 2005, p. 7). Therefore, although the analysis is being performed strictly on written texts derived from spoken narratives, this research will also acknowledge key attributes of Discourse described by Gee, particularly in how it relates to values, attitudes, beliefs, and

emotions which are critical aspects of both Euroscientific and Indigenous cultures. Discourse analysis then can take many forms. In fact, Gee himself states that there are many different approaches to discourse analysis and that even his isn't uniquely "right" (Gee, 2005, p. 5).

The sociology of language.

The discourse analysis disciplinary approach here can be viewed as coming primarily from the perspective of the sociology of language. According to Paulston and Tucker (2003), sociolinguistics developed in the last 50 years and became popular in the late 1960s as it became focused on the intersection between language and society. However, Paulston and Tucker differentiate sociolinguistics and the sociology of language by stating that "sociolinguistics is mainly concerned with an increased and wider description of language... [while] sociology of language is concerned with explanation and prediction of language phenomena in society at the group level" (Paulston & Tucker, 2003, p. 1). They believe sociolinguistics is used primarily by linguists and anthropologists and that the sociology of language is studied primarily by social scientists. While many of the methodologies used in this research are from authors that are considered sociolinguists, it may be more appropriate to think of this as a study in the sociology of language, as it is more concerned with explaining the language phenomena between two cultural groups than it is the methodological investigation of linguistics. That is, this research is more representative of an exploratory investigation into the social divide between cultural groups than the detailed linguistic devices generally associated with sociolinguistics.

Fairclough's categorizations.

As such, portions of the research includes a variety of language phenomenon that Fairclough (2003) categorizes into three groups that describe internal relations of text analysis: semantic relations, which are *meaning* relations between words, expressions, clauses, sentences, or even longer stretches of text; grammatical relations, which are relationships between parts of words or between words and phrases; and vocabulary relations, which look for patterns of co-occurrence between words or expressions (Fairclough, 2003, p. 36). This will be performed through the use of discourse analysis as a means to uncover and reveal examples on how language use can vary between different cultures.[4] Fairclough's categorizations contributions to the methodological approach is that it influences the analysis to be performed at three different levels; in simple terms, words, then grammar, followed by meaning relationships.

The data for this research came from transcripts of a public hearing on the issue of implementing a Caribou hunting quota in the Sahtu region in the Northwest Territories, Canada, was of interest because it a) included discourse of both Eurocentric scientists and Aboriginal community members, b) is in the form of a presentation where the speaker shares knowledge without interruption, and c) contained oral narratives (autobiographical in nature) of Aboriginal Elders. All three of these topics are of great interest and supports the philosophical goal for this research; which was to investigate the difficulties faced when Eurocentric scientists and Aboriginal communities come together. From an educational

[4] Fairclough also identifies a fourth relation, *phonological relations*, which deal strictly with spoken language and thus have been excluded from this analysis as the data is entirely based on written text.

perspective, it reveals how differences in the discourse of two cultures can be understood so that teaching in both Eurocentric cultures and Aboriginal cultures could benefit from knowledge about the other.

How the themes emerged.

It soon became clear that discourse analysis with a sociology of language perspective would be an appropriate discipline in which to perform the analysis of this data, but as mentioned, discourse analysis itself is neither purely a theoretical framework nor a analytic one. Therefore, the analysis began in an emergent and exploratory manner, by reading and rereading the transcripts and noticing patterns, similarities, differences, contradictions, etc. First, vocabulary relations were investigated and explored for similarities and differences. Because the language of science is a distinct culture within itself, the types of words used were the most obvious starting point. The analysis would consist of counting (significant) words and contrasting their occurrence between the two cultures. During the analysis, two other word themes emerged; the use of pronouns and repetition of words and phrases. The results of the vocabulary relations are presented in Chapter Five: Pronouns and Repetition.

The framework for the study of the grammatical relations was more difficult and required more of a structured approach for analysis. I therefore utilized Halliday's (2004) identification of the grammatical problems in scientific English which were originally published in 1989. He identified seven characteristics of scientific English, several of which were found here as strong

examples of the type of language scientists tend to use. They are presented in Chapter Five: Grammatical Problems in Scientific English.

It was during the analysis of the grammatical problems in scientific English that the semantic relations began to appear. The methodology employed was to look for topics that were first discussed by both cultures and then to look for topics that were discussed by one and not the other. For topics that were discussed by both, such as the movement of caribou herds, analysis was performed to see if there was agreement, not only on the topic, but on the way in which the topic was described. For topics that were addressed by one group and not the other, I had to first find the topic discussed and then confirm that it was not addressed by the other group. For example, the scientists may discuss the importance of using a Caribou population model, while that may not be of as much interest to an Aboriginal hunter. Conversely, Aboriginal speakers may discuss the importance of respecting the ground on which a Caribou is killed, which may not be acknowledged in the discourse of the scientists. It is important to note that this is not that the Aboriginal community members do not respect the work of the scientists, in fact, they make statements to the contrary appreciating the work that they have done, and it is also not to say that the scientists do not respect the practices of the community members, but they may just not have mentioned so within the discourse analyzed here.

The first theme that appeared from this approach was the observation of what appeared to be scientific language that either exuded power over other ways of knowing or failed to acknowledge specific components of other ways of

knowing. The approach taken was to see if comments made by the scientists reflected comments made by the Aboriginal speakers. That is, did they use the same type of language to discuss the common theme or did there appear to be a sense of superiority exuded through the discourse. Furthermore, because the Aboriginal speakers were given an opportunity to suggest reasons why they believe there is or is not a decline in caribou numbers it is important to investigate whether or not the scientists appear to acknowledge and accept those reasons or are they dismissed. The results are presented in Chapter Five: Power and provides an indication of whether there is a power imbalance present between the two groups.

The next theme that emerged was the use of metaphor within the discourse. For the methodological approach I first researched the use of metaphor within Eurocentric science and found there to be significant literature on the subject. I subsequently researched the use of metaphor within Aboriginal cultures and again found significant references. The question that remained was whether or not metaphors are used in a similar way between the two cultures. The research indicated that different types of metaphors can be used in discourse and therefore the data was scanned to see which groups utilized metaphor and whether or not they utilize the same type of metaphor for the same purpose. This is summarized in Chapter Five: Metaphors.

The benefit of working with such a rich data set in an exploratory and inductive manner is that often findings can be revealed that weren't known or even considered prior to the research. The research performed on metaphors uncovered

another theme that makes an important distinction between the two cultures. That theme represents how Aboriginal people view the relationship between people and animals and provides another opportunity for those with a Eurocentric background to broaden their understanding of both people and animals. There wasn't a specific methodological approach utilized here, rather, the research found many examples of the Aboriginal Elders speaking about animals at which point I then turned to the literature for support of the theme. While this approach may be "non-traditional" from a Eurocentric science perspective, it nonetheless revealed some fascinating knowledge that is shared in Chapter Five: People and Animals.

The final theme (Chapter Five: Narrative Sequence) that was studied in this research had to do with the narrative sequence that was employed by both groups. The methodological approach is based on Labov (Labov, 1997) and Labov and Walezky's (Labov & Waletzky, 2003) work with narrative structure, which is the order or manner in which a narrative is constructed. The methodology entails reading entire passages from the speakers and observing how the narratives are constructed in both space and time. Narrative sequence is the most complicated of the themes researched because the structures can be very complex and go far beyond just a single sentence or even groups of sentences. Narrative structure presents the entire "story" and the sequence that that structure occurs in can be different amongst varying cultures. Although this analysis does not use the detailed methodology laid out by Labov and Labov and Walezky, it does analyze structure based on the narrative sequence of events as presented by

the speakers. Determination of narrative sequence is important because, once again, differences in narratives styles can produce difficulties in understanding.

Chapter Six utilizes the themes revealed from Chapter Five and combines them with concepts of curriculum reconceptualization from a curriculum theory perspective. As such, the methodology is distinctly different and will be described in more detail within Chapter Six. The chapter presents a unique opportunity to observe the power of autobiographical narratives as an opportunity to share knowledge and thus substantiates the theoretical approach of autobiographical use in curriculum reconceptualization. Curriculum theorists have long supported the use of autobiography as a means of reconceptualization and the narratives employed by the Aboriginal speakers suggests that the method is both embraced by the community and an effective knowledge sharing tool.

Just as the three relations that Fairclough identified (semantic relations, grammatical relations, and vocabulary relations) were all revealed as the analysis grew more and more detailed, the distinct modes of thought described by Bruner also clearly emerged from the data. More importantly, the knowledge that was shared orally at the public hearing was shared with me through the written text, and I in turn, hope to share it with others through this research. As information and knowledge was revealed through the data, particular research methodologies were investigated that would best suit each analysis. Therefore, although there is not an overarching discourse analysis technique that is used for all sections, the philosophical, sociological, and educational goals are achieved throughout.

Rationale for the choice of discourse analysis.

The discourse analysis used for this research could best be described as descriptive in nature, in that it attempts to describe the structure of the discourse provided in the transcripts. The rationale for the choice of discourse analysis is to investigate how differences in Discourse (Gee, 2005) can lead to difficulties in communication between two vastly different cultures. Whether that division is between Euro-Canadian and Aboriginal cultures or between Western science and other Indigenous knowledge cultures, how the language is used within the Discourse can greatly affect the interpretation by various stakeholders in meaning. However, descriptive linguistics alone may not account for all of the important attributes that need to be investigated when observing the discourse between Eurocentric science and Indigenous knowledge cultures. Culture itself can be investigated through discourse analysis and is an important component of this research. Accordingly, this work includes a cultural analysis of discourse in an "effort to tease out, from discourse, the cultural meanings that underlie it" (Quinn, 2005, p. 3). Furthermore, cultural borders become even more difficult to cross when the language of instruction is not the same as the students' language. Because culture and language are so intimately linked, it is important to investigate the Discourse that exists between Eurocentric science and Aboriginal speakers so that as educators we can help mitigate transitioning between the two cultures. According to Aikenhead, "language is more than terminology; it is a cultural repository of worldviews that teaches people what to assume, how to think, and how to socially interact" (Aikenhead G. , 2006, p. 126).

The culture of communication.

Both Fairclough's categorizations and analysis of language as larger units of conversation contribute to how knowledge is communicated within a cultural group and externally to other cultural groups. The varying themes identified above can influence the Discourse used amongst members of Northern communities and is complex in both its commonalities and its disparities. For this purpose, discourse analysis offers an ideal framework, as Discourse "is both shaped by and helps to shape the human lifeworld, or the world as we experience it" (Johnstone, 2008, p. 33). Furthermore, Discourse is an important object of investigation for both scientific and Aboriginal learners because it provides a "window into cultural understandings and the way that these are negotiated by individuals" (Hill, 2005, p. 3). Culture itself is communication in that culture is a system of signs that must be communicated to be recognized. The public hearing data examined here involved speakers who possess Eurocentric scientific views of ecosystems or Indigenous social-ecological views of the environment, or combinations of both. In addition, the cultural arena in which narratives are delivered has a definitive impact on meaning of the narrative and the stories of both Eurocentric and Aboriginal speakers must be understood as "social units of exchange, in relation to the social institutions and practices within which they are produced" (Klapproth, 2004, p. 35).

While this approach to cultural understanding may be critical in some aspects, it is important to distinguish it from the field of Critical Discourse Analysis (CDA). Although much of the work of experts in the field of CDA has

influenced this research (Fairclough, 1989; Gee, 2005; Wodak, 1996), I believe that the goal of this research is not completely in alignment with the goals of many Critical Discourse Analysts. CDA is greatly concerned with evaluating the status quo and investigating questions of power and inequality in hopes of instigating change for the future. For example, while I certainly hope that this research will assist in bridging the borders between two different cultures, I do not believe the intended goal to be the same. Rather, the analysis will be of a more descriptive approach that is mindful of the critical components that influence discourse. As a researcher working with delicate issues within social and cultural contexts I hope to follow the model of Barbara Johnstone who believes that "sensitive discourse analysts should always be casting critical eyes on their own process of analysis and on the situation they study, whether or not methodological or social critique is the end goal" (Johnstone, 2008, p. 29). That being said, although CDA was not the approach being followed when this analysis began, the results did reveal issues of power which will be addressed in chapter five (Power). CDA has been well utilized in the field of education and a comprehensive review has been performed by Rogers et al. (Rogers, Malancharuvil-Berkes, Mosley, Hui, & O'Garro Joseph, 2005).

The interaction between science speakers and community speakers is complicated by the fact that the goals or intentions for each in describing the world in which they operate are different. Thus, the culture of communication is complicated further by the fact that these goals may not be in alignment. While science tends to define a world that is consistent and constant across all possible

environments, community speakers are involved in a "humanist" existence that "deals principally with the world as it changes with the position and stance of the viewer" (Bruner, 1986, p. 50). Therefore, any attempt to reach reconciliation and understanding between two varying goals of language use can become difficult if one group does not share or even understand the intentions of the other. Aboriginal speakers in a meeting forum may attempt to offer their experience in a manner that helps them construct their world and thus share its importance with others, while Eurocentric science speakers may attempt to create worlds that appear dispassionate, realistic and universal. As a result, a humanist may interpret science as a world that "leave[s] no place in them for possible alternative personal perspectives on those worlds" (Bruner, 1986, p. 54). Therefore, the purpose of this discourse analysis is to try to highlight where the views of various stakeholders connect or conflict and to build an understanding of the two modes of thought so that common ground can be reached on the issue of caribou harvesting in the region.

The Data

This research represents a discourse analysis on scientists and Aboriginal speakers that were all given opportunities to speak at a public hearing on the issue of implementing a Caribou hunting quota in the Sahtu Settlement Area in the Northwest Territories, Canada. The Sahtu Renewable Resources Board (SRRB) was established through a Land Claim Agreement (13.8) and the Sahtu Dene and Metis Land Claim Settlement Act (June 24, 1994) (Sahtu Renewable Resources Board, 2010). The mandate of the Board "with equal representation from

communities and territorial/federal government agencies, is dedicated to protecting, conserving, and managing all renewable resources in the Sahtu" (Sahtu Renewable Resources Board, 2010).

The discourse presented at the hearing takes the form of formal presentations in that they do not have the characteristics of conversation, but rather the form of monologues with the intention of influencing the committee on the decision to implement a caribou harvest quota. Public hearing transcripts are an excellent source for discourse analysis because they often provide complex and meaningful insights from multiple views. According to Scollon (2008), discourses can collide when disparate views of the physical world and nature are taken. He describes an 'environmental realism' view, which includes scientific theories, methods, and procedures; an 'environmental idealism' view, which as a form of romanticism provides a source of human values; and an 'environmental instrumentalism' view, which sees nature as a resource for exploitation and resource development (p. 75). When it comes to animal resource and management discussions held in a public discourse, it becomes clear that "scientists speak to other scientists, government bureaucrats to other bureaucrats, and environmentalists to each other with considerable ease and comfort" (Scollon, 2008, p. 76) however, when members of these groups need to speak with other groups, the discourse can become difficult to navigate. As a result, problems in communication can occur when they cross the borders formed by different stakeholders. The data used here are transcripts from a SRRB meeting held in November 2007 to consider establishing a total allowable harvest in respect to the

Bluenose-West Caribou Herd. The transcripts from the SRRB are an excellent example of the public discourse that Scollon defines as a "process in which quite different polities try to gain the public ear and eye in an attempt to persuade citizens to agree with their own position and to support it" (Scollon, 2008, p. 76).

The data set acquired from the meeting had Aboriginal speakers translated on site by two local translators. The translations and minutes from the three-day meeting were then transcribed by a professional transcription company and released as a public document through Digi-Tran Inc. (http://www.tscript.com/index.htm) and contains over 110,000 words. The line numbering for transcribed data is reproduced from the original transcriptions. The names of both the scientists and the Aboriginal speakers have been changed to respect their privacy. The pseudonyms created are fictitious first names only and were arbitrarily selected. The scientists positions and titles are maintained however as they indicate their experience and authority which is important for the research and the titles of the Aboriginal speakers (e.g., Grand Chief, Chief, Elder, etc.) are also maintained out of respect for their position.

The three-day hearing contained both question-and-answer periods as well as narratives. This research focuses solely on the narratives given by either the scientists or the Aboriginal community members. Although the question-and-answer periods would likely reveal interesting modes of thought as well, the discourse is of a different type than the oral presentations and as a result is not used in the study. Furthermore, although much could be learned from more extensive community involvement (i.e., interviews with speakers), this study

purposefully did not include meeting with any of the speakers as it was intended to be as objective as possible in the evaluation of language use. It was decided that the discourse analysis would be performed in a way that did not allow it to be biased by meeting with the speakers.

Chapter Five: Findings

Pronouns and Repetition

To begin the discourse analysis it is best to start with the simplest components, that of single words. Fairclough identified four internal relations of text which work at varying levels within all forms of discourse. When dealing with single words, in this case pronouns, we are most interested in the *vocabulary relations*, which he describes as "relations of collocation, i.e. patterns of co-occurrence between items of vocabulary" (Fairclough, 2003, p. 37). Discourse analysis allows us the opportunity to observe how speakers utilize pronouns and look not only for patterns, but also for the relations which are within the text (*in praesentia*) and those which are relations between what is actually in the text and what might have been present but is not (*in absentia*) (Fairclough, 2003, p. 37). In this section, vocabulary relations are identified in a number of ways. First of all, the use of pronouns by both the Aboriginal Elders and the scientists are explored in order to observe similarities and differences in usage. Comparison of the Aboriginal speakers' pronominal choice is also made to a previous study performed on Native discourse (Retzlaff, 2006). Next, a comparison is made on how many times pronouns are used per 100 words of spoken language. Following that, the use of repetition of words and phrases is studied in detail and examples

from both the scientists and the Aboriginal speakers are explored. And finally, the types of words chosen by the respective groups are evaluated to show what types of words appear to be important based on the number of times they occur in the discourse.

In reviewing Native discourse in newspaper media, Retzlaff found an abundance of pronoun forms including 'we', 'our', and 'us' and she believes that use of these pronouns "induce the readership to conceptualize group identity, solidarity, a national collective and the like as members of an in-group" (Retzlaff, 2006, p. 38). Retzlaff believes that this type of pronoun use is indicative of Native discourse because it "reflects a traditional value, namely a strong cultural preference of seeing oneself as related to and interconnected with others" (p. 40), which is symptomatic of Fairclough's *in absentia* vocabulary relations. The study reviewed five newspaper articles written by First Nations people for two Native newspapers. The results, summarized below in Table 1, reveal that out of 4334 words used in the articles, 330 of them were pronouns, equivalent to 7.6 pronouns per 100 words of text. A significant result is that 64.2% of all pronouns used were first person plural, which strongly supports the concept of a Native discourse that represents a community and collective social group. Conversely, first person singular pronouns and second person pronouns appear much less often (13.9% and 6.4% respectively). Third person plural pronouns appear 15.5% of the time.

By reading Retzlaff's article in isolation one might conclude that the occurrence of pronouns may be the result of a style of writing within newspaper articles as opposed to being representative of Native discourse as a whole.

Although Retzlaff's findings are of interest they only represent Native discourse in written newspaper articles. Therefore, it would be prudent to compare the use of pronouns to the oral narratives presented by Aboriginal Elders in a different context. Using the narratives from the Sahtu Renewable Resources Board public hearing this study replicates the analysis on oral narratives that were presented at the hearing in order to compare oral narratives to written Native discourse. Furthermore, it would also be interesting to compare Retzlaff's results and the Elders' results to non-aboriginal speakers, in this case, the scientists that presented their oral presentations at the same public hearing. The results would show whether or not Retzlaff's findings were related specifically to written Native discourse or whether we can make further generalizations to other forms of discourse, both Aboriginal and non-aboriginal.

At the public hearing, four scientists were given the opportunity to give oral presentations, therefore, all four were analyzed for pronominal choices. Although one of the scientists spoke several times, only her initial presentation was selected as I did not want any single speaker to skew the results. Also, this allowed for the total number of words analyzed to be similar to the amount of words that were analyzed by Retzlaff (2006). For consistency, four Elders were also selected out of 21 possible presentations for analysis. As the Elders' presentations occurred over a three day period, one was randomly chosen from each day and two were chosen from the day that had the most presentations. This ensured a cross section of speakers as different community groups spoke on different days. The eight narratives were then analyzed and categorized in

accordance with Retzlaff's (2006) results, with one additional category of pronouns added. While Retzlaff lists the pronouns that were tabulated she does not categorize them according to person (i.e., does not distinguish as 1st person, 2nd person and 3rd person). These categorizations have been added to Table 1 and reveals that third person singular pronouns were not included in Retzlaff's (2006) analysis. This was unlikely an oversight, but rather a manifestation of the nature of the newspaper articles analyzed and the fact that they represent written text as opposed to the oral narratives discussed here. In addition, the occurrence of a third person singular in this study is primarily due to the use of *it* rather than the other possible pronouns in that category that address individual people, such as *he, she, him, her* etc.

Table 1. Summary of distribution of pronouns (Retzlaff, 2006).

			1st person plural	1st person singular	2nd person	3rd person plural	3rd person singular
Retzlaff (2006)	Total Number of Words	Total Number of Pronouns	we, our, us, ourselves	I, my, me, myself	you, your	they, their, them	he, his, him,she, hers, her, it, its, it
Article 1	608	63	40	14	6	3	n/a
Article 2	673	51	39	7	1	4	n/a
Article 3	754	66	36	13	10	7	n/a
Article 4	1680	108	67	4	1	36	n/a
Article 5	619	42	30	8	3	1	n/a
Totals	**4334**	**330**	**212**	**46**	**21**	**51**	**n/a**
Percentage of Total Pronouns			**64.2%**	**13.9%**	**6.4%**	**15.5%**	**n/a**

Pronouns per 100 words	7.6

Elder pronominal choices.

The narratives provided by the Elders were translated from their native Slavey language into English by another Slavey speaker. The results of all four Elders, shown in Table 2, reveal some of the characteristics of pronoun use seen in Retzlaff's study, but vary somewhat due to the inclusion of third person singular pronouns. For example, although the percentage of first person plural pronouns is lower in the Elder's oral presentations (27.1 % versus 64.2% in Retzlaff's results), the Elders' presentations include an additional 166 third person singular pronouns (25.4% of the total number of pronouns used) which were not

included in their study. The occurrence of first person singular pronouns is very similar in both studies (17.9 % in the Elder narratives and 13.9% in Retzlaff's study) as is the occurrence of second person pronouns (6.1% in the Elder narratives and 6.4% in Retzlaff's study), which supports Retzlaff's observation that Native discourse more likely will include the use of "we" rather than "I" to "represent a reality in which the actions of the group are more valued than the actions of the individual" (Retzlaff, 2006, p. 41). The Elders' use of third person plural pronouns is somewhat higher than in the newspaper articles, but this appears to be an artifact of the topic that was being spoken about. The Elders were speaking on the state of caribou within the Sahtu region and when referring to caribou and other wildlife in the area the pronouns "they", "their", "them" and the form "themselves" were used to signify animals, not 'other' people. This is an important distinction if we are to conclude that Native discourse shares a common value of community and inclusion. For example, of the 52 third person plural pronouns used by Elder Alan, 23 refer to wildlife, 16 refer to people of their own community, 6 refer to their children, and only 7 refer to scientists. In other words, 86.5 % of third person plural pronouns still refer to the people and animals on the land while only 13.5% referred to an "other".

Table 2. Summary of distribution of pronouns of the Elders.

			1st person plural	1st person singular	2nd person	3rd person plural	3rd person singular
Elder	Total Number of Words	Total Number of Pronouns	we, our, us, ourselves	I, my, me, myself	you, your	they, their, them	he, his, him,she, hers, her, it, its, it
Elder Alan	1619	247	96	32	6	52	61
Percentage of Total Pronouns			38.9%	13.0%	2.4%	21.1%	24.7%
Elder Bob	550	73	17	10	3	26	17
Percentage of Total Pronouns			23.3%	13.7%	4.1%	35.6%	23.3%
Elder Darren	1743	233	33	62	14	56	68
Percentage of Total Pronouns			14.2%	26.6%	6.0%	24.0%	29.2%
Elder Kristina	676	101	31	13	17	20	20
Percentage of Total Pronouns			30.7%	12.9%	16.8%	19.8%	19.8%
Totals	**4588**	**654**	**177**	**117**	**40**	**154**	**166**
Percentage of Total Pronouns			**27.1%**	**17.9%**	**6.1%**	**23.5%**	**25.4%**

These results do not negate Retzlaff's conclusions, as first person plural remains the most commonly used pronouns, although just slightly more than a third person singular and plural usage. However, at critical times within the Elders' presentations, the use of first person plural pronouns is clearly emphasized

and intentional. The below narrative excerpt by Elder Alan highlights the use of first person plural pronouns and makes a significant impact on the listener or reader. His use of first person plural was the highest amongst the four Elders and the example illustrates how “Pronouns used in this way can convey empathy, commitment and solidarity” (Retzlaff, 2006, p. 40). In this case, the pronoun usage provides an almost poetic discourse and the use of repetition, particularly of the pronoun "we", exemplifies the poetic structures that can occur in discourse (Staats, 2008). First person plural pronouns are underlined to show the abundance of them within this section of the narrative (25 uses in 17 lines).

...we shouldn't, like, be talking too much about wildlife. For us, it's not proper. And those of us that are coming from Colville Lake, we still live very traditional. We don't live in rental houses. We don't burn oil. We all burn wood.

We don't have water hauled to us. We haul our own water. We still live very traditional, just like in the past.

We haven't changed very much from the past. Our ancestors, how they lived -- that's the same way that we still live today.

We live very different from the -- what do you call? -- civilized community. We -- if we burn oil and that maybe we'll be just sitting with our hands in

23 our pocket. And if we have no water, we have to get our
24 own water. If we have no wood, then we get our own. If
25 we don't have heat, we get our own wood (Elder Alan, November 22, page 133, lines 9-25).

Interestingly, although the overall use of pronouns appears to support Retzlaff's (2006) findings on Native discourse, there still exists a fair amount of variation amongst the four Elders. For example, although Elder Alan relied primarily on first person plural, Elder Darren had a stronger preference for first person singular. He begins his narrative with the following lines

3 And I'm just going to -- what I'm going to
4 speak about, long ago when I was a child, I want to talk
5 about back then.
6 From the time I came able to think for
7 myself, whenever the caribou start migrating they'd go
8 all over the land from then on and that's how it used be
9 long ago (Elder Darren, November 23, page 49, lines 3-9).

As you can see, Elder Darren is speaking in the first person singular, but is still doing so in a manner that connects him to the collective of his ancestors and his history on the land. Later, he shares his personal experience on the land, again using first person singular when he says "And I--I saw that, and then I was surprised that I witnessed that while I was hunting. And that's one of the things that I was really concerned about" (Elder Darren, November 23, page 53, lines 13-16). Elder Darren relies on the use of first person singular to reveal his knowledge

of what is happening on the land and to the animals. He also expresses his personal point of view by sharing what he is concerned about, rather than speaking for a collective. However, although he does not use first person plural pronouns as often as the others, he does use them in a way that expresses unity and group identity, as in the line "We work hard to get the animals that are on our land, and we take good care of them. That's the way we are because of the way our Elders talk to us in the past as well" (Elder Darren, November 23, page 55, line 1-4).

Elder Bob is the only Elder of the four that uses third person plural more often than any other pronouns (35.1%). The Elder makes a clear distinction between Aboriginal people and the others and as a result, third person plural pronouns are used to separate those in the community from the scientists working in the community. Of the 26 occurrences of third person plural, 21 are clearly referencing the work of the scientists. For example,

21 As well, they should have somebody that,
22 whenever they come, they should have people that travel
23 with them that -- that know about the same things, like,
24 have that traditional knowledge, so that when they speak
25 to people in the communities, they'll be able to have
1 somebody that can speak on their behalf (Elder Bob, November 21, page 80-81, line 21-25 and line 1).

The distinction between the Aboriginal community members and the others is made very clear through pronoun usage when Bob states "people make

money from our land from exploration. If they want to continue counting our caribou they--how much money they are going to be spending towards the study" (Elder Bob, November 21, page 81, line 3-6). The Elder identifies both the land and the caribou as belonging to the Aboriginal people by using the first person plural "our" to signify possession, a view common amongst Aboriginal people. This is contrasted with the third person plural usage that refers to people who are making money from the land, i.e., the others. Again, the way that first person plural is used is significant because it creates group identity, however, the way that third person plural is used creates an antagonistic position.

Elder Kristina has a similar distribution of pronoun usage but utilizes second person pronouns more than the other Elders. However, this appears to be more stylistic rather than an indication that she's trying to separate herself from the others. She is attempting to engage the listeners in a way that is convincing them of the importance of caribou to those that live on the land. For example, she states "when you live out in the land, you see lots of caribou. You don't see them when you're in the community. And you really work on the meat and looked after it well" (Elder Kristina, November 22, page 109, line 20-23). Although the second person pronouns are being used it is still clear that she is referring to the "we" of the local community members.

Scientist pronominal choices.

Another question that could be raised concerning the results of Rezlaff's (2006) analysis is that the occurrence and use of pronouns in Native discourse may not differ significantly from pronoun use in other distinct cultural languages.

In other words, a comparator is needed to verify the conclusions reached. Therefore, four oral presentations from English speakers were selected from the same Sahtu hearing in November 2007 were tabulated in the same manner (Table 3). These speakers therefore represent a Eurocentric scientific view of discourse as they were at the hearing to present on behalf of the Department of Environment and Natural Resources in the Northwest Territories. The first scientist, Ms. Marcy, is Director of Wildlife with the Department of Environment and Natural Resources, the second is Mr. David, Cumulative Effects Biologist, the third is Mr. Brian, Supervisor of Wildlife Management, and Ms. Debbie is a Manager of Wildlife Management.

The results show that 56.3% of the pronouns used were first person plural, similar to the percentage of first person plural usage in Retzlaff's (2006) articles. The question is, are the first person plural pronouns used in a way that reflects *we* as in people that are collectively concerned about caribou numbers or *we* as in a group of scientists. Closer analysis indicates it is most likely the latter. For example, Ms. Marcy used first person plural pronouns 35.9% of the time and they most often refer to the collective of scientists, as can be seen in the line "We look at what we hear from people in the communities who spend the most time with caribou" (November 21, page 20, line 20-22). Clearly she has differentiated between the scientists (referred to as "we") and the people from the community. Mr. Brian, who uses first person plural pronouns 57.4% of the time, also differentiates the scientists from people from the community by saying "this is what we heard about the survey design. Some people suggested our technique

misses animals that might be in canyons or below tree line…" (November 21, page 32, line 12-14). Ms. Debbie acknowledges the needs of the people from the community, but still separates herself as a scientist in the line "Although we know a lower harvest level would help caribou to recover faster, we also know caribou is an important food for communities" (November 21, page 36-37, line 25 and line 1-2). Her use of first person plural is the highest of all speakers studied, at 70% of pronouns used.

However, the scientists speaking at the hearing work and live in Northern Canada and their discourse may not be completely indicative of a larger, urban-based, Eurocentric scientific institution. In fact, there were occasions when they appear to take great care in their choice of words to allow for inclusive conversations. For example, Mr. David opens his presentation with the statement:

> 6 Winter distribution of our barren-ground
> 7 herds has been surveyed over the last several years. For
> 8 these surveys, people from the Sahtu communities were
> 9 involved as observers, including [speaker lists several community members] (Mr. David, November 21, page 21, line 6-12).

The pronoun choice of "our" for referring to the caribou herds signifies that this scientist is likely aware of the discourse used amongst Aboriginal speakers and has adjusted the oral presentation accordingly. By referring to the caribou as "our" caribou he indicates that all people, regardless of which culture they belong to, have a vested interest in the long term sustainability of the animals. Furthermore, the purposeful listing of community observers supports the desire for working

together as a collective. It is attention to details of language use such as this that could possibly help bring the two divergent cultures together and help cross the borders that divide them. As biologists, there is little doubt that the other scientists feel a similar way, but unfortunately, their pronoun choice during the hearing does not support that point of view.

Table 3. Summary of distribution of pronouns of the scientists.

			1st person plural	1st person singular	2nd person	3rd person plural	3rd person singular
Scientists	Total Number of Words	Total Number of Pronouns	we, our, us, ourselves	I, my, me, myself	you, your	they, their, them	he, his, him,she, hers, her, it, its, it
Ms. Marcy	744	39	14	8	5	3	9
Percentage of Total Pronouns			35.9%	20.5%	12.8%	7.7%	23.1%
Mr. David	815	48	33	0	6	8	1
Percentage of Total Pronouns			68.8%	0.0%	12.5%	16.7%	2.1%
Mr. Brian	1822	61	35	2	3	8	13
Percentage of Total Pronouns			57.4%	3.3%	4.9%	13.1%	21.3%
Ms. Debbie	698	10	7	2	0	0	1
Percentage of Total Pronouns			70.0%	20.0%	0.0%	0.0%	10.0%
Totals	**4079**	**158**	**89**	**12**	**14**	**19**	**24**
Percentage of Total Pronouns			**56.3%**	**7.6%**	**8.9%**	**12.0%**	**15.2%**

First person singular pronouns were used very rarely in the scientific discourse and, in fact, were used only 3.3% of the time by one scientist and never used another. This is likely representative of the fact that scientists will tend to use language in a way that will provide the appearance of objectivity. That is, a

traditional or historical view of science would see the scientist as an objective observer being removed from the science and as a result first person singular pronouns tend to be avoided (Kuo, 1999). Although many science educators are trying to move away from this historical view, the results of this research show that it still permeates within scientific modes of thought. Ms. Marcy utilized first person singular pronouns the most often of the four scientists (20.5%), but 7 of the 14 total occurrences that she used were during the introduction of herself and the description of her role amongst the other scientists. For example, "I will go to English. My name is Ms. Marcy, and I live in Yellowknife, I am director of wildlife…" (November 21, page 17, line 12-14).

Like Retzlaff's (2006) study and the Aboriginal Elders, the scientists rarely use second person pronouns. On average only 8.9% of all pronouns are second person with the highest average being 12.8% and the lowest 0.0%. Third person plural pronouns are used less than by the Aboriginal Elders and in a similar amount to the Native discourse found in Retzlaff's (2006) study. Almost all of the examples of third person plural pronouns are referring to caribou as opposed to other people, such as, "there's no overlap when they have their calves" (Ms. Marcy, November 21, page 19, line 24). Only occasionally are they used to refer to people, but when they are, they referred primarily to local hunters as in the example "they hunt all around Great Bear Lake. Almost all their harvest is within the traditional range" (Mr. Brian, November 21, page 29, line 3-5).

And finally, third person singular pronouns were used less often than the Aboriginal Elders (15.2% versus 25.4%). These pronouns were largely dominated

by the use of "it" and did not appear to be used in any particular situation more than any other. Again, this is likely the reason that Retzlaff (2006) chose to leave them out of their analysis.

Occurrence of pronouns.

There is however, another important differentiation in pronominal choices made by the Elders and the scientists. While the percentage of pronoun use is somewhat similar amongst the various pronoun categories, the total number of times pronouns are used by scientists is significantly less. That is, the scientists only use pronouns between 1.4 and 5.9 times for every 100 words, while the Elders use pronouns between 13.4 and 15.3 times (Table 4). So while the percentages may appear similar, the overall usage by scientists is demonstrably less. The occurrences of pronouns are more commonly used in oral Native discourse than in the written newspaper articles studied by Retzlaff (2006). When calculated as the number of pronouns used per 100 words the articles reviewed by Retzlaff (2006) had an occurrence of 7.6 pronouns per hundred words which is less than the oral narratives of the Elders. This may mean that although the writers of Native discourse in newspapers use pronouns to signify unity, the nature of written discourse may still be more "formal" than the discourse chosen during oral narratives. Interestingly, the comparatively rare use of pronouns during the oral presentations by the scientists show that their presentations were far more similar to the written discourse traditions of Eurocentric science than to oral narratives, particularly those of Aboriginal speakers (Kuo, 1999; Myers, 1989). This likely reflects the influence of the paradigmatic mode of thought that the scientists

possess that Bruner describes as a mental model that "guide[s] our perception, thought, and talk" (Bruner, 1986, p. 47). If the life experience that an individual possesses is based on a Eurocentric, scientific mental model, then the thought processes and the resultant word choice will be reflective of that model.

Table 4. Occurrence of pronouns per 100 words.

	Pronouns per 100 words
Retzlaff (2006)	7.6
Elders	
Elder Alan	15.3
Elder Bob	13.5
Elder Darren	13.4
Elder Kristina	14.9
Scientists	
Ms. Marcy	5.2
Mr. David	5.9
Mr. Brian	3.3
Ms. Debbie	1.4

Repetition.

Repetition in discourse, particularly in oral narratives or conversation, is not a rare phenomenon and actually occurs often as "writers and speakers repeat their own and one anothers' sounds, words, structures, phrases, and meanings, in every context" (Johnstone, 2008, p. 171). Aboriginal discourse, which is primarily an oral, narrative tradition, utilizes repetition extensively as knowledge and wisdom is passed amongst community members. Tannen identifies four categories for the functions of repetition: production, comprehension, connection,

and interaction (Tannen, 2007). Repetition helps *production* by constructing language in a more efficient way. It also aids in *comprehension* by facilitating semantically less dense discourse. Repetition also helps *connection* by repeating sentences, phrases, and words so that they are linked to earlier discourse which shows relationship among them. And finally, repetition creates *interaction*, particularly by achieving social goals within conversation (Tannen, 2007, pp. 58-61).

For this part of the study, the same eight oral presentations used in the previous section (four scientists and four Elders) were selected for analysis. Each was read through several times and repetitions were highlighted. The repetitions could consist of single words, phrases, or even ideas that contained different wording, but possessed similar meaning. Therefore, the internal relations of text were expanded to include Fairclough's groupings of semantic relations, grammatical relations, and vocabulary relations (Fairclough, 2003).

Repetition in Aboriginal discourse.

While Eurocentric science has performed extensive research on the environment and the ecological implications associated with it, assuming these concepts are equivalent to the Indigenous perspective of living on the land may lead to confusion and miscommunication. Nadasdy (2003) describes how Aboriginal people consider themselves to be part of the land, and as a result consider *kinship* to be part of the environment; a concept which would likely not exist within a Eurocentric scientific culture. Because of this, "separating "ecological" from "non-ecological" knowledge becomes nonsensical. This is

powerfully illustrated by Aboriginal elders, when asked to share their knowledge about the environment, are just as likely to talk about non-environmental topics like kinship or respect as they are to talk about animals and landscapes" (Nadasdy, 2003, p. 121).

In Elder Alan's oral presentation for example, repetition is used to emphasize the experience of living on the land. The concept of "the land" is extremely important in Aboriginal discourse and is repeated not only by individuals within a particular narrative, but also repeated amongst multiple speakers. Furthermore, the word "land" is repeated throughout many indigenous cultures, not just in North America, but around the world (Berkes, Kislalioglu, Folke, & Gadgil, 1998). Repetition can be used to add force to a particular point of a story and enhances a proposition in oral communications (Retzlaff, 2006). In Elder Alan's oral presentation of approximately 1600 words, the speaker emphasizes variations of "the land" statement ten distinct times as shown in the following examples (1)-(10). Most of the references deal with traveling on the land and the amount of time spent on it.

(1) ...and since then we've been going out on the land (November 22, page 128, line 21-22).

(2) ... because of all of the walking that we did on the land... (November 22, page 129, line 1-2).

(3) ... because of all that walking in the -- in the land with snowshoes (November 22, page 129, line 3-4).

(4) ... we travel on the land with snowshoes... (November 22, page 129, line 7-8).

Repetition of the phrase "the land" represents two important markers. First of all, the repetition brings emphasis to the idea and makes the image stand out amongst other images. Secondly, it reveals the connection the person has to the land, a connection that the speaker is likely aware does not exist amongst the intended audience, who in this case are represented by Eurocentric, scientific English speakers. Other uses of the phrase show how the Aboriginal people live off the land and rely on what is produced from the land, as shown below:

(5) ... we've, like, lived off the land (November 22, page 128, line 23-24).

(6) ... that's just about sixty (60) years that I've been living on the land... (November 22, page 129, line 9-10).

(7) ... I'm telling you that we -- still live on the land... (November 22, page 129, line 20).

In one instance the reference to the land is actually about the wildlife rather than the people, and this highlights the connection that Aboriginal People have to the land, the animals, and to the other people.

(8) The wildlife on our land... (November 22, page 129, line 5).

The final two references refer to the next generation of Aboriginal People who will need to live off of the land. The Elder makes these references late in his presentation, likely to emphasize how the land has provided for his forefathers, for himself, and needs to be able to provide to their children.

(9) The children that we brought to Horton Lake, those that are fifteen (15) and younger, they're all out in the bush right now as we speak (November 22, page 134, line 1-3).

(10) They're all out trapping; that's how much that they like to be on the land (November 22, page 134, line 3-5).

While repetition of the phrase "the land" occurred often and consistently within Elder Alan's oral narrative, similar repetition appeared amongst all four Aboriginal speakers. This indicates that the connection to the land is very important within the culture and it is through the sharing of oral narratives that knowledge is passed to both community members and others outside the community, highlighting intertextuality, or the presence of elements of other texts within a text (Fairclough, 1992; Lemke, 2004).

(11) The Creator made it for us on this land, and he put it on this land for us to use for food (Elder Kristina, November 22, page 108, line 22-23).

(12) And what I want to talk about is when we live out on the land… (Elder Kristina, November 22, page 109, line 16-17).

(13) -- our people are off on the land like that we wonder how they're doing; (Elder Bob, November 21, page 79, line 23-25).

(14) We work hard to get the animals that are on our land… (Elder Darren, November 23, page 55, line 1-2).

Not all repetitions, however, were those of a communal Indigenous knowledge, such as living on the land. Sometimes the Elders would repeat what they believe to be key or critical pieces of knowledge that they obviously felt needed to be passed on. These could be either personal experiences or observations that they have made, but it is clear that they utilize repetition in this type of oral tradition to make their point. For instance, Elder Darren addresses an issue of helicopter flights that he believes disturb the caribou. His observations are revealed during his oral narrative and his passion on the topic is revealed through the repetition of phrases which we can assume is done to emphasize how important he believes this issue is. The following six examples all occur within a brief section of the narrative that only covered approximately 300 words.

(15) And the helicopter used to fly around there and, then the mother used to take off on its young calf (November 23, page 51, line 22-24).

(16) … we could see on top of the trees, there was a helicopter flying over that area (November 23, page 52, line 13-50).

(17) And I looked at it, and I saw that it was flying around the--over that area (November 23, page 52, line 16-17).

(18) ... we could see the caribou running around in that area, and it would fly right above it in the caribou would try to be getting away from by moving away from it (November 23, page 52, line 21-23).

(19) … but it would be flying over it (November 23, page 52, line 25).

(20) And across <u>where you saw all that snow that was flying about, that's where they were bothering all these caribou with the helicopter</u> (November 23, page 53, line 2-4).

The above examples (15-20) are examples of semantic relations because the repetition is not accomplished through particular words or parts of words, but rather through phrases and expressions that clearly show similar meaning. A repeated image of a helicopter flying above caribou is constructed even though it is done so in grammatically different ways.

Repetition can also occur in the oral narrative not only through words and phrases, but within the structure itself, often referred to as parallelism. According to Retzlaff, parallelism differs slightly from repetition in that it "requires an element of identity and an element of contrast" (Retzlaff, 2006, p. 31). The example she provides uses the coordinating conjunction "but" between two equivalent units. Elder Alan provides an excellent example of parallel structure in example (21), shown below. Unlike the parallelism shown in the Native discourse of newspaper articles, Elder Alan's oral narrative uses a similar parallel structure but does not rely on coordinating conjunctions to signify them, rather, the structure of the clauses themselves are rhythmically coordinated to provide a poetic device that is easy to follow and presents a strong and impassioned presentation.

(21) We don't burn oil. We all burn wood.
We don't have water hauled to us. We all our own water.
We still live very traditional, just like in the past.

> We haven't changed very much from the past. Our ancestors, how they lived -- that's the same way that we still live today (Elder Alan, November 22, page 133, lines 12-19).

As you can see, the above example provides a parallel structure that is showing how Aboriginal people will live on the land and do not rely on Eurocentric technology or support for their way of life. The contrast is shown through the organization of the clauses themselves. The first two lines are structured to show how they do *not* rely on others, contrasted with clauses that indicate independence. The third line compares how they live currently to how they lived in the past. And finally, the fourth line, although slightly more complex, supports the comparison of the past to the present. All of this is achieved through a strong use of parallel clause structure.

Repetition in the language of science.

The scientists at the public hearing tend to not use repetition in their oral discourse. This has likely more to do with use of scientific English than anything else, as presenters of science appear to avoid repetition. The term scientific English is used here to denote the scientific language that predominates Eurocentric culture as described by several discourse analysts and linguists, in particular, the work of M. A. K. Halliday, who sees scientific English as a combination of not only technical terms, but also the complex structure that lies within the grammar (Halliday M. A., 2004). The use of "scientific jargon" adds value to discourse "by marking it off as the discourse of an intellectual elite" (Halliday M. A., 2004, p. 161). However, jargon alone does not signify scientific

English and the two cannot be easily separated from one another. Halliday believes that the grammar of scientific English can sometimes become overly complicated and in situations where scientific speakers and non-scientific speakers interact that the "difficulty lies more with the grammar than with the vocabulary" (p. 161). For example, the scientists initially acknowledge Indigenous knowledge of caribou calving through a plain and jargon-free description:

(22) Traditional knowledge says that caribou cows go to the same areas to calf (Ms. Marcy, November 21, page 19, line 1-2).

However, they then go on to show a “scientific” definition in a lexically dense and complex way (Halliday & Martin, 1993). This creates the opposite effect of repetition. By distinguishing itself from simple and straightforward language, its use separates and creates a border between the two cultures.

(23) We define calving grounds as the area occupied by pregnant barren-ground Caribou from calf birth through the initiation of foraging by calves (Ms. Marcy, November 21, page 19, line 21-23).

Although the meaning of the two sentences is essentially equivalent the lack of repetition of a particular clause may not show that the two phrases are in agreement. Listeners or readers of the scientific example (23) would unlikely recognize that it is synonymous with plain language shown in example (22) because of the complexity of how the definition is presented. More specifically, example (22) is comprised of clauses which are relatively easy to identify from a grammatical point of view. For example, the clause *traditional knowledge says that caribou cows go to the same areas to calf* contains an active agent or

grammatical subject (*traditional knowledge*) and a patient or grammatical subject (*cows go to the same areas to calf*) separated by an action verb (*says*). Example (23) also contains an active agent or grammatical subject (*we*) and an action verb (*define*), but the patient or grammatical subject is far more complex (*calving grounds as the area occupied by pregnant barren-ground Caribou from calf birth through the initiation of foraging by calves*). What allows the clause to be recognised as scientific English rather than commonsense knowledge is the result of a combination of complex grammar and scientific jargon. If we were to "unpack" the phrase *calving grounds* it would help us produce agnate forms that are "less metaphorical, less abstract and less general" (Halliday M. A., 2004, p. 30). For example, *calving grounds* may be unpacked into the form *the grounds where caribou calf*, which, ironically, is very similar to example (22). Similar unpacking can occur on the phrase *from calf birth*, which can be converted to a less metaphorical form such as *from the time a calf is born*. And finally, *initiation of foraging* is an extremely complex way of stating *when calves begin to eat*. These three examples exhibit the lexically dense use of grammar in scientific English that makes it difficult for non-scientific listeners or readers to comprehend. The lexically dense grammar is further complicated when technical jargon is combined within a sentence. The addition of this jargon is intended to ensure a precise definition that would be indisputable amongst scientific colleagues, however, when used amongst non-scientific speakers, it will likely only create confusion and misunderstanding. For example, describing the calving grounds as being occupied by *pregnant barren-ground Caribou* is needlessly

redundant. The fact that the caribou are calving makes the use of the term pregnant as unnecessary. Likewise, the use of the descriptor *barren-ground* is a way of separating these animals (*Rangifer tarandus groenlandicus*) from other subspecies of caribou such as the Woodland Caribou (*Rangifer tarandus-caribou*). From a scientific perspective, the distinction may be important, however, for the purpose of the discussion that was taking place, the identification of subspecies is unnecessary, as everyone present was well aware of which caribou were being spoken of. As a result, if the intention of the hearing is to persuade listeners to a particular point of view, the mental models that the listeners possess will unlikely be altered or influenced by the addition of scientific English that is packed in a lexically dense and highly technical way.

Comparison of the two subjects from examples (22) and (23) reveals that there is a different sense of agency within them. The first identifies traditional knowledge as an entity to which the scientist speaking appears to acknowledge its value. The sentence is spoken definitively and without any use of hedging (Hyland, 2004) such as *possibly*, *perhaps*, *maybe*, etc. Who the agent actually is however, is a little less clear. Traditional knowledge can usually be thought of as coming from Indigenous People living on the land, but no reference to specific people is actually made within this sentence. Rather, traditional knowledge is used in the sense of a body of knowledge, but whose knowledge is included within it is not explicitly stated. By comparison, example (23) uses the pronoun *we* to identify precisely whose knowledge is being referred to, in this case, that of the scientists. A sense of power is demonstrated by acknowledging the simplicity of

traditional knowledge and comparing it to the complicated and grammatically complex language of science, thus promoting the speaker into a possible position of authority (more on this in a later section). By using these parallel definitions the speaker creates a sense of conflict rather than agreement, thus contributing to the turbulence between borders. The comparison of the definitions creates (likely unintentionally) an *us* versus *them* scenario because of the simplicity of grammar within one compared to the complexity and density of the other.

Repetition in the scientists' narratives occurs through the use of synonymous phrases as opposed to exact repetition. The following three examples, all from the same speaker Ms. Marcy, provide details on what constitutes "calving grounds", but the variation in terminology makes it unclear if the phrases are synonymous or not.

(24) ... biologists say that animals that use the same areas and calving area form a herd (Ms. Marcy, November 21, page 19, line 3-4).

(25) Each June caribou cows from each herd will meet where they were born (Ms. Marcy, November 21, page 19, line 23-25).

(26) To date, 98 percent of those cows have returned to the same calving grounds (Ms. Marcy, November 21, page 20, line 3-4).

The underlined phrases show that the scientist uses three different descriptions to describe where caribou cows go to have their calves. Rather than incorporate repetition, the speaker uses variations in terminology, likely in an attempt to appear novel and interesting. However, this approach can leave non-scientific listeners confused and unable to follow the details being described. While the

culture of a Eurocentric science may be this type of variation within the language, cultures that rely on repetition for critical information sharing may not as easily adapt to this style of oral narrative.

Word choice.

The use of repetition, or lack of repetition, became evident in the four scientist and four Elder narratives studied above. As mentioned, repetition occurs not only within a single speaker's narrative, but could be seen throughout the narratives of members within each of the cultural groups. The following analysis was extended to include the entire narratives of the four scientists and all twenty-one oral narratives of the Aboriginal speakers (including one Grand Chief, two Chiefs, thirteen Elders, and three community members; Appendix A). The total number of words used by the scientists was 4932 and the total number of words used by the Aboriginal speakers was 23,281. Using word counts, an analysis comparing the number of times the words were used in the narratives of the scientists versus the narratives of the Aboriginal speakers was performed. The below list highlights words that were repeatedly used by one group and not the other, words that were repeatedly used by both groups, or words that we would have expected to be repeated by both groups, but were seldom used. The words were selected on two criteria. First, most were selected based on an occurrence of more than 5 times with the data, however, the list presented ignores words that, on their own, have little meaning (i.e., the, when, from, more, etc.). The second criteria were words that, based on the topic discussed and the interests of this

research, would have been expected to have been repeated often, but were not. These are indicated with an "*".

Table 5. Word usage for scientist and Aboriginal speakers.

Word or phrase	Total Usage (scientists)	Total Usage (Aboriginal Speakers)	Usage per 1000 words (scientists)	Usage per 1000 words (Aboriginal Speakers)
Ancestor	0	8	0.0	0.3
Animal	15	69	3.0	3.0
barren-ground	11	0	2.2	0.0
Bluenose, Bluenose-East, Bluenose-West	39	0	7.9	0.0
Caribou	94	325	19.1	14.0
community, communities	25	22	5.1	0.9
Creator	0	10	0.0	0.4
Decline	8	0	1.6	0.0
Elder	1	62	0.2	2.7
Harvest	94	19	19.1	0.8
Herd	93	5	18.9	0.2
Information	23	1	4.7	0.0
Knowledge *	4	5	0.8	0.2
management	27	2	5.5	0.1
Meat	0	22	0.0	0.9
Model *	4	0	0.8	0.0
People	40	193	8.1	8.3
Percent	17	0	3.4	0.0
Population	12	1	2.4	0.0
Quota	3	21	0.6	0.9
recommend	11	0	2.2	0.0
Region	14	2	2.8	0.1
Resource	12	13	2.4	0.6
Traditional	9	7	1.8	0.3
traditional knowledge *	3	1	0.6	0.0
Wildlife	13	52	2.6	2.2

Bearing in mind that the total words for the 21 narratives of the Aboriginal speakers outnumber those of the four narratives of the scientists by almost 5 times, we need to carefully look at the numbers presented. For example, because the Aboriginal to scientist ratio of words is approximately 5:1, an equal number of repetitions does not indicate that words were used approximately as often. For example, the word "resource" is used by the scientists 12 times and by the Aboriginal speakers 13 times, but 12 occurrences out of approximately 5000 words is a considerably higher usage than 13 occurrences out of almost 24,000 words. As a result, it can be inferred that scientists tend to use the word "resource" considerably more often than Aboriginal speakers (i.e., keeping a 5:1 ratio in mind, we would expect the Aboriginal speakers to use the word “resource” 60 times to be equivalent to the scientists). For easier comparison, the values were also relativized by calculating their occurrence per 1000 words of text (see Table 5).

The selection of particular words tells us something about how easy it will be to communicate between the two cultures. Repetition of particular words indicates the importance of those words to each culture; however, if the other culture rarely uses those same words, then the significance of those words may be lost. Take for example the tendency of the scientists to refer to caribou as "barren-ground" caribou. Distinguishing barren-ground caribou from other subspecies of caribou is a characteristic of scientific speaking or writing that is important within the culture of science. That is, a scientist does not want to make a claim about a subspecies of caribou that may not be appropriate for another subspecies, and

therefore they feel a need to distinguish amongst them. The Aboriginal community members that hunt caribou for sustenance are far less concerned with the distinction of species. As a result, scientists repeat the term "barren-ground" a total of 11 times (2.2 times per 1000 words) throughout their narratives and yet it is a term that none of the Aboriginal speakers use in the entire 23,281 word data set. Similarly, in reading the transcripts of the public hearing, questions were continually raised by the Aboriginal community members as to why the scientists separate their studies according to different herds. The scientists provide their explanation within the transcripts, but it becomes fairly clear that the community members see no reason for doing so. This does not seem to deter the scientists from continuing to refer to caribou by herds as the word "herd" itself was used 93 times by the scientists and only used 5 times by the Aboriginal speakers (18.9 and 0.2 times per 1000 words respectively). In addition, the scientists continually distinguish between the "Bluenose-East" and the "Bluenose-West" herds and these terms are used 39 times (7.9 times per 1000 words) in the scientists' narratives and yet are never referred to by the Aboriginal speakers. Interestingly, simply using the word "caribou" would have been just as easy and the results indicate that both groups use it approximately the same amount of time (19.1 times per 1000 words by the Aboriginal speakers and 14.0 times per 1000 words by the scientists).

There also appears to be certain words that are commonplace within a scientific mode of thought, but may not be commonplace amongst other ways of knowing. For example, the words "decline" and "percent" are words that can be

traced back to mathematical beginnings and have evolved into the language of science. They are used 1.6 and 3.4 times per 1000 words respectively by the scientists, yet never appear in the narratives of the Aboriginal speakers. Scientists also use the words "harvest" (19.1 times per 1000 words) and "population" (2.4 times per 1000 words) to discuss the issues involving caribou, yet the Aboriginal speakers use them far less often (0.8 and 0.0 times per 1000 words respectively). Likewise, words that derive from business or management practices are also commonplace within the language of science yet appear to have very little meaning to Aboriginal speakers. For example, "information", "management", and "recommend" are used 4.7, 5.5, and 2.2 times per 1000 words respectively by the scientists and used 0.0, 0.1, and 0.0 times per 1000 words respectively by the Aboriginal speakers.

The repetition of word usage also shows us more than just the occurrence of scientific language or scientific modes of thought, it also reveals how common, everyday words can be of importance to a particular cultural group or both cultural groups. For example the words "animal" and "people" appear to be equally important for both groups. Aboriginal speakers make reference to "animal" and "people" as often as the scientists do and both words occur equally often. Other words, however, commonly occur within the narratives of the Aboriginal speakers, but far less often within the narratives of the scientists. These words are not associated with a scientific mode of thought but have been shown to be important within Aboriginal societies. For example, the use of words such as "ancestor" (0.3 times per 1000 words), "Creator" (0.4 times per 1000

words), and "Elder" (2.7 times per 1000 words) appear within their narratives and it should be well known that these are words that are important in Aboriginal communities, yet the scientists used the word "Elder" only once and never used the other two words.

And finally, there are some words or phrases that were expected to be important to one or both cultural groups yet appear very infrequently. For example, the word "knowledge" is only used 4 times (0.8 times per 1000 words) by the scientists and 5 times (0.2 times per 1000 words) by the Aboriginal speakers. Considering that the hearing was expected to be an event for a sharing of knowledge we might have expected the word to be used more often. Additionally, as described above, much has been said about the importance of recognizing "traditional knowledge". If traditional knowledge is as important to Aboriginal People as Eurocentric science educators tend to believe then you might expect the term to appear often within their discourse. Surprisingly, the term is used more often by the scientists, albeit only 3 times, than it is by the Aboriginal speakers who only use it 1 time.

The importance of “models” to the Aboriginal speakers is also fairly clear. Model was selected as a word to investigate because the decision on what percentage of caribou harvesting to be allowed was being determined by a caribou population model. Therefore, the word was thought to be significant because important decisions were to be based on its outcome. Out of almost 24,000 words of transcribed data, the word *model* never appears in the narratives of the Elders. It is important to point out that this is not an indicator that the

Elders do not understand the modeling process, in fact, not only do they appear to understand it, but they challenge the validity of some of the variables. For example, Elder Bob says:

> 1 There's -- every -- every year when they
> 2 do this caribou count, I wonder how they -- they counted
> 3 it all. And they -- they keep track of it, take pictures
> 4 from the land and that from the air (Elder Bob, November 21, page 80, line 1-4).

During the Sahtu Renewable Resources Board (SRRB) public hearing, there were opportunities for scientists, government officials, and Aboriginal Peoples to speak openly about their thoughts and views on the apparent Caribou decline in the Northwest Territories, Canada. What dominates most of the discourse is scientists speaking as scientists, Aboriginal hunters speaking as Aboriginal hunters, and government officials and board members trying to communicate with both. As mentioned previously, this analysis was performed on 21 Aboriginal speaker's narratives and the remainder of the transcripts that included question-and-answer periods was excluded because they did not take the form of an oral presentation. However, although the Aboriginal speakers never mention the term model within the 21 oral narratives, the search was expanded throughout the rest of the data to see if the term "model" was ever referenced, referred to, or discussed during question-and-answer periods. This was done to see if word choice in the oral narratives was explicit to that form of communication, or if the term was just avoided altogether regardless of what form

of communication. As it turns out, the term is used, although rarely, outside of the oral narratives. The below excerpt is from an Aboriginal community member who is both trying to explain the Aboriginal perspective on animals and at the same time justify why the scientific approach being used is inadequate for the situation:

> It's kind of scary if you talk about something [the caribou] that you can't control 'cause the -- the Creator put it there for us and I can't tell somebody else what to shoot and what not, so I can't go tell Alvin he could allow only one (1) caribou.
>
> Like, the way you're using that model, the Inuvialuit model, they're trying to use that one. They have two (2) choice -- two (2) different herds they can hunt from. So I don't think they should use that model (Elder Timothy, November 23, page 78, line 16-25)

The rationale for not employing the model for a different caribou herd to the herd that this hunter lives off of is a sound argument and it is one of the rare instances where an Aboriginal speaker even acknowledges the use of a modeling tool on the Caribou. But what is intriguing about what the speaker is saying is that he reveals his beliefs in that they should not even be talking about something that the Creator has put on Earth for the Aboriginals and yet is able to also challenge the validity of the model as well. This conflicting view exemplifies how dissimilar cultural beliefs can make consensus difficult.

As a result, the selection of word choice when attempting to communicate with another culture is an important step towards trying to cross a cultural border.

Being sensitive to the cultural characteristics of a group, in this case, word choice, will likely make border crossing a more successful endeavour. Sensitivity of this can be as simple as being aware of the choice of words used to communicate with. Gee's view of Discourse is therefore captured within repeated phrases, repeated words, and even individual pronouns, as their use reflects the values, attitudes, and beliefs of the respective cultures (Gee, 2005). Nadasdy (2003), in reviewing terminology used in relation to land and wildlife management in the Canadian North found that many of the words used have no counterpart in the language of Aboriginal people. He believes the danger is when government officials and land managers "assume that the contested terms refer to agreed-upon realities when, in fact, they serve only to mask deep cultural differences, their use can lead to serious misunderstandings and perceptions of bad faith" (Nadasdy, 2003, p. 119). As a result, words associated with scientific modes of thought may be detrimental to achieving cooperation between two different cultures and may lead to alienation. Conversely, having an awareness of the words and their associated meanings that are important to cultural groups may go a long way in achieving harmony across borders.

Discussion.

Overall, the use of pronouns by the Aboriginal Elders appears to largely support Retzlaff's (2006) findings. Pronouns are clearly used to identify group solidarity and inclusion and appear to be used in a similar way through oral narratives as they were through Native media. It's difficult to compare percentages because Retzlaff did not include third person singular pronouns and as a result

direct comparisons cannot really be made. However, the results still provide an overview of pronominal choice that shows a predominance of first person plural pronouns over first person singular, which is an indication of community inclusion rather than individuality. Similarly, second person pronouns are rarely used in both the Aboriginal oral narratives and in the media discourse and third person plural pronouns were used in a similar way as well.

Interestingly, the percentages of pronoun use by the scientists were actually quite similar to both Aboriginal discourse types. In fact, the use of pronouns in the Native media Retzlaff studied and the scientists' discourse are strikingly similar. However, the number of pronouns used per 100 words of text is significantly lower in the scientists discourse than it is in either of the Aboriginal discourses. From this it can be concluded that scientists tend to use pronouns far less often in their oral presentations.

Repetition appears to be a very important component of Aboriginal discourse. Prominent examples are shown that highlight not only the importance of emphasizing a point within an oral narrative, but also adding a level of eloquence that separates the oral narrative tradition of Aboriginal speakers from a Eurocentric, scientific narrative that tends to avoid repetition.

And finally, word choice also highlights the differences in approaches to oral presentations and provides us with one of the possible areas that may lead to the creation of borders between two cultures. Word choice can either indicate an understanding for another culture by selecting words that are known to be important to it, or can distance itself from another culture by choosing words that

are likely to indicate superiority or dominance, whether that is done intentionally or unintentionally.

Fairclough's identification of vocabulary relations has therefore provided a starting point for looking at the internal relations within text. By simply looking at pronouns, repetition of words and phrases, and word choice, we are already provided evidence of two distinct cultural discourses. These vocabulary relations are indicators that Bruner's two modes of thought emerge from this discourse analysis. The narrative mode of thought, which Bruner identifies as a storytelling approach, is supported by the poetic nature of the repetition used in the Elder's narratives and by the selection of words that are culturally important. Conversely, the paradigmatic mode of thought is supported by the low number of pronouns used, the avoidance of repetition, and by word choice that tends to separate the scientific culture from the others. It is fairly easy to conclude that these factors will lead to borders being formed between cultures. Awareness of pronoun usage, repetition, and word choice may assist cultural groups in lessening the turbulence that can exist between two groups. Next, an investigation of the grammatical relations is required to see if the modes of thought are different at levels other than the vocabulary relations.

Grammatical Problems in Scientific English

Looking beyond the vocabulary relations of individual words to the grammatical relations created within cultures increases the complexity of analysis significantly. Within the *English* language there are dramatic variations in how grammatical structures are constructed, an example being the *language of science*.

Halliday (2004) believes that the language of science evolves in a very distinct way that separates it from other disciplines. He believes that as people move from primary to secondary school they move from the first phase of educational knowledge associated with abstracness into a later phase that is associated with technical knowledge. This "technical knowledge, the discourse of the specialized disciplines, depends on metaphor: metaphor in the grammatical sense, the wholesale recasting of the relationship between the grammar and semantics" (Halliday M. A., 2004, p. 19). This type of metaphor is different from the substitution, comparison, or interaction view of metaphor (to be described in detail in a later section) found in scientific thinking (Black, 1962), where specific words are used as a metaphor for complex ideas, like when we say a computer *virus* or a *plum pudding* model of the atom. Grammatical metaphor "allows any observation, or series of observations, to be restated in summary form – compressed, as it were, and packaged by the grammar – so that it serves as the starting point of a further step in the reasoning: some theoretical conclusion can be drawn from it" (Halliday M. A., 2004, p. 20). The example Halliday uses shows how a less advanced scientific speaker would say

If a fire burns more intensely it gives off more smoke

while a more advanced scientific speaker would use grammatical metaphor and say

Fire intensity has a profound effect on smoke injection

The meaning of both versions is exactly the same; however, the latter is used within the language of science so that observations and conclusions can be summarily written.

Halliday believes the evolution of scientific English began as early as 1390 when Chaucer wrote his *Treatise on the Astrolabe*, a "technical, perhaps proto-scientific discourse which is received into English from classical Greek via classical and medieval Latin" (Halliday M. A., 2004, p. 143). However, the true birth of scientific English likely is a result of Newton's *Treatise on Optics*, published in 1704. Halliday found that the clauses created in Newton's writing created a discourse for experimentation, as opposed to the simple instructions associated with Chaucer. Halliday found the technical terms to fall under five headings: (1) general concepts, (2) field: specific, (3) field: general, (4) apparatus, and (5) methodology and in these headings he found nominalization of words that refer to processes, e.g. emergence, whiteness, inequality, propagation, etc. (p. 147). Nominalization is an important process of grammatical metaphor that Halliday believes is a key distinguishing feature of scientific English and is seen "emerging in the language of this period, when the foundations of an effective register for quantifying, transmitting and extending the "new learning" are rapidly being laid down (p. 149).

As well as nominal elements, Halliday also found there to be a change in verbal elements. These verbal elements will either relate nominalized processes (either externally or internally) or will present nominalized processes. Thus, "The verbal group signals that the process takes place; or, more substantively, sets up

the logical relationship of one process to another, either externally (*a* causes *x*), or internally (*b* proves *y*) (Halliday M. A., 2004, p. 153). But more important than how scientific English evolved is to understand why it evolved. Halliday believes that the expansion of the grammar enabled the construction of a new form of knowledge. He writes "Up to that point, doing and thinking remain as separate moments in the cultural dynamic; in "science", the two are brought together (p. 157).

Interestingly, the scientific English that evolved is not necessarily more complex, depending on how one defines complexity. While the grammatical devices created can be more complex, "if we consider the intricacy of the sentence structure (the number of clauses in the sentence, and their interdependencies), then it will appear as simpler: mainly one clause sentences; and likewise with the clause structure – usually only two or three elements in the clause" (Halliday M. A., 2004, p. 157). The desire of many scientific writers and speakers is to be clear and concise, resulting in sentences that are actually quite short in sentence structure, so from this point of view scientific English may not be considered to be complex. Others believe scientific English to be riddled with large, complex words, but it appears that is not enough to distinguish it from other registers of English. In fact, the vocabulary appears not to be the most difficult component for readers and listeners of science to understand, rather, it is the grammatical structure created that can alienate non-scientific learners. Because scientific English is the language of experts it is important for learners of scientific English to understand how these grammatical processes occur. A better understanding of

how scientific language is constructed will allow for better communication between scientists and non-scientists. Furthermore, when members of the scientific community enter into a conversation with those outside of the scientific community, they need to be aware of the constructions they create if they truly hope that what they are saying will be understood.

Grammatical metaphor use by the scientists.

Once again looking at the narratives of the scientists that were presented at the Sahtu Renewable Resources Board public hearing in 2007, we can see that within the oral presentations there continued to be grammatical metaphor and nominalization, even though the scientists were clearly making an effort to simplify the presentation into what they would consider simple terms. Utilizing Halliday's (2004) identification of the grammatical problems in scientific English, the seven characteristics found by Halliday were examined within the language of the scientists presented here. Below are some examples of grammatical metaphor found within the discourse of the scientists. It is important to remember that most readers of these results may not at first see a difference between the grammatical metaphor and the non-scientific phrase, but the large majority of readers will be well-versed in the language of science and grammatical metaphor use and as a result may not initially perceive the difference. That is, the grammatical metaphor examples do not contain any words that on their own are particularly difficult, but it is in the structure of the grammar that they become more complex (Table 6).

Table 6. Grammatical metaphor versus non-scientific phrasing.

Grammatical metaphor	Non-scientific equivalent	November 21, 2007
Satellite-collared animals	Animals wearing a collar with a satellite receiver	Page 21, line 15
Over winter calf survival	The chances for a calf to survive through the winter	Page 21, line 21
Photographic census	Caribou counting using photographs	Page 23, line 14
Impacts from development will act indirectly on herd size	The size of the caribou herds will go down because of activity created from development	Page 26, line 14
Harvesting by Sahtu beneficiaries	Hunting of caribou by people living in the Sahtu community	Page 28, line 1
Sustenance harvesters	People hunting for food	Page 30, line 25
Post-calving photo census	Counting caribou after the time they have given birth	Page 32, line 19

It is critical to note that the four scientists giving the oral presentations made sincere attempts to keep the language of science to a minimum. In fact, far more of the discourse is representative of non-scientific phrasing than it is grammatical metaphor. The key point here is that the grammatical metaphor continues to make its way into the presentations even though there appears to be a conscious effort to avoid it. This is an indication that the mental models that the scientists possess makes it difficult for them to abandon completely when speaking with a lay audience. Mr. Brian provides an example of the effort the scientists are making to use non-scientific phrasing when he first uses a grammatical metaphor (wounding loss), but goes on to explain it in lay terms:

23 People also pointed out that harvest
24 estimates don't include wounding loss. These are animals
25 that are hit by bullets but are not retrieved. Many of

1 these will later die of their wounds or become rather

2 easy prey for predators (Mr. Brian, November 21, page 35-36, line 23-25 and 1-2).

The scientist is able to recognize that *wounding loss* represents a scientific term and is able to reword it into non-scientific phrasing that is much easier to follow. Again, neither the word *wound* nor *loss* are difficult words on their own, but rearranging them using grammatical metaphor puts them into a form that requires a scientifically literate background to fully understand. Awareness of the use of grammatical metaphor and ability to address it when presenting to a non-scientific audience is an important skill to be encouraged in speakers.

Interlocking definitions and semantic discontinuity.

Although the scientist presenters take great care in adapting their presentation for use at a public hearing, some of the grammatical problems in scientific English identified by Halliday continue to appear and may lead to confusion for some community members (Halliday M. A., 2004, p. 159). The first example includes what Halliday refers to as "interlocking definitions" (Halliday M. A., 2004, p. 163) which provide explanations that allow listeners to follow information being presented. But in order for the information to make sense the listener (or reader) “has first to reach an understanding of a cluster of related concepts, all at the same time, and then immediately use this understanding in order to derive more concepts from the first ones” (p. 164). Let us look at the following excerpt as an example:

19 These models tell us that, I'm

20 sorry, the higher the harvest of adult cows the longer it
21 takes for caribou numbers to increase.
22 As mentioned models of caribou populations
23 suggest that a sustainable harvest level of 3 to 5
24 percent in a population is stable or is increasing.
25 Although we know a lower harvest level would help caribou
1 to recover faster, we also know caribou is an important
2 food for communities. So when asked at meetings with
3 communities, we suggested that the maximum harvest should
4 be 3 percent of the population estimate and most of the
5 harvest should be bulls (Ms. Debbie , November 21, page 36, lines 19-25 and 37, lines 1-5).

It may be possible to understand what is being said by the scientist based on the information provided, but it is likely the case that if it is clear, then the reader probably already possesses a paradigmatic mode of thought and the meaning is understood because he or she is able to fill in some gaps and make some assumptions. Using Halliday's framework on the above discourse reveals that an explanation of the models used "tell us" that "the higher the harvest of adult cows the longer it takes for caribou numbers to increase" (lines 20-21) (as shown in Figure 1 below). Therefore, the listener first has to understand that the caribou population models have *somehow* determined the first concept, which is harvest levels. Assuming they understand the three variations of harvest levels, they next need to understand how the harvest levels relate to the hunting of adult

cows, which is the second concept. However, to make matters worse, the cows are only mentioned for the higher harvest level, not the other two. Assuming concept one and concept two are understood the listener then needs to understand how they relate to the third concept, which is whether the population can recover slowly, remain stable or recover faster. In addition, information on the importance of caribou for food is introduced as another variable. Clearly, an understanding of the caribou population model used requires an understanding of "harvest levels", as the input or output of the model is reliant on harvest levels. As a result, in order to understand what the caribou population model can or cannot produce, one has to first understand the input and output definitions that are required for model manipulation. If one does understand the central definitions, then further information can be extrapolated from the harvest levels. But the explanation presented links many ideas together that make it very difficult for the listener to follow as it is presented not only orally, but only one time. As Halliday states, each term in and of itself may not be difficult to understand, however, by interlocking the terms and explanations the listener or reader is confronted with a significantly more complex and difficult task in understanding what is being explained (Halliday M. A., 2004, p. 164).

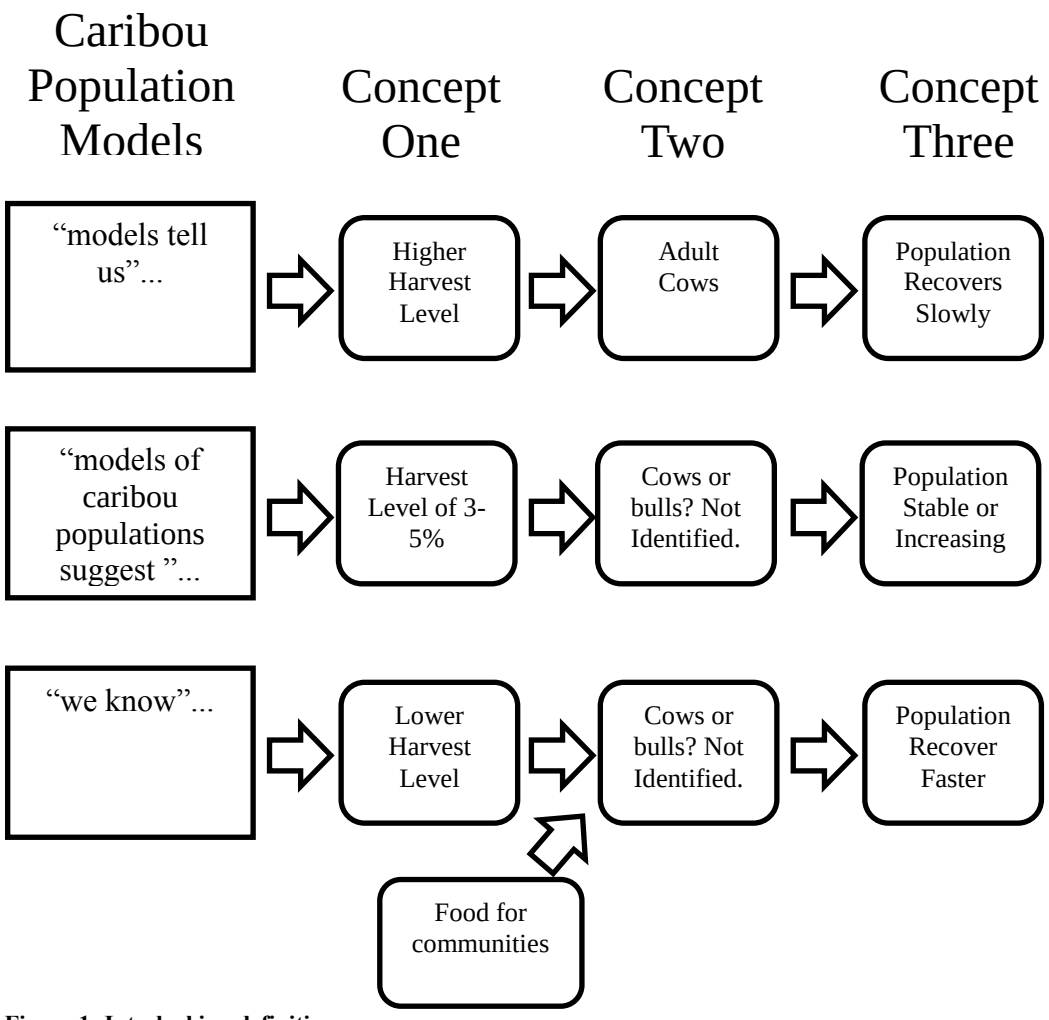

Figure 1: Interlocking definitions.

The above passage is complicated even further by the line "and most of the harvest should be bulls", which is an example of *semantic discontinuity*. Halliday describes semantic discontinuity as an occurrence when "writers sometimes make semantic leaps, across which the reader is expected to follow... in order to reach a required conclusion" (Halliday M. A., 2004, p. 176). In this case, the statement that suggests that the harvest should be primarily bulls could be interpreted in a number of ways. For example, the remainder of the sentence

that the clause is contained within does not appear to provide an explanation of why the harvest should be primarily bulls. Again, this might appear obvious to the speaker or to other scientists well versed in population modeling or caribou biology, but others would be unlikely to make a connection. Furthermore, the previous sentence explains that caribou is an important food for northern communities so one might conclude that there is preferential harvesting of caribou bulls for reasons related to quantity or quality of meat. It is only if the listener is able to recall a statement from three sentences earlier that identifies "the higher the harvest of adult cows the longer it takes for caribou numbers to increase" that one could possibly make the connection to the number of bulls to be harvested. Presumably the preference for caribou bull harvesting is related to this fact, although the actual explanation is never explicitly given and as a result the listener must make the semantic connection.

The grammatical problems in scientific English are important for scientists to be aware of, particularly when speaking to a non-scientific audience. Although the original intention of using grammatical metaphor may have been to compress and package statements by changing the grammar, the effect it has on non-scientific listeners can once again create turbulence between the borders of two distinct cultures. The language of science then, either intentionally or unintentionally, becomes more than just the language used by scientists; it becomes a language of power.

Discussion.

Halliday (2004) identified seven grammatical problems in scientific English. Although his work focused primarily on the written text of scientists rather than spoken presentations, it is believed that the language of one certainly influences the language of the other and therefore scientist discourse will likely show similar characteristics and regardless of whether it is spoken or written. Although not all seven of his grammatical problems were revealed in this research, three of them were clearly prevalent.

Grammatical metaphor, which is the substitution of a grammatical class or grammatical structure by another (e.g., *his departure* versus *he departed*) was found within the data and provides an excellent example of how language use can create turbulence between the borders of two cultures (Halliday M. A., 2004). Although the specific words used may not be unknown to a non-Eurocentric scientific audience, the grammatical devices can be overly complex. While local Aboriginal community members will speak about caribou in terms that are easily understood by both audiences, the scientists would occasionally include grammatical metaphor that makes their meaning more difficult to be understood. Again, the scientists were well aware of their audience and made several attempts to use language that was relatable to the community members. However, I argue that the paradigmatic mode of thought, and thus the mental models held by the scientists, are so strong and embedded that it is difficult for them to abandon the language of science so easily. It would be important for border crossing attempts

to be very aware of the power the grammatical metaphor and its ability to confuse, and thus distance, non-Eurocentric audiences.

Interlocking definitions and semantic discontinuity also contribute to the grammatical problems in scientific English. They most likely appear when there is an assumption that the audience can understand and follow the scientific mode of thought that is being shared. However, the examples show that even with a paradigmatic mode of thought is difficult to follow some of the assumptions presented by the scientific speakers. Examples reinforce how important it is for scientists to be cognizant of the language they utilize, particularly in a public forum.

The results thus far show that it is easy for scientific English to create turbulence between two cultural groups. Pronoun use, word choice, grammatical metaphor, and the grammatical problems in scientific English can, intentionally or unintentionally, create significant borders when used in ways to influence the opinions of an audience. The narrative mode of thought, which is characterized by storytelling and sharing of personal experiences, can easily become dominated by the paradigmatic mode of thought and it soon becomes evident that one can exude its power over the other.

Power

Power in the language of science.

Continuing with Fairclough's categorizes of internal relations of text analysis, we next observe the presence of semantic relations, which are *meaning* relations between words, expressions, clauses, or sentences (Fairclough, 2003).

Through these relations we can also observe the attributes of Discourse, especially as it pertains to values, attitudes, beliefs, and emotions (Gee, 2005). The semantic relations, in a sense, reveal to the audience what his or her values and attitudes are and it is through the Discourse that the speaker constructs and expresses them.

Nadasdy (1999) identified how Indigenous knowledge (specifically, traditional ecological knowledge or TEK) has become a focus of substantial research with government and academic institutions attempting to include Indigenous knowledge with other fields of knowledge. However, he found that "The principal objective of this activity has been to "collect and document" traditional ecological knowledge and to "integrate" it with scientific knowledge of the environment (Nadasdy, 1999, p. 1). While the attempt to do so does include Aboriginal communities into land management issues, to date there has been limited success in combining Indigenous knowledge with Euroscientific research. Nadasdy suggests rather than highlighting the obstacles that create the borders between the two it would be more beneficial to "consider instead the power relations underlying the project of integration itself" (p. 2). That is, do the borders that exist between the two cultures occur because there truly is such a distinction between the two types of science or is the hegemonic and conquering nature of Eurocentric science exerting its power over the other, making collaboration unsuccessful?

Nadasdy found that the gathering of Indigenous knowledge had a compartmentalizing effect because many aspects of the Aboriginal people's knowledge fell outside the realm of Eurocentric science. He uncovered that "a

whole array of stories, values, social relations and practices, all of which contribute substance and meaning to aboriginal people's relationship to the environment, must be "distilled out" of [Indigenous knowledge] before it can be incorporated into the institutional framework of scientific resource management" (Nadasdy, 1999, p. 7).

Bringing Eurocentric science and Indigenous knowledge together can actually create other issues as well. For example, Agrawal uses the term scientisation to represent the idea that by cataloguing traditional knowledge into databases, Indigenous knowledge will undergo the processes of particularisation, validation, and generalization (Agrawal, 2002, p. 291) which forces it to exist as fact only to satisfy the requirements of a Euroscientific world. As a result, the context in which Indigenous knowledge exists can be misunderstood or even lost and "statements that are successfully particularised, validated, and generalized become knowledge by satisfying a particular relationship between utility, truth, and power" (Agrawal, 2002, p. 291).

Hopefully, there was a sincere desire to bring Indigenous knowledge and Eurocentric science together at the Sahtu Renewable Resources Board public hearing being studied here. However, Cruikshank warns that "Concepts and categories have the potential to pull people together – to unite them – but they can just as easily be divisive, especially when they become legitimized by "expert" knowledge (Cruikshank, 1998, p. 12). Once again, the issues that may be creating borders between the two may not be based on the differences in scientific

approach whatsoever; rather, it may be deeply embedded within the power structure that exists.

This research reviews the discourse that happens between Aboriginal speakers and the Eurocentric scientists to see if power relations still seem to exist either overtly or subtly within the language used. Specifically, the results will either support or contradict Nadasdy's claim that collaboration with the Aboriginal people and their Indigenous knowledge results in a *distilled out* version of knowledge sharing rather than a sincere acceptance of cultural diversity.

The value of Indigenous knowledge is well known and respected within Aboriginal cultures. The Euroscientific community within this study appears to have adopted the term *traditional knowledge* and speak of it with respect and dignity. For example, the scientists acknowledge that traditional knowledge needs to be collected by stating "Some of the extra funding is being used to help the Sahtu Renewable Resources Board collect traditional knowledge on hunting laws" (Ms. Marcy, November 21, page 40, lines 15-17). However, whether or not the scientists truly understand the value of traditional knowledge remains to be seen. It should be noted that it is dangerous to assume that all scientists belong to the same Eurocentric scientific community. Like any social group there can be a wide variety and diversity of beliefs, norms, and acceptance. However, Bielawski (1996) found that even scientists that work specifically with Inuit in the Arctic still have difficulties in truly understanding an Indigenous way of knowing. For example, she found "one important contrast between the two is that Inuit do not

separate people from nature, but Arctic scientists do" (Bielawski, 1996, p. 216). Furthermore, the scientific mode of thought that the scientists are rooted within makes them part of a culture that they may not even be aware is influencing their thought. As a result, even though the scientists are attempting to acknowledge traditional knowledge they, possibly inadvertently, continue to refer to and rely on scientific modes of thought.

Take for example the sentence spoken by the scientist Ms. Marcy who says "we do know from other studies and traditional knowledge that wolves need caribou to live and if there's less caribou, there will be fewer wolves" (November 21, page 26, lines 21-24). The reference to traditional knowledge is an acknowledgment of respect towards an other way of knowing, but the reference is made concurrently with knowledge "from other studies" which leaves the listener to wonder whether traditional knowledge on its own would have been considered valid or not. And if so, why the need to support the statement with further scientific support? One possible reason for not letting the traditional knowledge stand on its own is that Eurocentric scientists may be "unable to make use of it, because it cannot be expressed quantitatively. In addition, it would be difficult to "prove" this information scientifically" (Nadasdy, 1999, p. 8).

The acknowledgment of traditional knowledge in the following excerpt does appear as a source of input toward scientific knowledge, but this is quickly followed by qualifying how biologists define calving areas more precisely:

1 Traditional knowledge says that caribou

2 cows go to the same areas to calf. By following caribou

3 movements, biologists say that animals that use the same

4 areas and calving area form a herd. (Ms. Marcy, November 21, page 19, lines 1-4)

PowerPoint slides are then shown that describe the movement of different herds with caribou cows equipped with satellite collars. From the data shown, the scientist concludes that "Based on the collar data, there's no evidence in the last ten (10) years that large numbers of animals have moved from one (1) herd to another, but there is some overlap between herds in certain seasons, and there's no overlap when they have their calves" (Ms. Marcy, November 21, page 19, lines 16-20). Phrases such as *there's no evidence* and *there's no overlap* indicate a position of assuredness that does not invite contrary opinions. Also, this shows that the conclusions have been drawn and that any other observations or explanations must, as a result, be invalid. The language used is clearly definitive and assertive and leaves very little room for debate, even when the addition of hedged terms *but*, *some*, and *in certain* are added when the results don't agree with the previous statement as seen in "*but* there is *some* overlap between herds *in certain* seasons". Therefore, even though the scientists' own results admittedly do not support their claims one hundred percent, they still use powerful statements such as *there's no evidence* and *there's no overlap.*

The scientist concludes her narrative by explaining in more detail the types of data that are gathered to determine if a caribou herd is increasing or decreasing in size. She states:

17 For these reasons, it's important to

> collect information about each herd. Biologists use several types of information gathered over several years to see if a herd is increasing or decreasing. We look at what we hear from people in the communities who spend the most time with caribou.
>
> We look at the last few counts of a herd, and we look at other information collected more often, such as calf survival, pregnancy rates, condition, adult sex ratio, and distribution. (Ms. Marcy, November 21, page 20, lines 17-25 and page 21, line 1)

In the above statement we can see the scientists are attempting to bridge the border between traditional knowledge and scientific knowledge. The scientists in the area are likely well aware of the importance of traditional knowledge and even more so of the need to respect Aboriginal ways. The statement "We look at what we hear from people in the communities who spend the most time with caribou" is a clear indicator that the scientist's intention is to create a sense of inclusion. However, what follows this statement may be an example of why Aboriginal and scientific cultures continue to struggle to find a common meeting ground. Rather than more precisely explain what it was that the scientists heard from the people in the communities, she quickly switches into a scientific mode of thought and lists the data input required for modeling caribou numbers. Although some of the survey data collected is, in fact, collected by "people from the Sahtu communities [who] were involved as observers" (Mr. David, November 21, page 21, lines 8-9),

the data collected was only that which can be incorporated into a scientific mode of thought, in this case, into caribou population models. While the scientist's early statement may well be respectful of the community members it is unlikely that it will be included in the computerized world of modeling that the scientific community commonly relies on, as a result any data other than that which can be scientifically quantified appears to be disregarded or forgotten. This finding suggests that the scientists at the public hearing seem to maintain the position of power as described by Nadasdy who found that having all discussions as science-based experiences limits Aboriginal peoples' involvement and even though "they are welcome to participate, the "truth" of their input is evaluated strictly according to the standards of forestry, ecology, geology, or geo-physics" (Nadasdy, 1999, p. 7) which results in scientists and resource managers holding a monopoly on these knowledge fields.

One of the scientists also attempts to make a connection between the increasing and decreasing intervals of caribou populations and traditional knowledge by stating that:

> The scientific information we've collected over the past forty (40) years support the traditional knowledge. We don't know why this happens, but it may be linked to long-term climate patterns. Biologists in Alaska have interviewed people and looked at historical records and recorded similar cycles over the last hundred fifty (150) years for at least five (5) caribou herds in

14 Alaska. (Ms. Marcy, November 21, page 25, lines 7-14)

Again, although the attempt to connect with the traditional knowledge is made and is likely a genuine and sincere attempt on the part of the scientist, the scientific authority overrides much of the traditional knowledge that is presented at the hearing. For example, the scientist again divides the knowledge of Eurocentric science from the traditional knowledge when she states that the information "we've" collected is a separate entity from knowledge of the land. This is strong evidence that the scientist holds two very distinct modes of thought, a scientific one and an "other" one. The statement shows that the same event or occurrence still needs to be categorized into either a scientific mode or a non-scientific mode, rather than seeing the event or occurrence simply as "knowledge". The distinction is further widened when the scientist uses an adjective to describe the "scientific information" collected. The addition of the word *scientific* insinuates that a distinction between the knowledge of science and the traditional knowledge is necessary. However, a more discouraging dismissal of traditional knowledge lies in the fact that even though the biologists have interviewed local Aboriginal hunters and spent much time with Elders of the community they claim to not know why a decline is happening. To make matters worse, the scientist proposes an alternative explanation when she says "it may be linked to long-term climate patterns". Not only is this another example of semantic discontinuity as described in the previous section, but the inclusion of the hedged term "may" indicates that she is not even convinced that the climatic patterns are definitely the cause of the cycles, yet because of its scientific nature

she includes it as what she believes to be the most likely explanation as it appears to still be better than accepting some of the traditional knowledge explanations (see next section). As a result, the power of scientific thought clearly dominates any other mode of thought even though the intention was to "support the traditional knowledge".

What is most disappointing in the statements made by the scientists is that the local community members have offered many explanations as to why there is a decline in the caribou population, yet it seems that because these explanations do not connect with scientific mental models they are subsequently dismissed. Nadasdy (1999) recorded a similar experience when working with resource managers and Aboriginal people on the issue of hunting Dall sheep in the Yukon, Canada. He writes:

> …scientists and resource managers interested in gathering the [traditional knowledge] of Dall sheep, for instance, are not particularly interested in hunters'opinions or observations regarding ground squirrels or otters, since these seemingly have nothing to do with sheep. Their interests, however are even more circumscribed than this. It is not simply that they are interested only in sheep; rather, they are only interested in *certain kinds of information* regarding (only) sheep (Nadasdy, 1999, p. 7).

Aboriginal perspectives of the decline of caribou.

Even though the scientists have collected over 40 years of data on the increasing and decreasing caribou populations and admittedly "don't know why this happens" (Ms. Marcy, November 21, page 25, line 9), they do not appear to

accept the sharing of Indigenous knowledge from the Aboriginal community members as true knowledge. Bruner believes that the narrative mode of thought and the paradigmatic mode of thought are each creations within our minds that create two "possible worlds" (Bruner, 1986, p. 45). The paradigmatic mode of thought relies heavily on presupposition, that is, it relies greatly on phenomena that are taken for granted and are expected to be the case. Ideas that fall outside of expectation are closely examined and eventually *fit* into expected explanations. Bruner claims that are central nervous system has evolved in a manner that deals with expected and unexpected events. He found that if an event that "impinges on us conforms to expectancy, to the predicted state of the model, we may let our attention flag a little, look elsewhere, even go to sleep. Let input violate expectancy, and the system is put on alert" (Bruner, 1986, p. 46). Thus, the paradigmatic mental models held by the scientists in this study are conditioned to understanding the life of caribou within one possible world. Anything outside of that world is likely ignored or rejected.

However, there is another world, described by Bruner's narrative mode of thought, that shares wisdom within a culture in a much different way. These "folk theories" are a means of knowledge sharing that help construct a world through a more "humanist" approach. The humanist can be a historian, a literary critic, a philosopher, an interpreter of culture, an artist, or a storyteller (Bruner, 1986, p. 49). Even though the mental model created by the narrative mode of thought is different from the paradigmatic one, a "folk narrative of this kind has as much claim to "reality" as any theory we may construct in psychology by the use of our

most astringent scientific methods" (Bruner, 1986, p. 49). In other words, the Indigenous knowledge shared through the narrative mode of thought must be viewed within the context of that possible world and given the same legitimacy of reality and truth as any scientific mode of thought. For example, many of the Elders comment on their reasons for the caribou decline. In fact, many don't believe there is a decline, but rather, a displacement of the caribou for variety of reasons. The following passages are examples of Indigenous knowledge that is shared in the oral narratives of the Aboriginal speakers that goes unrecognized or is given minimal acknowledgment by the scientists.

Elder Steven explains how caribou are sensitive animals that will move away from disturbances such as fires, helicopters, and prospectors:

17 You know it -- that animals are not -- are
18 pretty touchy animals, you know, they move away from
19 stuff, like, Mark and Jenny (phonetic), not only forest
20 fire chased them away, and helicopters all over the
21 place, prospectors (Elder Steven, November 21, page 78, lines 17-21).

Elder Bob shares a similar opinion has noticed too many planes and helicopters in the area:

5 And in the last couple of years, there's
6 been too much planes and things flying around. I think
7 that's why we -- the -- the caribou haven't been coming
8 around that much (Elder Bob, November 21, page 80, lines 5-8).

Elder Peter believes the oil companies have destroyed the areas the caribou once grazed in and as a result may no longer go to that area:

> But the bulldozer he -- this oil company destroy that. No more. They [said] the caribou keep moving there, they don't stop there anymore, because they destroy the food there (Elder Peter, November 21, page 85, line 5-9).

Chief Michael believes that the process of caribou counting, which includes capturing, tracking, and collaring the animals is putting stress on them. He recommends doing this type of research every 50 years instead of every 2 years:

> They should wait, maybe, about a -- maybe, about fifty (50) years or so before they start counting. It's just like they're doing it repeatedly, every, like, two (2) years. That's too much.
>
> And -- and the tags that they put on to the caribou, we don't -- the collars that they put on the caribou, we don't know how much its disturbed them and -- and the stress it's caused on them. And, as well, these helicopters that are flying around -- like, around them. (Chief Michael, November 22, page 10, lines 5-13)

Elder Timothy doesn't even believe there is caribou decline, rather, that is just getting harder to find them because they are avoiding noise created from the diamond mines:

> out there all the time and I don't believe that the

22 caribou's declining, it's just that they're getting

23 harder to find. There's a lot of noise from the diamond

24 mining and that, so (Elder Timothy, November 22, page 62, lines 21-24).

Elder Andrew also identifies the creation of seismic lines and the associated helicopters as reasons for caribou decline:

19 There used to be a lot of caribous. Used

20 to go by dog team around halfway to Colville. Get a lot

21 of caribou. But since the seismic and all this choppers

22 and all that start coming around, caribou are getting

23 kind of scarce (Elder Andrew, November 22, page 97, lines 19-23).

Elder Shirley believes that speaking of caribou will force them to move away from the people:

12 We depend on it for our survival. And I don't really

13 talk too much about wildlife, because we work so hard for

14 it, and we are so greedy for it, and we are fearful that

15 if we talk about it, it might disappear on us. So we, as

16 Deline people, have this belief that we don't talk too

17 much about the wildlife (Elder Shirley, November 22, page 105, lines 12-17).

Elder Kristina shares how treatment of an animal after it has been killed is known by the other caribou and mistreatment forces the caribou away:

7 And, well, however way you treat an animal

8 and it's body, that animal is aware of it, and it would

9 not return to that area (Elder Kristina, November 22, page 110, lines 7-9).

Elder Sue identifies the use of skidoos, in particular, following behind caribou as another reason for them to move away:

11 And sometimes they fly around them with

12 the helicopters and it'll move away from those noises.

13 And with the skidoos too -- they travel after the caribou

14 with skidoos and it moves away from this areas. And

15 whenever they start hunting in an area with skidoos, the

16 animals tend to move away from that area. That's how

17 they are (Elder Sue, November 22, page 112, lines 11-17).

Acknowledgement by scientists.

The above examples are repeated throughout the narratives and can be found in almost all of the Aboriginal speakers' oral presentations. The scientists involved in the hearing and the community members have had previous discussions on these issues and it is clear from the respective discourse analysis that their two knowledge systems have yet to completely cross the border of one another. It is clearly evident that the autobiographical narratives represent the narrative mode of thought as described by Bruner, and it has also been established that the scientists are influenced by the paradigmatic mode of thought (Bruner, 1986). How then can we tell if information from one mode of thought is understood or acknowledged by the other? The Sahtu public hearing transcripts

provide an opportunity to determine this to some extent. At the end of the three-day hearing the scientists were given an opportunity to provide closing remarks to summarize what they heard, share their commitments for their work in the future, and review suggestions made by the Aboriginal community members. The closing remarks were provided by Mr. Brian and were read from a prepared statement rather than presented as an oral narrative. The reason for doing so was not provided.

Based on the autobiographical narratives of the Aboriginal speakers above, there appears to be several suggestions as to why the caribou numbers have decreased within the region. The scientist first acknowledges how the Department of Environment and Natural Resources will continue to work with people in the community so that they can "be more involved in the studies that we do" (Mr. Brian, November 23, page 115, lines 14-15). His suggestions include providing the opportunity for community members to witness how they do their census and find ways for young people to work with the biologists to learn what they do. They also intend to "meet with leaders, Elders, and youth in Colville Lake to go over how we do our various studies, and how they can become more involved in what we do" (Mr. Brian, November 23, page 116, lines 3-6). Once again, the comments made by the scientists are polite and outwardly appear to be attempts toward inclusion. However, closer investigation using some of the discourse analysis ideas generated in earlier sections reveal that the borders do not yet appear to have been crossed. First of all, the pronoun selection makes a clear division between the scientists and the non-scientists. Secondly, all of these

suggestions and recommendations are aimed towards one goal, that is to "educate" community members in the ways of a scientific mode of thought. The sharing of knowledge is clearly in one direction only and one cannot help but sense the underlying attempt to employ the power of science by exposing the community members to the ways of science rather than an equal sharing of two distinct modes of thought. Their goal is clearly to have Aboriginal members become "more involved in what [scientists] do" rather than the other way around.

The scientist next reiterates that information they have collected shows that there are fewer calves in the herd than there were between the years 2000 and 2005. Yet after three days of information sharing from the Aboriginal community members, the scientists state

> We do not know why this was occurring -- sorry. We also saw that calves were being born later, in June, and even into July. We do not know why this was occurring, but it is known that late-born calves have a less chance of survival (Mr. Brian, November 23, page 119, lines 3-7).

Remembering that these comments occurred after all of the Aboriginal community members had already been given a chance to speak indicates that none of the suggestions the Elders offered seem to have been accepted as possibilities for decrease in caribou numbers. Again, it appears that the scientists would rather say that they do not know why something is happening and apologize for that fact by saying "sorry" rather than consider the explanations provided by the Elders.

The scientist does indicate that they were listening to what was being said at the hearing when he states

> During this Public Hearing, people have said that caribou numbers go up and down naturally - we agree. While there are many reasons for this, human influence and activity now plays a role. Disturbance by aircraft, development activities, habitat changes and harvesting all affect the rates of decline and recovery (Mr. Brian, November 23, page 119, lines 8-14).

This is an acknowledgment to at least some of the suggestions made by community members. For example, the disturbance of aircraft was suggested several times by several different Elders as having a negative effect on caribou. So does the acknowledgment of these effects on caribou mean that action will be taken other than implementing a caribou quota system? Apparently not. At this point in the closing remarks the scientist states that based on their information "our advice on the most important thing we can do in the short term is to lower the number of animals taken, particularly cows" (Mr. Brian, November 23, page 119, lines 20-21). He then lists five actions that could be taken to lower harvest, all of which require a change in hunting practices by the community members rather than government or industry involvement:

> 1. People can voluntarily agree to take fewer caribou for a few years. We have heard during this

4 Hearing that this is already occurring.

5 2. People should reduce wastage and

6 wounding loss as much as possible.

7 3. People can take young bulls rather

8 than cows.

9 4. Areas could be identified where there

10 should be no hunting, such as along winter roads.

11 5. A limit could be set as to how many

12 caribou should be taken, such as has already been done in

13 the Inuvialuit, and Gwich'in areas (Mr. Brian, November 23, page 120, lines 2-13).

In other words, it is up to the actions of the Aboriginal community members to implement what can be done "in the short term" (Mr. Brian, November 23, page 119, lines 20) to help caribou numbers, rather than any actions taken by the other contributors of caribou decline, such as the "Disturbance by aircraft,development activities, [or] habitat changes" (Mr. Brian, November 23, page 119, lines 12-13). And finally, the scientist states that if the actions are taken to lower harvest, then they should be followed up by changing the caribou management zones to fit with the scientists' definitions of herds and that "Patrols by wildlife officers should be increased" (Mr. Brian, November 23, page 120, lines 21-22). In other words, management through traditional means utilizing Indigenous knowledge appears to not be an option.

Based on the summary and recommendations made by the Department of Environment and Natural Resources, it is difficult to believe that the three days of information sharing had much effect on the scientific mental models held by the science speakers. Their response is clearly based on Eurocentric scientific views only and very little acknowledgment of other ways of knowing is recognized. There appears to be very little change, if any, of the recommendations made at the scientific presentation made on the first day of the hearing to the closing remarks made on the last day. As a result, it appears that the opportunity for legitimate knowledge sharing was lost.

Discussion.

Nadasdy's recognition that attempts of Aboriginal and Eurocentric collaborations can often lead to a distilled out version of knowledge sharing is important starting point for any research that hopes to work within the two cultures. While many statements and expressions of intent are given that appear to make scientists willing to accept Indigenous knowledge as a bona fide source of information, one can't help but feel that the mental models that the scientists possess do not truly allow for the input of *all* components of other ways of learning. In fact, it might be unrealistic to even believe that they could. However, a lack of understanding and a lack of acknowledgment are two different borders to be crossed. A lack of understanding implies that a person's mental model does not fit with information being presented. However, it leaves open the possibility for learning to occur by trying to accept another's mode of thought. On the other hand, a lack of acknowledgment once again implies that a person's mental model

does not fit with new information, but rather than try to understand the other model, it is simply ignored or passed off as irrelevant, unscientific, or unnecessary. Science educators are not immune to this same trap. Once again, their intentions may be noble and genuine, but if their mental models do not allow for other ways of knowing to contribute to them, then the distilled out version of knowledge begins to appear, as Nadasdy has suggested.

The examples in this section illustrate that the scientists continue to see a significant difference between biologists and local community members. Their comments, which are by no means unusual in a scientific setting, do not offer the type of opportunities for border crossing that could have occurred based on the fact that both groups want what is best for the caribou and are so willing to work together. Although the sincere attempts were clearly made to acknowledge Indigenous knowledge, for it to truly have an impact on the audience, it needs to address all components of their knowledge, not just the ones that fit within a Eurocentric scientific model.

The Aboriginal Elders present statement after statement of possible reasons for the decline in caribou, and it would be difficult for anyone, local community members included, to synthesize all the information in entirety as there is an array of opinions shared, including contradictory ones. However, the scientists miss an opportunity to really connect with another way of knowing because in their response they focus primarily on issues that can be addressed in a Eurocentric scientific manner. Even though some of the issues presented may not fit within a paradigmatic mode of thought, it would have been an excellent

opportunity to lessen the turbulence between borders by acknowledging statements that do not normally fit within their mental model. It was an opportunity for scientists to not only acknowledge and appreciate another mode of thought, but an opportunity to actually learn from it. Imagine the impact that could have been made if one of the scientists said “we are also concerned about how the caribou are being treated, and we hope today's discussion does not make them move away from us. Perhaps the more we can learn about what stresses our caribou, the more we can work together to ensure they remain on the land”.

Metaphors

Thinking of caribou as something more than just an animal requires an ability to incorporate metaphor and to think metaphorically. Both formal and informal science makes use of metaphors and how they are utilized will often be revealed through discourse. The history of science is filled with metaphors that are used as "crutches to help us get up the abstract mountain. Once up, we throw them away (even hide them) in favor of a formal, logically consistent theory that (with luck) can be stated in mathematical or near-mathematical terms" (Bruner, 1986, p. 48). Models formed in this way are maintained while the metaphors that helped create them are often forgotten, unless science educators revitalize them in order to tell of the history of science or use them as a teaching tool. In addition, the use of metaphors influence mental models which are functional analogue representations of real-world or imaginary situations, events, or processes (Nersessian, 2008, p. 93). We, as educators, need to understand “that science is not something that exists out there in nature, but that it is a tool in the mind of the

knower-teacher and student alike" (Bruner, 1996, p. 115). If metaphors and the mental models that are formed from them exist within both informal and formal science environments, then it is reasonable to assume that they play a significant role within both Eurocentric and Indigenous science as well. If the evolution of metaphor use has occurred in the past half-century within the realm of Eurocentric science, has it crossed the border into Indigenous science? Or did it always exist there? Do Aboriginal people possess mental models as well or do they continue to communicate primarily through metaphors? Science educators are well aware of how Eurocentric science utilizes metaphors "as every historian of science in the last hundred years has pointed out, scientists use all sorts of aids and intuitions and stories and metaphors to help them in the quest of getting their speculative model to fit "nature"" (Bruner, 1996, p. 124). However, there is a paucity of evidence on the use of metaphors in the narratives of both Eurocentric science and Aboriginal speakers addressing a common topic within a public discourse. In this case, the issue of caribou hunting and the possible implementation of hunting quotas are discussed via oral narratives and how metaphors contribute to that discourse and how the construction of mental models is exhibited through oral narratives is of immense interest to both science educators and scientists.

The development of metaphors and mental models in science.

The use of metaphors has been discussed in depth throughout both science and science education. Philosophy of science writers in the 1960s began to analyze and define the role of metaphors and re-examining their early work is an important starting point for analysis and review. Significant texts recognized in

the field by Max Black (1962), Mary Hesse (1966), and William Leatherdale (1974) deal primarily with models, metaphors, and/or analogies. As science and science education research progressed, the use of metaphors became increasingly complex, and more recent research indicates that there appears to be an emphasis utilizing model-based learning or mental modeling theory (Matthews, 2007; Koponen, 2007; Greca & Moreira, 2000; Halloun, 2004). This mental modeling theory an advancement of Bruner's mental models described earlier. Bruner's idea is that we each possess our mental model that we use as we face novel events. Model-based learning or mental modeling theory is more of a tool that we construct in our minds to assist in our learning process. The evolution of model-based learning is well documented and shows how our understanding of metaphors has led to an important way of thinking about scientific thought processes and development (Nersessian, 2008).

Most often, research on metaphors is applied to Eurocentric scientific practices as opposed to other ways of knowing. The connection to a particular space can have a much different meaning for an Aboriginal person who possesses a mental model built upon an entirely different system of knowledge. Mental modeling should not be viewed as belonging to only Eurocentric science but rather "is a combination of an individual's biology and learning, and develops in interaction with the natural, social, and cultural realities in which one is embedded" (Nersessian, 2008, p. 108). For example, although most are aware of the important connection Aboriginal people make with the land, the Dene Tha of northwestern Alberta differentiate between what they call “our land” and “the

other land" (Goulet, 1998, p. xxvii). A Euro-North American might assume this distinction to be between the natural and the supernatural, or more specifically, between a scientifically constructed mental model and a mental model built on mysticism or religion. However, the other land "is experienced firsthand in dreams or in visions when the soul journeys away from the body. It is in the other land that one meets relatives who have passed away as well as Christian figures such as Mary and Jesus" (xxvii). As a result, the Dene Tha perspective on the two types of land demonstrates that different worldviews and ways of knowing provide different background knowledge upon which mental models are constructed. Therefore, mental models reflect people's beliefs and in order for a mental model to be useful for explaining or predicting phenomena "it has to be functional to the person who constructs it" (Greca & Moreira, 2000, p. 3). Evidence of the mental model that shows the connection of people, animals and the land can be seen in the following passage:

> 2 And listen -- listen to the
> 3 grass -- the people that live off the land cause, we're
> 4 out -- I'm out there every day and night. Listen to the
> 5 land, the caribou, and the elders on their paths (Elder Timothy November 22, page 60, line 2-5).

Critical to this research then is the question whether or not Indigenous science also values metaphors and if so, are those images uncovered during the oral narratives of the Elders? According to Bruner, "We all know by now that many scientific and mathematical hypotheses start their lives as little stories or

metaphors, but they reach their scientific maturity by a process of conversion into verifiability, formal or empirical, and their power at maturity does not rest upon their dramatic origins" (Bruner, 1986, p. 12). The act of speaking in the form of stories is an important cultural distinction for many Aboriginal societies and research has revealed how these narratives are shared amongst Aboriginal communities (Klapproth, 2004). Indigenous science therefore, "is a reflection of the metaphoric mind and is embedded in creative participation with nature" (Cajete, 2000, p. 14). If the stories that are shared contain metaphors it may indicate that the learning processes and the creation of mental models may, in fact, be similar between both scientific and Aboriginal cultures. If however, there are distinct differences, then both scientific and Aboriginal speakers need to be aware of the others' understanding when the sharing of knowledge is occurring. The transmission of knowledge through storytelling relies on the meaning that is constructed as stories about events or experiences are created. These stories, which can be passed on through many generations, are susceptible to change and alterations as they are retold to be meaningful for the time. As a result, "personal narratives based on shared metaphors and responses to common problems in one generation may be reworked quite differently by the next" (Cruikshank, 1998, p. 2).

Research has shown that for more than a half-century philosophers of science have tried to document and understand the role of mental models in science which has led to studies that "examine model-related topics such as the nature of scientific theory, the status of hypothesis, the role of metaphor and

analogy in scientific explanation, thought experiments in science, and the centrality of idealization for the articulation, application and testing of models" (Matthews, 2007, p. 648). The use of metaphors plays an integral role in understanding scientific or natural phenomena and it is through an understanding of them that we can recognise the existence of mental models. The theoretical framework of mental modeling is built around the concept that people already have existing ideas and knowledge they have constructed. By inquiring within these mental models they are able to not only further understand phenomena but also acquire skills that allow them to predict and make hypotheses. Therefore, "model formation, we assume, is the construction of a model of some phenomenon by integrating pieces of information about the structure, function/behaviour, and causal mechanism of the phenomenon, mapping from analogous systems or through induction" (Gobert & Buckley, 2000, p. 892).

The oral narratives that occur at an event such as a public hearing can create a blending of discourses, or interdiscursivity, that brings one discourse into a relationship with another (Scollon, 2008, p. 79). The term interdiscursivity, introduced by Fairclough (1992) and derived from Bakhtin's (1981) concept of intertextuality, describes how all discourses are interconnected to other discourses and as a result they can "cross-reference each other, be traded upon, or be incorporated into each other" (Scollon, 2008, p. 79). It is important then to incorporate an understanding of what Eurocentric scientists and Aboriginal people deem as important and have an awareness of the cultural background they both bring to the table during an oral narrative. Evaluating the discourse that occurs

within the oral narratives of a public hearing requires a theory of language "for making meaning that includes a socially and culturally sensitive semantics of text and discourse. Syntax alone is not enough" (Lemke, 2004, p. 5). In other words, we need to evaluate not only what is said within the transcripts, but also what is *meant* within the language of a particular community, whether that community is a Eurocentric scientific one or an Aboriginal one.

Metaphor.

Discourse analysis provides evidence of these assumptions as it has been reported previously that within Eurocentric cultures, "primarily on the basis of linguistic evidence, we have found that most of our ordinary conceptual system is metaphorical in nature" (Lakoff & Johnson, 1981, p. 287). Aboriginal people in particular share knowledge in terms of metaphorical statements. For example, Cruikshank describes how one Aboriginal Elder, who was, at the time, considered to be one of the oldest living people in the Yukon, felt it was important for her to make a record of her memories about the past for younger people to learn from. She did so by creating an analogy of her own life to a jackpine by stating "my roots grow in jackpine roots... I grow here. I branch here... I'm the oldest one" (Cruikshank, 1992, p. 163). The Elder creates a metaphoric image of herself as a tree to convey the similarities of her connection to the land as being similar to the connection of a tree to the land.

Metaphor then can be far more than a mere poetic device, it is a method of thought and meaning making and "if we are right in suggesting that our conceptual system is largely metaphorical, then the way we think, what we

experience, and what we do every day is very much a matter of metaphor" (Lakoff & Johnson, 1981, p. 287). In fact, we could ask: "are there any concepts at all that are understood directly without metaphor? If not, how can we understand anything at all?" (Lakoff & Johnson, 1981, p. 312).

Early on, Max Black (1962) identified how metaphors are used in literary works (for example, "the chairman plowed through the discussion" or "light is but the shadow of God"). Metaphor in this sense is used in a relatively simple way and it is employed when referring to a sentence or expression that has some words being used as metaphors while others are not (p. 27). Furthermore, metaphor here is used when referring to the meaning of a sentence, not to its phonetic pattern or grammatical form. William Leatherdale (1974) identifies the concept of metaphor in science as going back to as far as Aristotle. He identifies the close connection between models and analogies and highlights Mary Hesse's book *Models and Analogies in Science* as evidence (p. 1). Leatherdale describes an analogy as "a more fundamental and simple concept than metaphor or model" (p. 1). As a result, he claims metaphors express an analogy while models work by an analogy. Leatherdale's separation of the term analogy from metaphors and models is significant, as many other writers and speakers of science see the terms as synonymous.

Black (1962) showed that the philosophy of understanding language lies in the grammar, but not in the sense of identifying nouns, adjectives, etc., but in classifying them into "meaningful units of speech (i.e., "morphology")" (p. 1). Morphology, together with the syntax that builds sentences, is used to find

ontological conclusions that begin with the grammar of language. In Black's words, "To use a well-known distinction, "metaphor" must be classified as a term belonging to "semantics" and not to "syntax" - or to any physical inquiry about language" (p. 28). Using the example illustrated above, the sentence that the metaphor is contained within is said to be the frame while the word (or words) that act as the metaphor are called the focus. Thus in Black's first example "plowed" is the focus which is framed within the rest of the sentence. In this case, the metaphorical use of the word "plowed" is used to substitute a literal expression. In Black's words, "instead of saying, plainly or directly that's the chairman dealt summarily with objections, or ruthlessly suppressed irrelevance, or something of the sort, the speaker chose to use a word ('plowed') which, strictly speaking, means something else" (Black, 1962, p. 30). Black refers to this as a *substitution view* of metaphor.

Metaphors can also be used to fill in gaps when a literal word does not exist. This can often happen in science investigations and is where many of the "new" scientific words first began. This "putting of new senses into old words" is a metaphor known as catachresis and can be exemplified by the word "orange" which originally referred to the fruit but through catachresis was applied to the colour as well (p. 33). Today, the word ‘orange’ is accepted as colour as well so catachresis no longer exists as the word is no longer metaphoric, but has become metonymic. A contemporary example might be the use of the term 'virus' in computer software. When first developed, there would have been no existing word that could describe the qualities of these computer constructed nuisances.

Thus, *virus* was used to give meaning by showing the similarity to the biological organism. Today, however, a computer virus is a well-understood and recognized term that may no longer be considered metaphoric.

When catachresis can no longer apply, that is, when the use of a metaphorical expression is available, then the purpose for using a metaphor becomes more stylistic. Thus, the metaphor (M) is similar or analogous to a literal equivalent (L) (p. 35). Black uses the expression *comparison view* to represent these types of metaphors, which include both similes and comparisons.

Examples of metaphor use.

Surprisingly, the substitution view and comparison view of metaphors are almost completely absent in the oral presentations of the scientists. This is a significant finding because much has been written about the importance of metaphor for scientific thought. The following example is representative of how the scientists spoke at the public hearing and you can see that it is devoid of metaphorical use.

3 Most people were worried about the
4 caribou. They felt that caribou numbers had declined and
5 that we needed to do something quickly and that the
6 communities and boards need to work together. Most
7 people thought all harvest that was not subsistence
8 should be eliminated. Some people suggested we need
9 quotas for subsistence harvest until the herd recovers
10 its numbers. Others suggested that tags could be a way

11 of monitoring harvest levels (Mr. Brian, November 21, page 35, lines 3-11).

There are two possible explanations for why the scientists might be avoiding metaphor during their oral presentations. The first is that they may be purposefully trying to avoid complicated language in order to accommodate a non-scientific audience. Use of metaphor in Eurocentric scientific thinking is well recognized and established, but that may have more to do with the mental models of scientific thought rather than the presentation of results, which these oral narratives characterize. The second is that they may be trying to exert their authority as scientists and are trying to present 'just the facts' in an objective and impartial manner that contains no personal biases or emotions. From the transcripts we know that the scientists have had much contact with community members on the issue at hand. They visited all of the communities and schools within the Sahtu region and heard all of "the comments and the suggestions for management actions" (Mr. Brian, November 21, page 32, lines 1-2) which were recorded and presented a year prior to this hearing. Thus we can assume that the scientists were well aware of the reaction that the community members would have to the implementation of a quota for caribou hunting. This knowledge may have influenced the language that they chose to use during their presentations because knowing that their suggestion of implementing a quota system was going to be met with resistance, they may have hoped to appear objective and emotionless on the topic and therefore avoided metaphor, as it is associated with the humanities rather than *hard* science.

What may be even more surprising is that these types of metaphors are also absent in the oral narratives of the Aboriginal speakers. Just as it is with Eurocentric scientists, is well known that Indigenous science is also heavily reliant on the use of metaphor, but to say that all types of metaphor are utilized may be inaccurate. The oral narratives of the Aboriginal speakers are dominated by the sharing of first-hand experiences and knowledge, and as a result substitution and comparison metaphors appear to be rarely used[5].

Black (1962) believes the *interaction view* of metaphor explores how two thoughts can be connected together, but to do so requires a certain amount of filtering that will allow the intended metaphorical meaning to be seen through all of the other possible meanings, which would likely be nonsensical and unrelated. The example Black uses to illustrate this view is "Man is a wolf" because the intended metaphor is thought to be well understood and "a suitable hearer will be led by the wolf-system of implications to construct a corresponding system of implications about the principal subject" (p. 41). As a result, the fierce, hungry, hunter image of a wolf is likely to be employed as a comparison to Man, while characteristics of wolves that are less associated with its reputation, such as nurturing, protective, and socially bonded, will be filtered out.

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[5] It is important to remember that the transcripts of the Aboriginal speakers are translated from their native language into English by local translators. It is possible that there was some use of metaphor in what was originally said and the translators avoided metaphor use for simplicity. However, the accuracy of the transcripts, the consistency of all 21 narratives, and the detail in which they were transcribed makes this unlikely.

Once again, the scientists appear to not use this type of metaphor, but it is present in the oral narratives of the Elders when they speak of caribou. When speaking of caribou, many Aboriginal people do not separate man from animals so the underlying comparisons between them are important metaphors because they are deeply embedded in the modes of thought, or mental models, of the speakers.

> 19 ... it kind of worries me because I
> 20 think about my father's words where he said caribou are
> 21 like people, you can't talk about them too much. They --
> 22 they live the way they want to and they travel where they
> 23 want to too and they don't live by man. (Elder Laura, November 21, page 117, lines 19-23)

Metaphors of this type are far more than mere poetic devices. They represent an Aboriginal perspective of caribou and reveal the deep connection that the people make with the animals in the region. According to Lakoff and Johnson (1980), values are deeply embedded in culture and they have found "that our values are not independent but must form a coherent system with the metaphorical concepts we live by" (p. 22). The metaphorical way in which Aboriginal people view caribou is a deeply rooted belief within their culture that is structured within a system of values, and these values are clearly distinct from those of a Eurocentric scientist, as can be seen in the following excerpt:

> 4 Animals are like us. They -- they have
> 5 feelings too. If us, we went out on the land -- if

6 there's even a twig that poked us it would -- we would,

7 like, work on it until we get it out. It's the same way

8 for them, the caribou (Elder Bob, November 22, page 127, line 4-8).

The recognition of caribou having feelings are not meant as a substitution view or comparison view of metaphor, that is, the caribou's feelings are not representative of something else. Rather, Elder Bob is explicitly stating that caribou possess feelings, just as humans do, and although the view of caribou is still metaphorical because we as humans, do not share all of the qualities of caribou, certain characteristics are the same. This metaphorical view of caribou is a cultural attribute with deep-rooted meanings to the Aboriginal speakers. They are not intended to be poetic or flamboyant, but are intended to reveal the values and attitudes held within the community. They are also not a conceptual overlay which we may or may not place on experience and "It would be more correct to say that all experience is cultural through and through, that we experience our "world" in such a way that our culture is already present in the very experience itself" (Lakoff & Johnson, 1980, p. 57).

Black's (1962) view of metaphor then has important ramifications for cultural metaphor usage because if a particular culture has a different view of what the intended metaphor represents, then the metaphor will be, at least, misunderstood, or more importantly, misdirected or misrepresented. For example, understanding how a wolf (*Canis lupis*) is used metaphorically within a Linnean, Eurocentric scientific perspective is much different than how it is spoken of for a Cree student (*mahihkan*). As a result, "for an Aboriginal student familiar with

mahihkan, the myriad of images and concepts associated with the word mahihkan is very different from the images and concepts science teachers want students to associate with *Canis lupus*" (Aikenhead G. , 2001, p. 345). Black states, "I am assuming that in any given culture the responses made by different persons to the test suggested would agree rather closely and that even the occasional expert, who might have unusual knowledge of the subject, would still know "what the man in the street thinks about the matter"" (Black, 1962, p. 40). Unfortunately, Black does not fully seem to take into account the diversity of meanings and representations that can take place within different cultures. Fortunately, more recent literature acknowledges that Eurocentric scientists will consider these aspects of metaphor as "a researcher who concentrates on a particular metaphor without looking closely at the context in which it was used will likely not see how the metaphor urges a larger shift in perspective by a specific scientist and the broader scientific community" (Johnson-Sheehan, 1998, p. 177).

How does this metaphorical view of caribou then affect the mental models held amongst the Aboriginal community? Because the metaphor is so deeply ingrained within the narratives of the Elders, it appears they also construct the mental models held by members of the community. This is revealed in the following excerpt which describes how the caribou will react to mistreatment, in this case, by being hit with a stick.

8 If you ever hit a caribou with a stick,
9 the caribou would leave that area and not come back. And
10 we don't know what it -- where it goes. And there was

11 one time we heard about the time that a caribou was hit,

12 they already knew who that person was and the Elders

13 really talked about it and from that time on, the caribou

14 left for a long time. We don't know where it went.

15 Even if you hit one (1) caribou, it just

16 seems like all on the land, all the caribou know about it

17 already. And from that time, it would all take off

18 towards the barren grounds. (Elder Darren, November 23, page 55, line 8-18)

Through this narrative we can see that the metaphorical view of caribou is reflected in the mental models held by the Elders. The caribou is not substituted or compared to another person or thing, and the stick is not meant to be symbolic of another object. Rather, the metaphor lies in how the Aboriginal people interact with caribou with the key attributes of animals and humans being one and the same. The Elder, Peter extends the metaphorical view of animals to the wolf as well, which takes on a role of a doctor for the caribou, by killing the sick and ensuring that other caribou don't become sick.

24 So the wolf we can't blame the wolf.

25 Maybe too much now the world is changing. But the wolf

1 is just like a doctor for caribou. If the wolf it

2 doesn't bother caribou then he will die off. They kill

3 only the one that are sick, they'd known that they're

4 sick so they kill them; that's the -- that's the way the

5 wolf are doing. They know that (Elder Peter, November 21, page 82-83, lines 24-25 and 1-5).

Jim also sees both themselves and the Eskimo as crows that are strong and follow the rules of the land:

10 Well, Eskimo and all of
11 us we are crow. We are the same as crow. Everybody
12 tough, that is the way we are.
13 We're just same as crow. We look at the
14 land and we got the rules to follow (Elder Peter, November 21, page 92, lines 10-14).

Although Eurocentric scientists are passionate about the wildlife they study and try to protect, it would be difficult to believe that they would state that caribou have these types of feelings. The objective nature of scientific study and the general idea of conquering nature rather than being equal to it would make an acknowledgment of an animal's feelings difficult if not impossible for a Eurocentric scientist, especially to publish within a peer reviewed publication.

Discussion.

The results show that metaphors are critically important in both Indigenous and Eurocentric sciences. Metaphors will appear in both the paradigmatic and narrative modes of thought and even though they might be used in slightly different ways, it is clear that they are an important component in the construction of knowledge. Metaphors then contribute to interdiscursivity (Fairclough, 1992; Scollon, 2008) and are actually an important opportunity for

different cultures to come together through discourse, as they show how discourses can be interconnected, crossed referenced, and incorporated into one another. So while much of the discourse of Eurocentric science and Indigenous knowledge may appear different, it may be through metaphor that border crossing can be initiated, as both cultural groups value metaphor usage greatly.

Metaphor helps construct a conceptual system that is influenced by cultural assumptions, but if a metaphor goes against the mental models held by the listener then it becomes more difficult for the metaphor to reveal its culturally laden value. That is, when people face an unexpected event that violates their currently held mental model, then our nervous system reacts a way that tries to adapt to the new experience being confronted. As Bruner would say, "If what impinges on us conforms to expectancy, to the predicted state of the model, we may let our attention flag a little, look elsewhere, even go to sleep. Let input violate expectancy, then the system is put on alert" (Bruner, 1986, p. 46). When a person with a Eurocentric view of science is exposed to the idea of caribou not only having feelings, but having the ability to react to mistreatment and relay that mistreatment to other caribou so they collectively react, would likely violate the mental model held by that scientist. However, the exact same story told to a person familiar with other ways of knowing would easily accept the story as truth. The value of understanding metaphor then becomes an ability to not only comprehend what the metaphor represents but to appreciate the cultural laden components of it as well.

People and animals

How mental models affect human and animal relationships.

As shown above, the metaphors that contribute to the construction of mental models for Aboriginal people are easily revealed when discussing animals. For the barriers between cultures to be crossed it is important for Eurocentric scientists and science educators to truly pull themselves out of their own mental model and attempt to understand relationships between people and animals differently. As this research is focused on discourse regarding caribou hunting in northern communities, it is important to understand the connection between animals and Aboriginal people. For example, the Dene "think of a powerfulness inherent in plants, animals, or other substances, which can affect human beings knowingly or unknowingly. This powerfulness can be tapped by human beings to change the course of events in their lives or the lives of others" (Goulet, 1998, p. 60). The connection that the speakers have with the animals is revealed through the discourse and shows how "Aboriginal peoples of the North American Arctic and Subarctic do not make as rigid a distinction between human and animal as do most Euro-North Americans" (Nadasdy, 2003, p. 83). The Dene see animals as having superior powers to those of humans and "One can never demand or take what is up to the animal to give freely. Humans cannot coerce other-than-human people to act in a certain way. At best, Dene Tha must treat the animals with respect, and then the animals will make themselves available again as game or will choose to whom they will give leftover powers" (Goulet, 1998, p. 63).

How the Elders speak of animals.

The Elder Steven attempts to explain this perspective when he describes the governing role that Aboriginal people play in caretaking for all of the animals, not just the caribou.

> You know, native people were self government before white people. Before white people they were self government, they look after everything: Wildlife, fish, fur animals, their land, with respect for the land. They don't try to kill everything in one part of the country that -- on the land there. They -- they know it's getting less, they go to the other part. They don't stay in one place for years and years 'til they kill everything. Even the fish Lakes too, they keep moving, they're like animals the native people (Elder Steven, November 21, page 77-78, lines 1925 and 1-3).

The connection between people and animals is particularly strong in his last statement (page 78, line 3) when he states that the native people are like the animals themselves. From a Eurocentric perspective, comparing people to animals may be seen as an insult, as the metaphor would imply that the people are uncivilized or unsophisticated. However, from an Aboriginal perspective, the implications are deeply rooted within their culture and the metaphor is used to show how similar and connected the Aboriginal people are to the animals on the land.

As a result, there is a great respect for animals who are "seen not only as game but as powerful, sentient beings who freely go out of their way to contact humans to give them a power or information that they would otherwise not possess" (Goulet, p. 62). This view of animals as sentient beings can be found in the discourse of the oral narratives of the Aboriginal speakers. Elder Peter speaks to how the caribou know the land and the country just as the Aboriginal people do, even referring to a certain area as "home":

1 They're going home, eh. We see that, can't believe
2 they're all going home and these caribou they're going
3 towards Colville Lake. You see that? They don't go to
4 each other, no, they know their own country. That's the
5 way they were (Elder Peter, November 21, page 87, line 1-5).

The idea of animals freely choosing to contact humans is another concept that is unfamiliar in Eurocentric sciences. For example, there is a Dene story that speaks of a special medicine man who received a pipe from a caribou leader who promised the medicine man could call upon the caribou leader when the people were starving. If the medicine man smoked this caribou pipe "then the leader would appear to him and tell him where the herds were, or bring them near the starving people so they could hunt them" (Blondin, 1997, p. 187).

The Elder Laura speaks of the leader of the caribou herd as well. Her reluctance to even speak of caribou demonstrates her respect for the animals and she believes that the leader of the herd will know when it is being talked about.

10 My father also said that the leader of the

11 -- the herd if that's the one, if you talk about it --

12 that one -- even it -- even that it knows. If we talk

13 about how we're going to hunt them, all those kind of

14 things, they know about it (Elder Laura, November 22, page 117, lines 10-14).

In addition, there exists a spiritual connection to caribou on the land because of its importance to the community as food. Traditional songs, ceremonies, and rituals have existed in North America for more than 10,000 years and these rituals "were founded upon an intimate understanding of the behavior of the animals hunted, a respect for their life needs and for the ways those animals should be properly used and treated" (Cajete, 2000, p. 159). Relationships like these "formed the basis for an ecological ethic of such a depth and intimacy that it continues to have a profound impact on contemporary Indigenous people" (Cajete, 2000, p. 159). It is clear through the discourse of the narratives here that the speakers all possess this sense of ecological ethic. For example, Elder Diane describes the respect that is taken even after the caribou has been killed:

21 -- my mother would tell me, I'm

22 going to teach you how to work properly on food. And if

23 people are transporting meat or transporting food on the

24 roads, she told me not to walk around that area; that's

25 how much they respected food back then. They took great

1 care that wherever meat and that was transported, we

2 didn't just walk on those trails (Elder Diane, November 22, page 136-137, line 21-25 and 1-2).

The social relationship between people and animals.

It is believed in Aboriginal culture that in distant time the boundaries between animals and humans were not as defined and distinct as they are today, and although this is no longer the case there exists a social relationship and intimate bond between animals and human beings (Goulet, 1998). While Eurocentric scientists often regard themselves as observers of nature, the Dene of Northern Canada consider themselves as "people of the land; we see ourselves as no different than the trees, the caribou, and the raven, except we are more complicated" (Blondin, 1997, p. 18). This view is clearly evident in the narrative of Elder Timothy who speaks of the land as a living entity which is shared amongst people and the animals:

6 And that's
7 something my grandpa talks about. The land is a living
8 thing. If you don't use the land, it's not alive. So
9 the caribou knows that. He knows you have to live off it
10 to survive out there (Elder Timothy, November 22, page 61, line 6-10).

The treatment of animals, not only in how they are hunted, but how they are respected as sentient beings, are lessons that are shared throughout the Aboriginal community. In the below example, Elder Daniel tells of an incident where a child hit a caribou with a stick and the caribou, as a collective group,

moved away from the people for a period of four to five years. This shows how the caribou are seen as beings that choose whether they want to give themselves to the people or not.

> 25 Back in 1942, 1943 from back that time
> 1 there were five (5) years or four (4) years that were the
> 2 -- there was no caribou because of a child that had hit a
> 3 caribou with a stick and for four (4) years there were no
> 4 caribou after that. And after that the caribou start
> 5 moving back and to this day the -- the patterns have been
> 6 -- remain the same. And it's still the same (Elder Daniel November 22, page 113-114, line 25 and 1-6).

Eurocentric perspective of animals.

While Eurocentric science focuses on quantifiable caribou population models, population counts and predictions, the Dene possess a relationship with the caribou that is built upon a delicate balance between the need for food and respect for the animal. This type of association with caribou explains why Aboriginal people may be defensive with Eurocentric science researchers that come on to the land to study caribou. John Sandlos (2007) provides a detailed and thorough historical account of wildlife management within Northern Canada and sheds light on events that led to the introduction of caribou management in the Arctic and subarctic. He recounts the history of caribou hunting through examination of the reports produced by early naturalists, hunters, and government officials from 1870 on. From the early 20th century, Euro-Canadians viewed

Aboriginal hunters as barbaric and wasteful, which led to the implementation of legislation by government officials who felt it was their responsibility to impose hunting restrictions on Aboriginal People. Sandlos provides important historical knowledge that must be understood and taken into consideration when evaluating current caribou hunting practices. According to Sandlos, we should not ignore the events of the past that led to the present situation because "the free-roaming herds of Northern bison, caribou, and muskox may have survived to the present day, but so too has the memory of wildlife conservation as a projection of federal government power over both humans and nature in the Northwest Territories" (Sandlos, 2007, p. 244).

The Aboriginal speakers' view on hunting is also revealed through the discourse and shows that the historical portrayal of Aboriginal hunters as barbaric or wasteful is truly inaccurate. For example, Elder Richard speaks to the fact that caribou are shot in a way does not let them suffer:

> 13 And myself, since I was a young person, I
> 14 have travelled to go hunt caribou. And not once, all the
> 15 people that hunt, I have never witnessed a person
> 16 shooting caribou in the neck. And I've seen many
> 17 caribous being shot, but I've seen -- I never heard of a
> 18 caribou neck getting shot (Elder Richard, November 22, page 82, line 13-18).

The people and animal relationship in the Aboriginal way of knowing is one of a deep-rooted respect that is highlighted by equality and reverence. Even

though the technology for hunting has changed (i.e., using skidoos rather than dogsleds), the belief that the animals are sentient beings remains. It is unclear at what point Eurocentric science changed its view of animals from being equally sentient beings to lesser beings to be used for study or as commodities. However, this is an area that Eurocentric science could truly learn from an *other* way of knowing. If Eurocentric scientists and other members from Eurocentric cultures were to have the same level of respect for animals, there would unlikely be a need for wildlife management boards, because the animals would be revered as cultural icons that commanded respect and would be treated in a ways that would ensure their existence.

Discussion.

Perhaps the most discernible difference between the mental models held by the scientists and the mental models held by the Aboriginal speakers is the difference in how they express the relationship between people and animals. One might think that scientists, particularly biologists, would have a similar view of animals as sentient beings, and in fact they might. However, if the scientists do view animals in a similar way, those impressions were not shared during the discourse of the public hearing. There is no doubt in the mind of this researcher that scientists, biologists in particular, also share a deep respect for animals. How that respect is communicated could play an important role in the crossing of borders as it would show a common concern and provide a chance for the two cultures can come together on a shared topic. The Aboriginal speakers were very articulate and open in sharing their perspective on the caribou as co-inhabitants of

the land and had the scientists shared a similar perspective, it may have gone a long way in bridging the borders between them. Unfortunately, the language used by the scientists did not contain the same type of connection between people and animals as was described by the Aboriginal speakers. Through their narratives we are offered a unique perspective on the relationship that they experience with the caribou and the narrative becomes a wonderful opportunity for knowledge sharing.

Narrative Sequence

Basic structures of narrative.

Narrative analysis begins with understanding the basic structures that create a more complex narrative and Labov and Waletzky (2003) believe "that such fundamental structures are to be found in the oral versions of personal appearances: not the products of expert storytellers that have been retold many times, but the original production of a representative sample of the population" (p. 74). Narrative sequence adds structure and is "what gives narratives *coherence*, that is, an orderly flow of information that makes sense to the listener" (Hudson & Shapiro, 1991, p. 93). While Fairclough's influence recognises the relations between types of discourse, narrative sequence is the structure that contains the discourse. As such, the oral narratives of both the Aboriginal and scientific speakers in this study provide an excellent opportunity to try to examine important narrative components. A key component of a narrative analysis is the narrative sequence itself, which is simply the order or manner in which a narrative is constructed. Although the concept may be simple, the resulting structures are

anything but. Variation in narrative sequence between the two cultures can be another factor that makes collaboration difficult, and is a distinguishing difference between Aboriginal and scientific oral narratives. The narrative mode of thought is made evident through the presentations of the Aboriginal speakers and can be viewed from the perspective of a sociolinguistic narrative or "story-telling" point of view (Labov, 1997). Labov found that tellers were often ordinary people whose narratives "were an attempt to convey simply and seriously the most important experiences of their own lives. Sometimes the stories had been told many times, but very often they had not been, or were perhaps told for the very first time" (p. 396). This method of storytelling is evident within the presentations of the Elders and highlights the need for a deeper cultural understanding of its importance. Although this analysis does not attempt to describe narratives using the detailed analytical frameworks developed by Labov and Waletzky's (Labov & Waletzky, 2003; Labov, 1972; Labov, 1997), it does highlight how speakers from different cultures employ varying methods of narrative techniques. Although Labov and Waletzky's contribution to narrative research is significant, their work is reliant on the fact that there has to be a chronologically ordered structure which matches narrative clauses to events. Aboriginal speakers, often speaking metaphorically or through the use of stories, rely on narratives as an important cultural sharing of knowledge and will often "invoke the past to talk about the present and the present to talk about the past" (Cruikshank, 1998, p. 2). Most discourse analysts who focus on Eurocentric speakers believe there to be a strict frameworks in place during storytelling. For example, Stubbs describes the narrative organization of

stories as having both descriptive and methodological components in which descriptive stories in conversation "have recognizable and describable beginnings and endings" (Stubbs, 1983, p. 25). He describes transcribed talk as possibly looking chaotic at first, "But on closer study, [speakers] turn out to be telling a story which is highly constrained, conventional sized and ritualized…" (p. 26). Of interest here then is whether or not the Aboriginal speakers have these descriptive elements or employ an alternative methodology that is difficult for Eurocentric listeners or readers to comprehend.

Elder narrative structures.

Many of the narrative structures of the Elders' presentations were, for the most part, logical and somewhat sequential. That is, they followed a main line sequence that started in the past, moved toward the present, and then discussed the future. A narrative sequence that is chronological in order also helps to develop the concept of causality, where the cause precedes the effect (i.e., A causes B) (Leon & Penalba, 2002, p. 165). For example, Elder Kristina explains that caribou are important because "The Creator made it for us on this land, and he put it on this land for us to use for food" (Elder Kristina, November 22, page 108, line 22-23). Thus the creation of caribou (cause) is for use as food (effect). Following Bruner's narrative and scientific modes of thought, Leon and Penalba believe that in narratives "it is easy to make a mental model, because the reader [or listener] has plenty of background knowledge and knows the temporal framework in which the sequence of events is structured" (p.171). In other words, narratives usually exist in chronological order because it is believed that we more naturally

understand causal relationships when they occur in an antecedent-consequent structure. For example, Elder Alan's narrative begins with a historical recounting of life on the land and makes reference to the speaker's grandfather. In his opening statement he begins the timeline by not only relating his first encounter with caribou hunting, but he specifically states what year it occurred in.

> 20 In 1947 -- that's the first time that I
> 21 shot two (2) caribou -- that was in 1947 -- and since
> 22 then we've been going out on the land (Elder Alan, November 22, page 128, line 20-22).

Next, the Elder speaks of the amount of time that they have spent on the land and how as a result, they know all about the wildlife on the land: "all of their habits and everything else -- we know all about it" (Elder Alan, November 22, page 129, line 5-6). This continues to follow chronologically and maintains the cause and effect structure in that the experience on the land (cause) has led to knowledge of the animals (effect). Furthermore, it brings the speaker, and thus the listeners, into the present.

However, the Elder's narrative next contains a phenomenon that Hill (2005) describes which departs from the main line of action and is referred to as a "flash" (p. 162). In this case, they appear to be flash "backs", in that the speaker jumps back in time to an incident from the past. He does this by once again stating a date from the past "And in 1947 -- since 1947 -- that's just about sixty (60) years that I've been living on the land" (Elder Alan, November 22, page 129, line 9-10). He then provides a brief explanation of his grandfather's view on wildlife, and

shares the lessons that he learned from him, which is also an event from the past. Then, Elder Alan moves back to the present by cuing us with the phrase "What we are talking about now is wildlife" (Elder Alan, November 22, page 129, line 19). The Elder has now brought the listener into the present and speakers of Eurocentric languages, particularly those that are speaking in scientific narratives, would expect the remainder of the narrative to either stay in the present or progress to the future, however, the narrative changes temporally at this point as the Elder returns once again to a time in the past and has also moved spatially to another area:

> 19 And there was people that were from
> 20 -- from Arctic Red River. He was talking about – this
> 21 Elder Nab Norbert (phonetic) -- he was talking, and he
> 22 was talking about these tags that they were putting on
> 23 the animals. (Elder Alan, November 22, page 130, lines 19-23)

While this may be disconcerting and hard to follow for speakers of English, "social memory" exists within both a spatial and temporal context re-told as speakers relive their life journeys through both space and time. The Elder's narrative is similar in construction to the Anishinaabe people described by Davidson-Hunt and Berkes:

> The practices, moons, seasons, and ceremonies that mark the passing of diurnal, yearly, and life stages often structure the journey temporally. Spatially, the paths of travel link places that can be revealed and described as they are encountered (Davidson-Hunt & Berkes, 2003, p. 12).

Elder Alan continues to recount spatially related stories that contain no reference to time, but only to place. This fits well with Davidson-Hunt and Berkes' idea of "learning as you journey" (Davidson-Hunt & Berkes, 2003, p. 3), in that they believe that journeying on the land is "not in the sense of passing through, but in the sense of traveling and re-traveling in an area, such that an intimate relationship with the land is developed" (p. 3). For example, Elder Daniel says:

7 And one time back in how many years when I
8 went out to the barren lands where the people -- the
9 caribou I saw it run and there was lots of caribou that I
10 saw. And from the one end and it over the land I was
11 trying to see how far they come and it -- I just couldn't
12 see the end of the herd. And it won't go away
13 completely. And when they come down to Colville Lake
14 they kind of split up the herds. And where Gabriel
15 there's living at Loche Lake it's coming to that area
16 now. (Elder Daniel, November 22, page 114, lines 7-16)

We are given a clue that Elder Daniel is recounting an event from the past because the first clause opens with "And one time back in how many years". Interestingly, he does not state how many years, but rather refers to where the event took place with the clause "I went out to the barren lands". He then recounts his experience with the caribou on the land during that time period and describes how the caribou split up the herds as they approach Colville Lake, another reference to space

rather than time. And finally, the recollection of his journey becomes complete as he brings his narrative to the present day, but we only know this because he states that "now" the caribou are "coming" to Locke Lake, to a place where Gabriel lives (another spatial reference). The recounting of the story appears to occur in association with traveling the land as opposed to temporal timescales with the result being that the "stories link human history to place" (Cruikshank, 1998, p. 18).

Another Elder, Laura demonstrated a very similar approach during her narrative. Laura begins her narrative making reference to a spatial journey by saying:

> 22 When
> 23 -- when we -- we go to Horton Lake it's not only by the
> 24 lake that they migrate, it's on both sides, because it's
> 25 the barren lands is a big area. (Elder Laura, November 22, page 116, lines 22-25).

Her statement, cued by the spatial reference to Horton Lake, reveals her knowledge of the movement that caribou make near the lake and although she is speaking about when they travel to the lake there is no reference to time or to when she made these observations. Elder Laura seems to be recalling the experience spatially rather than temporally. In the paragraph that follows, the Elder flashes back using a temporal reference by remembering the words of wisdom that she learned from her father and her grandfather as she recalls what they taught her about speaking about caribou. The subsequent paragraph again

refers to the space that is occupied by caribou when the Elder states "they only go to where it's good for them on the land" (Elder Laura, November 22, page 117, line 16). The switching between spatial and temporal references occurs throughout Laura's brief narrative and the wisdom she possesses is revealed through her own experience and through the wisdom that was shared with her by her father and grandfather.

The following excerpt by Elder Darren is an excellent example of how Elders recall their stories spatially rather than temporally. Even though he begins with the phrase "But one time" the remainder of the narrative piece relies on recollection of spatial elements.

6 But one time, I was walking on -- off
7 hunting and there was a place where there was an opening
8 and way off there was a place where it just looked like
9 the snow was blowing and so with my children, we went in
10 that area when we were off hunting.
11 And where that wind was blowing, we went
12 into that direction. We could see the caribou tracks and
13 as we were going to that -- getting closer, we could see
14 on top of the trees, there was a helicopter flying over
15 that area. (Elder Darren, November 23, page 52, line 6-15).

The detail in which Elder Darren is able to recall events from spatial connections is much greater than we would expect to find in Eurocentric narratives. The blowing snow that he witnessed ended up being a helicopter flying over the area,

but his recollection of the experience was clearly spatially connected rather than temporally.

Hill suggests that we could better understand culture by attending to "such structural units and, especially, to apparent deviations from what would be predicted by the general theory of narrative" (Hill, 2005, p. 167). In other words, Eurocentric language speakers may be unaccustomed to changes in timelines during oral narratives and as a result may miss important information or messages contained within the narratives. A characteristic that makes narratives of interest is they can impose "a discursive order on events and observations that, in themselves, have no particular coherence and may even seem unintelligibly cruel" (p. 160), particularly to a listener with a Eurocentric scientific mode of thought. As such, scientific or paradigmatic thought follows a formal and logical system of description that may rely on familiar stories to help fill in gaps of knowledge until the stories can be replaced when the causes for them have been determined (Bruner, 1986, p. 13). As a result the story is replaced with scientific evidence with the end goal of obtaining empirical truth, and thus the language used "is defined not only by observables to which its basic statements relate, but also by the set of possible worlds that can be logically generated and tested against observables" (Bruner, 1986, p. 13).

Scientist narrative structures.

As evidence of the paradigmatic mode of thought we can see that the scientists create their oral narratives in quite a different manner. They employ categorization, conceptualization and operators to establish a system that connects

one idea to another in a formal and logical way (Bruner, 1986, p. 12). The scientists are far more likely to follow Labov and Waletzky's (2003) classical structure of a personal narrative, by reporting primarily in the past tense and using a variety of structural components that organize narratives.

My name is Ms. Marcy, and I live in Yellowknife, I am Director of Wildlife with the Department of Environment and Natural Resources. I would like to introduce the other staff that we have here today.

...

Our presentation will probably take about forty-five (45) minutes, and will cover the following areas:

How are barren-ground caribou herds defined;

Why are herds the basis for management;

What information is collected to track the population cycle;

What other factors affect individual herd size;

What do we know about the harvest of Bluenose-West Caribou?

What have we heard at meetings and

16 workshops in the last two (2) years; and we'll also talk
17 about different levels of harvest and other management
18 actions that have been taken in other areas.
19 The Panel will take turns making this
20 presentation, so, you will hear from all of us.
21 The land claim agreements make reference
22 to developing management actions and plans for individual
23 caribou herds. For example, the Sahtu Dene and Metis
24 Comprehensive Agreement refers to preparing a management
25 plan for Bluenose Caribou (Ms. Marcy, November 21, page 17-18, line 12-25 and 1-25).

Again, it is difficult to use Labov and Waletzky's framework precisely because these are not personal narratives in the sense that the scientists are telling stories, rather they are doing presentations of scientific material, which is not exactly the same experience. However, many of the structural components still seem to apply. For example, *orientations* direct "the listener in respect to person, place, time, and behavioral situation" (Labov & Waletzky, 2003). Ms. Marcy introduces herself and her colleagues and begins her oral narrative by providing an estimation of how long the presentation will take. She then gives an overview of five questions that will be answered during the presentation, similar to the *complications* of personal narratives that are leading up to the main event. Following the introductions, the scientist then provides background on when and where the data for their research was collected by stating "What have we heard at

meetings and workshops in the last two (2) years; and we'll also talk about different levels of harvest and other management actions that have been taken in other areas" (lines 15-18). In other words, this information provides the *cause* in the cause and effect relationship. Next, reference to the land claim agreements that justify the research being done are presented to show the need for "developing management actions and plans for individual caribou herds" (lines 22-23). Labov and Waletzky (2003) believe that for a personal narrative to be complete it needs to have a high point or *evaluation*, otherwise, it makes narratives difficult to follow. The lack of high points within the presentation of the scientists is what distinguishes them from true personal narratives and maybe one of the reasons that listeners that do not possess a Eurocentric scientific background may find them difficult to follow, particularly listeners that are used to a personal narrative form of knowledge sharing. Likewise, the oral narratives of the scientists seem to lack *resolution* (i.e., resolving any complications) and *codas* (i.e., closing the story and bringing it to the present) described by Labov and Waletzky (2003).

Further evidence of the scientist's use of categorization however, can be revealed explicitly through the discourse by observing the specific linguistic elements that are selected to either organize the discourse or reveal the speaker's stance towards its content. These discourse elements, called metadiscourse, are divided by Hyland (2004) into either textual metadiscourse (which is used to organize information so that an audience will find it coherent and convincing) or interpersonal metadiscourse (which expresses a speaker's or writer's perspective towards their propositions and listeners or readers) (Hyland, 2004, p. 112). The

scientist utilizes a type of textual metadiscourse that Hyland refers to as *frame markers* which "signal text boundaries or elements of schematic text structure" (p. 112). For example, when discussing the movement of caribou that have been followed she uses the frame marker "And in the last ten (10) years" (Ms. Marcy, November 21, page 19, line 25) to signify the sequential order of events that have taken place in her research. The sentence that follows opens with another frame marker “To date” (November 21, page 20, line 3) which signals to the audience that she has now moved to the present time and has included all information up to that moment. Ms. Marcy also uses the frame markers "first" and "second" to begin sentences to explain why they manage caribou by herds. Although these frame markers are not necessarily in a temporal sequence, they are still used to organize the discourse as presented. The textual metadiscourse selection along with the temporally sequential framework strongly supports the paradigmatic mode of thought presented by Bruner (1986) because it connects the thoughts in a way that a Eurocentric science speaker would see as formal and logical.

Frame markers.

The next question then is; do the Aboriginal speakers also employ the use of frame markers? In fact, it appears they do, although as with the narrative sequences discussed previously, it seems that they do not follow a sequential timeline. For this analysis, a piece of narrative from the Aboriginal speaker, Elder Diane, was selected and analyzed in detail to identify all of the frame markers used within a 753 word excerpt. Her narrative was not selected randomly, but was

chosen on the fact that it appeared representative of the Aboriginal speakers as a whole.

What is interesting about Elder Diane's narrative is that it does contain identifiable frame markers (see Table 7), even though the frame markers are not as definitive as those used in scientific discourse (i.e., they are not as identifiable as first, second, third, etc.). But what is even more interesting about the frame markers used is that they are also good indicators of how the speaker moves back and forth from past to present in a very non-sequential way, yet the frame markers give the listener an indication of the movement between past and present. This is indicated in the column entitled "Timeline" in Table 7. The frame markers are recorded in sequence of how they appeared in the transcripts, and as you can see, the movement from past to present happens throughout the excerpt in a consistent way.

Table 7. Frame markers for Elder Diane.

Frame Marker	Page	Line	Timeline
At first	136	5	Beginning
Right from when I was little	136	8	Past
And now	137	15	Present
And when I used to live here	138	1	Past
...but now	138	3	Present
...right away I went back	138	10	Past
And now I live like that	138	12	Present
And recently	138	17	Near Present
Total	**8**		

Although frame markers appeared to be equally abundant in both the narratives of the Aboriginal speakers and the scientists the use of another textual metadiscourse item, *logical connectives*, are far more abundant in the discourse of

the Aboriginal speakers. Logical connectives are defined as "mainly conjunctions and adverbial phrases which help readers to interpret pragmatic connections between ideas by signalling additive, resultive and contrastive relations in the writer's [or speakers] thinking" (Hyland, 2004, p. 112). Elder Diane uses them extensively, particularly cued by the conjunction "*and*" and even though they are often used within the sentences to show the relationship between main clauses she also uses them at the beginning of sentences, presumably with the intention of connecting ideas together (see Table 8) rather than elements of sentences. In this way her narrative becomes connected and maintains a continuous flow, even if the narrative sequence does not follow a chronological ordering.

Table 8. Logical connectives for Elder Diane.

Logical Connective	Page	Line
...but I've been living	135	25
...and I just ended up staying	136	1
And also	136	2
...and they told me	136	3
...and I wanted	136	4
...but after thinking about it	136	6
...and so my mom	136	9
And because	136	13
And the big animals	136	16
And if people	136	22
And my mother many times	137	3
...and he would	137	4
...and he'd come	137	5
...and she'd say	137	7
And how my mother	137	9
And she told me	137	11
And I grew up	137	13
...and that's how I lived	137	13
...and they are like me too	137	14
And for me	137	19
And those people	137	22

...and I'm really thankful	137	23
And I thought	138	6
But if I wanted to live there	138	9
And I didn't forget	138	10
...and I thought	138	12
And when they	138	13
And I went	138	19
...and I went again	138	20
And the men go off to go	138	21
And they also	138	24
Total	**31**	

Another scientist, Mr. Brian, demonstrates the difference between narratives that utilize spatial descriptions versus those that use primarily temporal ones. At first glance, the below excerpt appears to make spatial references similar to those used by the Elders, but a closer analysis reveals that although the references to spaces are made, each is still associated with a very specific time that follows a clearly chronological framework. Notice that each spatial element is connected to a temporal element:

In October and November I went with Sahtu board members or staff to all Sahtu communities and schools. The results of what we heard at the meetings, both the comments and the suggestions for management actions, were presented by the executive director to the Sahtu board in February 2006. After the 2006 counts, we repeated the meetings in communities and schools.

The next set of slides show what was heard at meetings in Inuvialuit, Gwich'in, and Sahtu

7 communities in 2005 and 2006. (Mr. Brian, November 21, page 31-32, lines 23-7)

Discussion.

Narrative sequence, that is, the order or manner in which a narrative is constructed, appears to vary between the Aboriginal speakers and the scientists. The Aboriginal speakers, who are embedded in the narrative mode of thought, often follow chronological order as would be expected by other modes of thought. However, they appear to relay their stories as they recount their own personal journeys in both space and time traveling on the land. As such, it can be difficult for speakers that are used to a chronological approach to follow. The flash backs described also indicate another difference in narrative sequence that could make communication between the two cultures challenging. This approach, compared to the scientists approach that utilizes categorization and strict chronological ordering.

The use of textual elements, called metadiscourse, is apparent in both the discourse of the Aboriginal speakers and the scientists. Although the Aboriginal speakers' use of frame markers are not as easily identifiable as is with the scientists, they highlight once again how the speaker can move back and forth between past and present. In combination with the frame markers, the Aboriginal speakers also use logical connectives that help them relay their story by connecting ideas together.

The narrative sequences created by the Aboriginal speakers and the Eurocentric scientists uncover differences in construction that are clearly

culturally embedded. The above examples exemplify how different mental models can be revealed through the study of the sociology of the language and how, once again, different cultures need to be aware of the differences in language use in order to truly respect and understand the knowledge that is being shared within a public forum.

Chapter Six: Curriculum Reconceptualization

Where the Journey Led

The findings shown in Chapter Five originally formed the bulk of the content of my thesis. But as I performed the research and became intimately tied to the data something very special happened. I found that I began to question and challenge some of my own beliefs, which were admittedly dominated by the paradigmatic mode of thought. Although I believed I was open-minded to other ways of knowing there was still a part of me that was reluctant to accept certain pieces of knowledge that challenged my own mental models. But the more I read and the more I researched on topics that dealt with Indigenous knowledge, the more I realized that I had begun my own journey of learning.

It was at that moment that I realized the connection between my interests in reconceptualizing how we approach curriculum and the autobiographical narratives of the Aboriginal Elders. It became apparent that autobiography was a pedagogical approach that very effectively opened my eyes to a whole new world of knowledge and interests. Although the Elders were not speaking to me directly (because their audience were the people present at the public hearing) their

autobiographical approach spoke to me in very meaningful ways. This led me to the work of curriculum theorists who believe autobiography to be an important tool for curriculum reconceptualization.

As a result, this chapter was created based on the findings from Chapter Five combined with my desire to investigate ways to lessen the turbulence between borders. I begin with the review of how borders are created followed by an explanation on why it is important to acknowledge those borders and the events that led to their existence. By sharing my own personal autobiography I believe I offer a means to show how autobiographical narratives can assist in border crossing and reducing turbulence. A review of the work of the reconceptualists that developed autobiography as curriculum reform is then provided and the connection between the Aboriginal Elders' autobiographies and autobiography as curriculum reform is made. Finally, an in-depth analysis of the Elder autobiographies is performed and the framework categories that are derived from their narratives are examined.

Borders

Few Canadians would have difficulty in describing Aboriginal groups in Canada as a distinct culture. Possessing distinct languages, history, artists, heritage and traditions makes it is somewhat easy to define them as discrete cultures. However, fewer Canadians might recognize that the scientific community is also a distinct culture. With its own way of discussing, publishing, relating and engaging in research, "science can be thought of as a culture with its own language and conventional ways of communicating for the purpose of social

interaction within the community of scientists" (Aikenhead G. , 2001, p. 24). It possesses its own set of values and even when scientists are knowingly trying to simplify the jargon and terminology when communicating with another culture they must "be aware of the values and norms that are potentially inherent in the language conventions of scientists (their discursive practices)" (Aikenhead G. , 2001, p. 27).

As a result, when two cultures work together with a common theme in mind, it is imperative that the differences in the cultures does not hinder or impede cooperation. But crossing a border into a cultural group that not only has a different language but an entirely different way of knowing can be a sizable task. In the case where the two groups congregate to share experience and knowledge it is critical to understand that they are coming from two different cultural perspectives. For example, Aikenhead (2001) identifies Aboriginal and Western science as having different social and intellectual goals. He feels Aboriginal science tends to be concerned with the survival of people and co-existing with nature, while Western science is often more concerned with the gaining of knowledge for power and the explaining of nature. Furthermore, subjective, interrelated Aboriginal science differs from objective, decontextualized Western science "in other ways as well: holistic Aboriginal perspectives with their gentle, accommodating, intuitive, and spiritual wisdom, versus reductionist Western science with its aggressive, manipulative, mechanistic, and analytical explanations" (Aikenhead G. , 2001, p. 32).

Acknowledging the past.

One of the first steps in trying to foster border crossings is to understand and acknowledge the events that led particular cultures to where they are in the present. There is a significant body of work that highlights the differences between Aboriginal (or traditional) knowledge and scientific knowledge. Nadasdy believes that "one cannot examine the question of traditional knowledge for long without being confronted by a barrage of such dualistic comparisons (often arranged neatly in the table) purporting to sum up the differences between traditional and scientific knowledge" (Nadasdy, 2003, p. 117). Although these differences are real and need to be understood in order for a sharing of knowledge to occur, the borders that exist between the two cultures possess a much deeper history. According to Dussel's concept of transmodernity, one can elicit a self-realization that acknowledges the "other" through acceptance of the hegemonic oppression of colonialism and capitalism (Dussel, 2000). Acknowledgment of this type might be required to understand how colonization and Eurocentric science have created a power structure that can challenge even the best of intentions when working between the two cultures. What is often forgotten, or not realized, by Eurocentric scientists is that the language that they speak is rooted in power and dominance. Management practices for wildlife in Canada's North means that Aboriginal peoples must learn to speak the language of wildlife biologists, administrators, and lawyers, if they wish to become part of a co-management process, but doing so immediately puts them at a disadvantage and "by agreeing to play the "rules of the game," First Nations peoples tacitly acknowledge the

legitimacy of that game, thus taking for granted the unequal power relations within which they are embedded" (Nadasdy, 2003, p. 6).

John Willinsky's work provides us an ethics of accountability that "concerns the significance of such divides as East and West, primitive and civilized; it concerns how the world has been constructed around centers and margins, and how these divisions were bolstered through forms of scholarship supported by imperialism" (Willinsky, 1998, p. 16). His views provide us an insight on how to remove, or at least minimise, the effects of borders by addressing and acknowledging the World's history and the conflicts that have brought us to where we are today. If we therefore recognize and acknowledge not only the events that led to a dominant Eurocentric society, but also come to a realization about the structure of the management practices in Canada's North, then it may make border crossing a more realistic ambition.

Acknowledgement of the histories that have led to the creation of borders may assist in minimising some of the effects of colonialism, as it has been shown that Aboriginal Peoples have managed to preserve their culture while adapting in their dealings with the Euro-Canadian society. Aboriginal Peoples have adapted by being able to "continue to use the very cultural meanings and practices they are trying to "preserve" as a basis for interpreting and acting upon the world - including in their interactions with Euro-Canadian people and institutions" (Nadasdy, 2003, p. 3). As a result, Aboriginal Peoples have learned to accommodate and adjust to colonial influences and it should be the goal of educators to incorporate a culturally responsive approach that includes a

“both/and” rather than an “either/or” methodology (Brayboy & Castango, 2008, p. 788). Willinsky (1998) believes educators must acknowledge and address the impact of previous generations that have brought us to where we are today and that the young are owed “an account of the historical divisions out of which we have fashioned ourselves as educated people, even as we work together to move beyond our current understanding of an inexorably divided world” (Willinsky, 1998, p. 20). It is only though acceptance of our current state of affairs that multiculturalism can truly flourish through an understanding of world histories and their relationships to one another. Addressing the history of capitalism and colonialism in terms of a Eurocentric science specifically will help students mitigate borders allowing teachers to “address Aboriginal students’ conflicting feelings toward the culture of Western science, thus making a student feel more at ease with learning and with appropriating that subculture’s content without accepting its values and ideologies” (Aikenhead G. , 2001, p. 341). If the borders are not mitigated, then Indigenous knowledge may become reduced to a lower-status “in relation to the high-status for the natural sciences” (Mueller & Tippins, 2009, p. 13). Therefore, this research is intended to be an opportunity for both Eurocentric science speakers and Indigenous knowledge speakers to not only better understand a culture different from their own, but also an opportunity to take a reflexive look at their own culture to see if there are more effective ways of communicating one's position, personal beliefs, and world view.

While it may offend some involved in education to hear that their experience within a school system is limited or bounded, it needs to be understood

as such so that teachers may appreciate the situation they have experienced and perhaps think about what they might be able to offer as educators to those who have not had the same experience. The educational system has been confined by administrations "by linking the curriculum to student performance on standardized examinations" which means that "politicians have, in effect, taken control of what is to be taught: the curriculum" (Pinar, 2004, p. 2). Teachers may be afraid to face this type of critical analysis because they feel that it degrades teaching as a profession or belittles their brilliant efforts within their classroom, but as Pinar tells us, it has already been degraded, and it is time to re-establish and reconceptualize the teaching profession.

Derek Hodson understands that students can hold a wide variety of ideas and views that can be unique to a multitude of contexts. He calls this awareness of complexity his "personal framework of understanding" and says that within it "students can hold a multitude of diverse and sometimes contradictory views - among them, some entirely erroneous views" (Hodson, 1998, p. 127). The diversity of views results in a much broader definition of what defines "science" and therefore should be investigated within the culture of the individual. In other words, science is not bounded by strictly a Eurocentric history, but can exist is any individual's location, and that location can vary from one person to another. Location in this sense can represent the culture of a community, an area, or an entire country. Cynthia Chambers, in a chapter aptly named *The Topography of Curriculum*, understands very well the concept of location and states "memory and history, both individual and collective, are located in particular places, giving

rise not only to concrete experiences, but local, personal, regional, and national identities" (Chambers, 2003, p. 233). A student's culture is determined by a vast array of factors and students within the same class can be located within multiple cultures. Therefore, learning should have meaning for each individual.

My own autobiography.

As a Métis, I am not intending to be an advocate for Aboriginal rights, nor am I intending to take for granted the benefits that I have received in a Eurocentric culture for appearing outwardly "white". While I have no doubt that our quality of life has benefited greatly because of the advances of Eurocentric sciences, it seems that we are now reaching a stage where those benefits are coming at a cost to the planet. Other ways of knowing may offer Eurocentric scientists a way of reconnecting with Nature that may influence their perspective on our global priorities. In the words of the eminent biologist E.O. Wilson "We have a long way to go to make peace with this planet, and with each other. We took a wrong turn when we launched the Neolithic Revolution. We have been trying ever since to ascend *from* Nature instead of *to* Nature" (Wilson, 2006, p. 13). My hope is to find a balance in the interconnectedness that binds all things together. Historically and presently, I believe the emphasis in education has been placed on the idea of incorporating 'traditional knowledge" into a Eurocentric scientific framework. *Science* should be recognized in all its forms, whether that be Eurocentric sciences or Aboriginal and Indigenous sciences. Perhaps the Eurocentric scientific community can one day also learn from other ways of knowing, rather than just acknowledge them, which may help reduce the

turbulence between the borders that exist amongst different cultures. For example, it has been found that Yukon storytellers of First Nations ancestry have an ability to bring people together and help connect using "narratives to dismantle boundaries rather than erect them" (Cruikshank, 1998, p. 3). The hope for this research is that it will bring an awareness to both Eurocentric and Aboriginal people in ways to calm the turbulence between borders and that this analysis will support both cultures in achieving their shared goal of protecting caribou populations while maintaining the dignity and respect for various ways of knowing.

We are entering a critical time on our planet. Globalization and capitalism have penetrated throughout the world at the cost of our environment and, possibly, our education. It is time to reclaim the curriculum and this can be achieved through the study of curriculum theory and by embracing the "revolutionary potential of becoming a transnational, gender-balanced, multiracial, anti-imperialist struggle" (McLaren, 2005, p. 10). The task that lies before educationists is enormous and no single person or research project will have an impact in isolation. However, the voices of many may slowly create an opportunity for all members of a society to look inward and evaluate those ethics and ideals that are truly important to us during our time on this planet. It is my research undertaking to add my voice to that emerging revolution and reconceptualization.

Autobiographical narratives as a means to border crossing.

The question is then how can we come to realize the differences that create borders between distinct cultures? And upon realizing those differences, what steps can be taken to legitimize them and foster change for the future? Curriculum theory might provide us the answer through a reconceptualization in our current mindset. William Pinar defines curriculum theory as "the interdisciplinary study of educational experience" (Pinar, 2004, p. 2). Examining Aboriginal and Eurocentric scientific cultures is certainly an interdisciplinary event and the broadness of an educational experience certainly encompasses knowledge that can be exchanged between two cultures. While governments, government agencies, and resource management boards continue to try and bridge the borders between Aboriginal peoples and Eurocentric agents, they may find that they are better served by reconceptualizing how they view and share knowledge. Curriculum theory provides an option to not only imagine a different future but also provides strategies for looking inwards and evaluating one's own method of knowledge sharing.

William Pinar's method of currere which was introduced early (Pinar, 1975) and emphasised again more recently (Pinar, 2004) might be our best starting point. The method of currere is described as "a strategy for students of curriculum to study the relations between academic knowledge and life history in the interest of self understanding and social reconstruction" (Pinar, 2004, p. 35). The method's four steps (regressive, progressive, analytical, and synthetical) point to both a temporal and a cognitive mode to help define an educational experience.

These modes are important in this research for two reasons. First, the temporal nature of the steps will help in evaluating both Eurocentric scientific and Indigenous knowledge fields from a global perspective that acknowledges the *others* and the path that brought us into our current state of curriculum thought. Secondly, the cognitive mode is critical as it will illuminate why individuals perceive scientific power as they do. That is, knowing that each individual has their own currere moments, we can more deeply investigate the cognitive and psychoanalytical aspects of past knowledge and determine how that knowledge supports other ways of knowledge sharing. One of the most engaging ideas of currere is that it asks educationists to "consider your position as engaged with yourself and your students and colleagues in the construction of a public sphere, a public sphere not yet born, a future that cannot be discerned in, or even thought from, the present" (Pinar, 2004, p. 38). This public sphere ideally would be inclusive of other ways of knowing and would incorporate, for example, the oral narratives of Aboriginal Elders as their use of oral traditions "speaks to the persistence and adaptability of narrative as a framework for bridging social fractures that threaten to fragment human relationships" (Cruikshank, 1998, p. 24).

Autobiographical narratives help provide a "sequence of ourselves as individuals and as educators [that] might enable us to awaken from the nightmare we are living in the present" (Pinar, 2004, p. 5). Shifting toward a theory of a reconceptualized curriculum that encompasses Aboriginal cultures and Indigenous ways of knowing does more than just include them in a current curriculum, rather,

it introduces an alternative way of thinking that may or may not appeal to thinkers of Eurocentric background. However, the reconceptualization allows for individuals to experience an array of learning methodologies allowing them to choose for themselves which ones become part of their personal method of currere. As a result, learning should have meaning for each individual within a community as opposed to schools that are "preoccupied with priorities, purposes, programs of “intended learning” and intended (or unintended) manipulation" (Greene, 2004, p. 135).

Peter McLaren believes that “the decompression chamber in which [educator’s] pedagogy currently rests must be opened up to a rematerialized critique” (McLaren, 2005, p. 9). This requires all members of a society, not just those directly involved in education, to look outside of the only system they have ever known and redefine their purpose and priorities. Cynics will state the effects of capitalism are too great and to have a significant change within education is too difficult a task. I argue that indeed it may be only through education that a revolutionary social change is possible. Again we find ourselves addressing borders to progressive change, with the effects of colonialism defining the terms in which education is to occur. Curriculum inquiry “serves the important purpose of generating new ways of thinking about the state and its relationship to the production of and possibilities for human agency both now and in the critical years ahead of us” (McLaren, 2005, p. 9).

Grumet (1989) also believes that autobiographical writing for teachers is a tool that will help recover the curriculum. She describes it in three phases with the

initial writing phase inviting people to "recover the world within which they came to be knowing subjects" and to "recover their own intentionality" (Grumet, 1989, p. 15). By this Grumet is saying that autobiographical writing takes thoughts from the world and gives it a tacit place in time where it acquires logic, order, and ethics (p. 15). However, in her view, autobiography is far more than just writing, it also requires a second phase of reading. Grumet believes that "reading autobiography invites its writer to discriminate the particular from the general in her own account" (p. 15). The reading phase allows the writer to differentiate and compare the world that the teacher comes from to the world that the students are experiencing.

The final stage is to critically read the narratives from various perspectives, and it is this stage that is particularly salient for this research. This requires the help of colleagues and fellow teachers and researchers. Autobiography, as a type of narrative, is described by Grumet as "a creature of culture [that] shapes the way we think about our lives and itself distorts our knowledge with assumptions about the storytelling self" (Grumet, 1989, p. 15). Thus, Grumet believes that one of our distortions is that as individuals we tend to keep our thoughts private and "schooling has reinforced the separation of private thoughts from public matter" (Grumet, 1989, p. 15). She gives an excellent example of how students have been taught to write essays objectively and to only "put their own ideas in the last paragraph of the essay, as if they had not been motivating all the paragraphs that preceded the candid conclusion" (Grumet, 1989, p. 15). As will be seen in the autobiographical narratives of the Elders, their

"own ideas" resonate throughout the entire narratives as opposed to just within particular sections.

Autobiography has also been recognized by curriculum theorists as a means to evaluate how Eurocentric cultures have their own histories and the role they played in expanding colonialism. Autobiography allows us to not hide from the truth, but to look more deeply at that history and address it, openly and honestly. From an educational perspective "we must teach what the cover stories hide, exposing and problematizing the "hidden curriculum"" (Pinar, 2004, p. 39). According to Pinar "what is necessary is a fundamental reconceptualization of what curriculum is, how it functions, and how it might function in emancipatory ways" (Pinar, 2004a, p. 154). However, as Pinar points out "there is no *educational* reason why *everyone* must take advanced algebra or chemistry or study Shakespeare. Nor is there any educational reason these subjects must be kept compartmentalized within aggressively patrolled disciplines" (Pinar, 2004b, p. 227). The reconceptualization of Eurocentric science requires us to critically examine why we impede scientific thought by promoting only a Eurocentric curriculum. True scientific inquiry should be allowed to occur based on the histories, moments of currere, and interests of the individual, not on the interests of a school or administrative system.

Reconceptualization of curriculum in science education has two components. The first is influenced by the work of curriculum scholars, such as Madeleine Grumet, William Pinar, Maxine Greene, Cynthia Chambers (Grumet, 1980; Pinar, 2004; Greene, 2004; Chambers, 2003) and others, and looks at

curriculum inquiry as an intellectual challenge of our current system and the way we do things; a challenge that most curriculum theorists (certainly the reconceptualists) believe is now long overdue. The second component relates to recognition of other ways of knowing and allowing ourselves to look past the world as we see it and acknowledge that there are other ways of experiencing our world that are equally valid. One of the problems with having a science curriculum that is derived exclusively from a Eurocentric perspective is that "it fails to consider the sociocultural environments in which students and communities live, it presents scientific knowledge as objective and universal, and thus fails to recognize that scientific knowledge is itself socially constructed" (Brayboy & Castagno, 2008, p. 739). Therefore, just as Eurocentric scientists hope that their results can be shared and understood by communities at large, we should also seize the opportunity to listen and learn from the wisdom of Aboriginal Elders when they offer to speak in a public forum. The narratives presented by the Elders in this research are autobiographical in nature and demonstrate a means of knowledge sharing that has successfully worked for many generations within Aboriginal cultures.

Bruner separates modes of thought into the logical or inductive arguments of scientific reasoning and the stories or narratives that contribute to the building of "life making" (Bruner, 2006, p. 129). He states

> And just as it is worthwhile examining in minute detail how physics or history go about their world making, might we not be well advised to

> explore in equal detail what we do when we construct ourselves autobiographically? (Bruner, 2006, p. 129).

Bruner believes that the telling of autobiographies is more than just the telling of a story, whether that be formal or informal. Rather, cultures shape both the cognitive and linguistic processes that construct autobiographies which "achieve the power to structure perceptual experience, to organize memory, to segment and purpose-build the very "events" of a life" (Bruner, 2006, p. 131). In other words, the structure of autobiography itself is constructed as a cultural experience. As a result, the act of telling an autobiography becomes a model for how the structuring of experience will develop. He believes that you cannot separate a life as led from a life as told and from his research on narratives he believes that "Our excursion into experimental autobiography suggests that these formal structures may get laid down early in the discourse of family life and persist stubbornly in spite of changed conditions" (Bruner, 2006, p. 139). Therefore, paying attention to the autobiographical narratives of the Elders requires more than just respectful listening, it requires an understanding of the cognitive and linguistic characteristics that an individual culture uses to construct an autobiography. That is, it is more than just a re-telling of experience, but rather, a construction of a life making cultural event.

Elder Autobiographies

As mentioned, those life making cultural events were shared with me through the transcripts in this research. Many Eurocentric scientific researchers have listened to the narratives of Aboriginal people in an attempt to acquire

content knowledge on a variety of topics. However, the tendency is to pick and choose the content items that are of interest from a scientific point of view and (respectfully) ignore the rest (Nadasdy, 1999). However, through reconceptualizing what is being shared within autobiographical narratives, non-aboriginal cultures can learn far more than just content revealed by the narrative process. By living through another's autobiography rather than just listening to it, one has the opportunity to share in a very personal and intimate experience and perhaps expand one's perception of living with nature. Therefore, we must look at not only the content and shared experiences of the autobiography but at the framework itself which will reveal how the Elders construct their most meaningful life events. As Bruner states, "the ways of telling and the ways of conceptualizing that go with them become so habitual that they finally become recipes for structuring experience itself, for laying down routes into memory, for not only guiding the life narrative up to the present but directing it into the future" (Bruner, 2006, p. 139).

Methodology.

For this analysis, the oral narratives of one Grand Chief, two Chiefs, thirteen Elders, and three community members were examined (21 distinct narratives in total). The narratives were selected only if they could be distinguished as an oral presentation. That is, discourse that occurred during question-and-answer periods or other discussion periods was not included because it represents more of a "conversation" than a presentation. The narratives used for this analysis occurred when the Chair of the Sahtu Renewable Resources Board

publicly announced that the speaker was to have the floor and they were able to share their point of view without interruption or rebuttal. The scientists were also afforded the same opportunities. From this analysis, framework categories were derived.

Autobiography framework categories.

If the experiences shared by the Aboriginal speakers are shaped by the framework of the autobiographical narrative, then we would expect to see patterns or similarities within the various autobiographical narratives. Therefore, each narrative was examined and common themes were extrapolated to see if a framework was present. Take as a starting point the opening statement by Chief Michael in which he reveals not only his personal feelings on the issue of caribou, but also the responsibility of Aboriginal people in caring for them:

> 11 I am going to speak
> 12 briefly about how I feel – my feelings on this issue.
> 13 This caribou, it's something that's very important to us.
> 14 We've been caretakers or, basically, taking care of the
> 15 caribou for a long time as Aboriginal people, as Dene
> 16 people, we have our own – our own laws on taking care of
> 17 the caribou. This was passed down to us from our
> 18 ancestors (Chief Michael, November 22, page 7, lines 11-18).

From each autobiography, common frameworks began to appear. Chief Michael's autobiographical narrative begins with a statement that reveals a personal, rather than objective, point of view because they represent "his feelings" on the topic.

This subjective point of view, while not unseen in Eurocentric scientific narratives, is commonplace within the Elder narratives. The narrative then reveals the connection that Aboriginal people have with animals as caretakers. He goes on to reveal the unity of Aboriginal people when he speaks of both “Aboriginal people” and “Dene people”. Their role as caretakers is then described as a set of laws and responsibilities that were passed down to them from their ancestors. These laws are not laws in a legal sense, but rather, are the unwritten laws followed while living on the land. They can be thought of as "Dene laws" similar to those described by the Sahtu Renewable Resources Board that were developed as advice in communicating within their community. The board developed five Dene laws; 1) Take only what you need, 2) Harvest fewer cows, 3) Monitor harvests, 4) Reduce wastage, and 5) Educate, educate, educate (Canadian Arctic Resources Committee, 2007, p. 39) and share these laws through the use of narratives. Therefore, these laws are collectively categorized as Dene laws here. Again, although the Dene laws do not necessarily exist in a Eurocentric form they are nonetheless just as important and are upheld as such. The importance of the caribou to the Dene people comes across loud and clear and the scientists, with their Eurocentric scientific background did not divulge a similar type of passion, at least within these formal presentations. Even within the formal setting of a public hearing the Elder is able to elicit emotion and share knowledge at the same time. The categories that could be derived from the narrative example are summarized in Table 9.

Table 9. Autobiographical framework of Chief Michael.

Personal or Objective point of view		I am going to speak briefly about how I feel – my feelings on this issue.
Animal and people relationship		We've been caretakers or, basically, taking care of the caribou for a long time
Unity of Aboriginal people		As Aboriginal people as Dene people
Dene laws		we have our own -- our own laws on taking care of the caribou
Ancestry		This was passed down to us from our ancestors

From Chief Michael's autobiography derived five distinct framework categories. A similar approach was applied to the other autobiographies in order to see if the framework categories were consistent amongst speakers and if other categories existed. Elder Laura's autobiographical approach shares not only her ancestry on the land, but speaks of the ability of caribou to know the thoughts of the people with whom they share the land.

2 My father and my grandfather they spoke
3 about it, and they used to tell us like the habits and
4 what was going on with the caribou. They also told us
5 that the caribou knows Deline as people, our thoughts,
6 how we want to, like what we want to do, like, with them
7 as animals. Things like that, that's why they said it's
8 no good as elders, they said it's no good to talk about
9 it too much (November 22, page 117, lines 2-9).

Similar to the previous example by Chief Michael, Laura constructs her narrative with ancestry, sharing of knowledge of Dene laws, unity of Dene people, and, indirectly, their role as caretakers. The connection between the animals and the

Dene people is a critical piece of knowledge and one in which Elders know that Eurocentric scientists do not either comprehend or understand. Thus, another framework category appears in this autobiography, that of Indigenous knowledge. It is shared through the teaching of "habits" of the caribou that is passed on as knowledge from one generation to the next. The idea that animals may possess abilities that are either equivalent to or even superior to that of humans is one that very few Eurocentric thinkers will believe to be true. But it is through the autobiographical approach that the Elders attempt to engage, illuminate, and educate, the "others" on concepts that they likely cannot conceive. Autobiography then becomes an educational tool that the Elders utilize in an attempt to inform others. The real power of autobiography lies in its ability to promote a reconceptualization of culturally held ideas and teach, in this case scientists, that other ways of knowing can lead to other ways of understanding. Of note, the order or sequence of events that the framework categories occur in is not the same as in Chief Michael's narrative.

Table 10. Autobiographical framework of Elder Laura

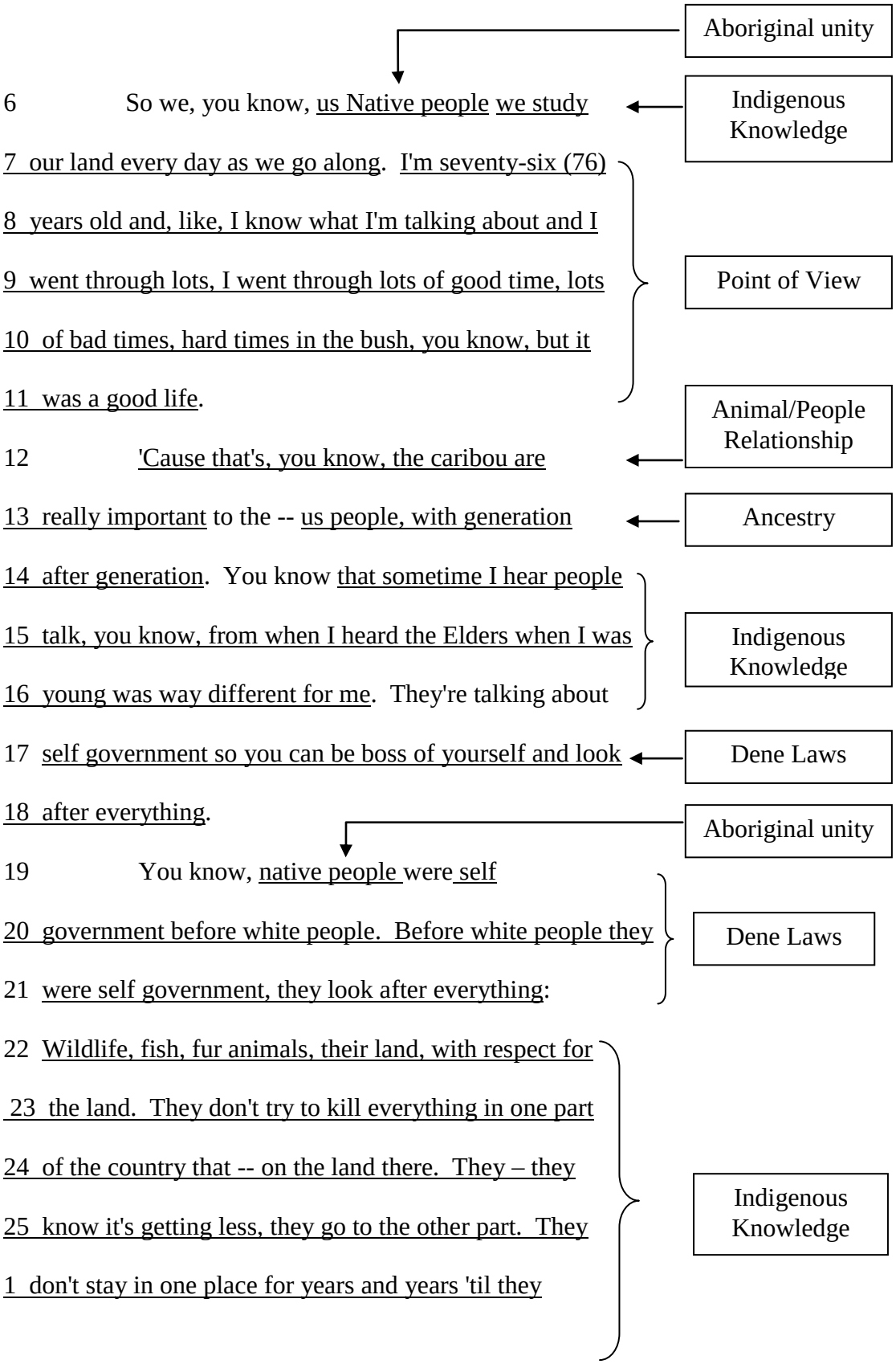
Ancestry		My father and my grandfather they spoke about it
Indigenous Knowledge		they used to tell us like the habits and what was going on with the caribou.
Animal and people relationship		They also told us that the caribou knows Deline as people, our thoughts, how we want to, like what we want to do, like, with them as animals.
Unity of Aboriginal people		Deline as people as elders
Dene laws		Things like that, that's why they said it's no good as elders, they said it's no good to talk about it too much

The autobiographical framework in the above examples are shown within single paragraphs, but as these are transcripts derived from oral narratives the insertion of them as paragraphs is a decision made by the transcriber, not necessarily an intention of the speaker. Therefore, for some of the speakers the framework extends throughout their narrative, constructed in a narrative sequence that is familiar to those within a particular culture (see chapter on Narrative sequence). Therefore the remaining autobiographical narratives of the Elders were examined and six distinct framework categories emerged (Table 11).

Table 11. Framework categories.

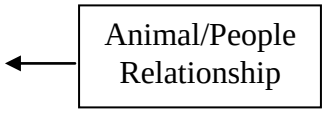
Framework Category	Brief Description
Ancestry	• highlights importance of knowledge sharing from generation to generation • indicates strong familial bonds
Point of view	• subjective point of view • reveals personal opinions and feelings • sharing of experiences both positive and negative
Indigenous knowledge	• reveals the knowledge shared amongst the community • includes both content knowledge (e.g., caribou habits) and methodologies (e.g., methods of observation) • knowledge of animals comes through a connection with them and the land
Dene laws	• shows that the Aboriginal communities follow a distinct set of laws or rules • laws are passed on through oral narratives rather than written documents
Aboriginal unity	• shows the unity of Aboriginal People and their history of working together as a collective
Animal/People relationship	• reveals the relationship that Aboriginal People and animals have

Below is an excerpt from Elder Steven which represents approximately 230 words out of a total of 800 for his entire narrative presentation. Using the framework categories developed above we can see that the framework, again arranged in a different sequence, is consistent in structure and as a result, in thought. In other words, what might appear to a listener of a Eurocentric background as unsequenced talk that lacks chronological, and perhaps even logical order, is in fact a consistent and thoughtful manner of knowledge sharing.


Aboriginal unity
Indigenous Knowledge
So we, you know, us Native people we study
our land every day as we go along. I'm seventy-six (76)
years old and, like, I know what I'm talking about and I
went through lots, I went through lots of good time, lots
of bad times, hard times in the bush, you know, but it
was a good life.
Point of View
Animal/People Relationship
'Cause that's, you know, the caribou are
really important to the -- us people, with generation
Ancestry
after generation. You know that sometime I hear people
talk, you know, from when I heard the Elders when I was
young was way different for me. They're talking about
Indigenous Knowledge
self government so you can be boss of yourself and look
after everything.
Dene Laws
Aboriginal unity
You know, native people were self
government before white people. Before white people they
were self government, they look after everything:
Dene Laws
Wildlife, fish, fur animals, their land, with respect for
the land. They don't try to kill everything in one part
of the country that -- on the land there. They – they
know it's getting less, they go to the other part. They
don't stay in one place for years and years 'til they
Indigenous Knowledge

2 kill everything. Even the fish Lakes too, they keep

3 moving, they're like animals the native people.



(Elder Steven, November 21, page 77-78, lines 6-25 and 1-3).

The above autobiographical narratives are examples of Elders that are sharing their perspective of their life history. That is, the framework of their autobiographies are constructed in a manner that is intended to share their experiences with the listeners. However, some of the Elders also chose to share negative experiences that they have been a part of or have witnessed as Eurocentric cultures have advanced within the Sahtu region. Below are excerpts from the narrative of Elder Richard a narrative of approximately 2400 words that contains all of the above framework categories, but includes some additional comments that should be looked at in more detail. For example, in one section he addresses how non-aboriginal hunters are now using the same land:

Today and in our boundary area across in the mountains there are tourists, big game hunters that go hunting across there, and it's from the past twenty-five (25) years or so that they've been going across into the mountains to go hunting for big game, animals that have antlers and horns.

And they kill these and they take this -- the hides and the meat -- they take the horns, but I'm not sure what they do with the hides and the meat and it's in our boundary area, and I'm thinking about that. And -- and I'm just wondering if -- like the -- the game

14 warden -- there's no one really monitoring what they are
15 doing in the mountains there.
16 And it just seems like that they just do
17 whatever they want, and the government in one (1) year,
18 all -- all the animals that they killed -- whatever they
19 get, they're not paying us as Dene people, all that money
20 goes to the government.
21 And so we are -- it would be good if we be
22 more concerned about things like that. And the White
23 people that come here, we ask them to come and meet with
24 us, but they haven't come to us yet. We are still
25 waiting to meet with them (Elder Richard, November 22, page 80, lines 3-25).

Richard's autobiography speaks strongly to the Aboriginal unity category. Statements such as "our boundary area" (line 3), "us as Dene people" (line 19), and "and it's in our boundary area" (line 11-12) supports the idea of unity amongst the community. Indirectly, he demonstrates the unity through emphasizing the existence of the "other". For example, "tourists, big-game hunters"(line 4) and "the White people" (line 23) are clearly identified and the personification of the government as being responsible for "all the animals that they killed" (line 18) all support the notion of an existing border between the Aboriginal community and the others. The point of view category is demonstrated though the lines "but I'm not sure what they do with the hides and the meat" (line 10-11). This indicates that Richard is sharing an observation, but not making a judgment. He is merely asking a question, that question being; who is monitoring the non-aboriginal

hunters? This view is enforced in the following line which states "and it just seems like that they do whatever they want" (line 16-17). References to ancestry, Dene laws, and the animal/people relationship are made throughout the remainder of his narrative and are consistent with the previous examples shown. The difference in this particular narrative is that there is a mixture of both Indigenous knowledge and knowledge of Eurocentric activities, in this case, game hunting. Richard is clearly aware that non-aboriginals are hunting on the land and even mentions that it has been occurring for approximately the past 25 years. He makes the distinction between hunting for game and hunting for food by stating that the non-aboriginal hunters are hunting for "big-game, animals that have antlers and horns" (line 7-8) as opposed to the "hides and the meat" (line 11). Although Richard is referring to the activities of non-aboriginals, he continues to use a similar framework in how he presents that knowledge. That is, he relates his knowledge via a narrative framework as observation rather than as a mechanistic analytical explanation. The distinction is an important one because although the content of what he is speaking of is the result of Eurocentric encroachment, the manner in which he speaks of it continues to be in the form that is consistent with the other Aboriginal narratives. This may indicate that the Elder's act of telling an autobiography is derived from a model for the structuring of experience, as Bruner (2006) suggests. Otherwise we would have expected the speaker to take on attributes of the encroaching culture. Accordingly, the framework category *Indigenous knowledge* could be divided into separate categories of Indigenous knowledge and Eurocentric knowledge, but even though the knowledge content

may differ, how that knowledge is revealed through the autobiographical process appears to remain the same. Therefore, separation of knowledge types does not appear to be necessary for this analysis.

In a similar vein, Grand Chief James addresses Federal laws (as opposed to the Dene laws described earlier) in regards to the land claim settlements during his narrative. Once again, he begins by speaking of the relationship between caribou and Aboriginal people and the importance of it to his ancestors. He then describes his point of view by stating "what we are talking about today is something that we are trying to set for ourselves for the future" (line 15-17). Again, this creates an atmosphere of cooperation and is representative of the Elder's desire to work collaboratively. His next statement refers to the land claims agreements which represent Eurocentric law rather than Dene law. As Grand Chief, he has met with federal officials on the issues that affect the people he represents, yet the way he relays that information follows an autobiographical narrative framework. His experience in dealing with federal officials is described in the same format as he would had he encountered a caribou during a hunt, as an observational event that has become part of his life story.

13 Now, that we are talking about this
14 caribou, in the past, for a long time, our ancestors have
15 lived off of this caribou. What we are talking about
16 today is something that we are trying to set for
17 ourselves for the future. This land claims -- that was
18 established, it was made to help us.

19 I went to Ottawa and had a meeting with
20 Fisheries and Oceans, and this -- and they were talking
21 about harvesting. They were talking about the fishing
22 areas where you can harvest, and Deline, they had a
23 really hard time with it.
24 They -- they wanted to know why we had a
25 land claim settlement if -- if we still have White people
1 making regulations for us. The government -- we're
2 talking to them and asking them, Why is it so difficult
3 to make these changes (Grand Chief James, November 23, page 27-28, line 13-25 and line 1-3)

Discussion.

Border crossing is presented as a means to allow two distinct cultures to work with each other without allowing the differences between them to create turbulence that is difficult to mitigate. While Aboriginal cultures are easily identifiable, scientific cultures are not necessarily as easy to discriminate. The first step in promoting border crossing requires acknowledgment and recognition of past events. Adopting Brayboy & Castango's (2008) "both/and" rather than "either/or" methodology seems to be the most logical way to fully incorporate all cultural groups into one education system, however, too often the authority embedded within the Eurocentric scientific community appears to overwhelm the others. Furthermore, it may be too simple of an approach to think that an entire culture can defines all people within it, rather, all individuals are possessed their

own frameworks that are constructed through their life experience and location. Therefore, one's location can consist of local, personal, regional, and national identities and learning should therefore have meaning for each individual.

Individual location can be shared and experienced through the act of autobiography. Introduced as a strategy for social reconstruction, autobiography offers the opportunity for each individual to find their own location. In addition, it offers a method of knowledge sharing that goes far beyond just content, that expresses a life history and perspective that provides a much deeper look into issues of interest, such as protecting caribou populations. Whether an autobiography is shared through oral narratives or through the writing process as Grumet (1989) suggests, it provides an opportunity to deconstruct preconceived borders and to allow individuals to construct themselves with ideas and beliefs that are meaningful to them personally.

The Elders' autobiographies provide us with excellent examples of what knowledge sharing can look like in a different context. From their autobiographies we can see that framework categories are constructed that are consistent amongst community members and these categories represent the issues that are of most importance to them as a culture. The beauty of autobiography is that it allows people to express the thoughts, emotions, and ideas that are the most meaningful to them, rather than conform to cultural norms or expectations. Autobiography can therefore be an opportunity for reconceptualizing how members of one particular culture can broaden their exposure to others and make the crossing of borders a realistic and obtainable goal.

Chapter Seven: Conclusions

This research, centered on the relationship between caribou and people, offers unique prospects for observing the sociology of language as it is constructed when members of two distinct cultures come together on an issue of mutual interest. As such, it presents opportunities for both members of Aboriginal communities and Eurocentric scientific communities to share knowledge in an open forum. Understanding the similarities in how language is used by the respective cultures and understanding how can assist in border crossing opportunities that may ease the turbulence created between two historically divided worlds. Conversely, awareness of the differences in language use offers opportunities for educationists to mitigate how those differences affect learning and allows curriculum design the power of reconceptualization and a renewed hope for successful cultural border crossings. As a result, there are implications for both science education and for members of the Eurocentric scientific community.

Implications for Science Education

This research will also be reflexive for educators and scientists who possess a Eurocentric scientific mode of thought and may not be aware that the language used within a science discourse is a distinct "culture" of its own. Because they are immersed in their own culture they may need to assess their own linguistic techniques and methods in order to more easily build a bridge between themselves and other ways of knowing. Educators' awareness and point of view

about Indigenous knowledge can range from highly aware to unaware as described by Aikenhead and Ogawa:

> At one extreme, a highly Eurocentric reader embodies Eurocentric knowledge and likely has little appreciation or understanding of Indigenous or neo-indigenous knowledge systems. At the opposite extreme are in-depth bicultural readers who embrace Indigenous or neo-indigenous knowledge systems and who appreciate and understand Eurocentric knowledge (Aikenhead & Ogawa, 2007, p. 540).

The different modes of thought are also greatly influenced by the fact that they are often learned in much different settings. Eurocentric science is primarily learned in formal environments (i.e., schools), while Indigenous knowledge will be learned informally through the home and living on the land. Scribner and Cole (1973) describe three important characteristics of informal science which are also relevant to other ways of knowing. First, it is particularistic because it occurs in the family and is more strongly related to who a person *is* rather than what he or she has accomplished. Secondly, informal education fosters traditionalism, for example, Elders hold the highest status. And finally, informal education "fuses emotional and intellectual domains" (Scribner & Cole, 1973, p. 555), which I take to mean that learning within a context has a deeper meaning because of the relationship between teacher and learner. Informal science can be closely linked to Indigenous knowledge which is a view of science that contains multiple ways of obtaining knowledge and "recognizes the role of culture, subjectivity, and perspective in making sense of the world, and it draws attention to the notion that

we all interpret reality through a particular cultural lens" (Brayboy & Castagno, 2008, p. 736). Hodson (2004) advocates for the use of informal science to help build ecological relationships through direct experiences outside of the classroom. He believes we need to make learning a joyful experience that includes both seeing and understanding. Informal science experiences, which are dominant in aboriginal science learners, allow students to experience a connection to nature that is not only from a Western scientific perspective. He writes:

> By learning to be sensitive to the spirituality of the caves, volcanoes and trees – rather than seeing them merely as products of erosion, the outcome of geothermal activity and resources for making paper or furniture – children can recover what many indigenous peoples around the world have never lost: a sense of unity between humanity and the environment (Hodson, 2004, p. 222).

Psychologists have long been aware that there has been a discontinuity between formal and informal education which creates a hostile relationship that Scribner and Cole describe by stating "the antagonism the schools generate by their disrespect for the indigenous culture and by ignorance of its customs almost guarantees the production of non-learners" (Scribner & Cole, 1973, p. 558). The awareness of the importance of Indigenous culture and informal science may, at first, sound as a complaint against formal education. On the contrary, it is not a rejection of the importance of formal education but rather it is an acknowledgment for "the reclaiming and rearticulating of indigenous knowledge,

languages and cultures" (Stewart-Harawira, 2005, p. 154) for the purpose of reconnecting with our natural world.

Discourse analysis when analyzed through the lens of the sociology of language, can reveal many characteristics of language use that are important for science educators to be aware of. The results here show that pronoun usage is much higher in Aboriginal Elders' narratives than in the narratives of Eurocentric scientists. Many similarities to Retzlaff's (2006) study on Native discourse were found, however variation amongst Aboriginal speakers existed as well. That being said, it is clear that the Aboriginal speakers use pronouns in a way that marks community and identity whereas the pronoun usage by the scientists tended to separate scientists from community members, which could result in the creation of greater turbulence between the borders of the two cultures.

Repetition is used by the Aboriginal speakers for a number of reasons. First of all, they repeatedly make reference to "the land", not only within individual narratives but amongst all four narratives studied. Secondly, they utilize repetition to highlight particular experiences or observations that they feel is critical to be passed on. And finally, repetition is also appears through the use of parallelism. The Aboriginal speakers often use parallels and contrasts their experiences and life on the land versus the Eurocentric people that come to use the land for a variety of purposes. Conversely, the scientists, while avoiding the use of jargon, still speak in a lexically dense way (Halliday M. A., 2004) that creates a separation in how they speak about Eurocentric science versus how they speak about Indigenous knowledge or traditional wisdom. The complexity of the

grammar makes it clear that the language used within the Eurocentric scientific culture is different from the Aboriginal culture. By unpacking the lexically dense scientific grammar, science educators would be able to continue to think in Eurocentric scientific mental models but be able to communicate in the language of the other cultures, which would be a tremendous aid in cultural border crossings. In addition, the selection of particular words tells us how each of the cultures view the importance of words. Repetition of certain words indicates the importance of those words to that culture; however, if the other culture rarely uses those same words, then the significance of those words may be lost.

Unfortunately, the state of affairs regarding power as described by Nadasdy (1999) seems to still be in place at the Sahtu Renewable Resources Board public hearing in 2007. Public recognition of the term traditional knowledge continues, but the scientists involved still appear to be firmly entrenched within their Euroscientific mental models. As a result, efforts to cross the borders between Eurocentric science and Indigenous knowledge have not yet reached an equitable level and the power of Eurocentric science seems to persist.

Barnhardt and Kawagley believe that non-Native people "need to recognize the coexistence of multiple worldviews and knowledge systems, and find ways to understand and relate to the world and its multiple dimensions and varied perspectives" (Barnhardt & Kawagley, 2005, p. 9). This means that in order for Aboriginal and Euroscientific cultures to truly connect there needs to be a coming together of knowledge systems rather than a simple acknowledgment that the other exists. Furthermore, training and including community members in

the act of scientific data collection benefits the scientific community, but does that gesture of cooperation truly acknowledge the contribution that traditional knowledge could offer in the decision making process for caribou management? It is hard to imagine that “calf survival, pregnancy rates, condition, adult sex ratio, and distribution” are core values of Aboriginal knowledge systems. If the paradigmatic or scientific mode of thought seeks to "transcend the particular by higher and higher reaching for abstraction" (Bruner, 1986, p. 13) then its end goal becomes a process which can conflict with the values, beliefs, and practices of the narrative mode utilized by Aboriginal speakers.

Bishop & Glynn, (1999) working with the Maori people in New Zealand found that "No significant advancement is being made in addressing cultural diversity in society in general or mainstream education institutions, including classrooms, because current educational policies and practices in most Western countries were developed and continue to be developed within a framework of colonialism" (Bishop & Glynn, 1999, p. 11). They believe that education systems also need to revisit current strategies and they suggest a model that focuses on "the sense-making and knowledge-generating process of those cultures the system seeks to marginalize" (p. 13). In other words, empowerment of the other is the most likely way to achieve success in the sharing of knowledge.

Educators, particularly those who received their education entirely within a Eurocentric culture, need to be aware of the impact that power can play in the acknowledgment of Indigenous knowledge. The idea of fitting Indigenous knowledge into a Eurocentric curriculum is fraught with danger if it is only the

Eurocentric scientific components (i.e., those components which can be quantified) that are included. As the results from this study show, even when attempting to include Indigenous knowledge, those with a Eurocentric scientific background, whether they are scientists or science educators, often exert their power over the other through the discourse that they choose. It is through education that a balance of power may one day be achieved. Aikenhead believes that integration can be achieved by attaining three goals: "to help students cross a cultural border into and out of school science, to nurture and expand students' self-identities, and to prepare students to live proficiently in both their indigenous and Western worlds" (Aikenhead G. , 2006, p. 123). Achieving these three goals will go a long way in reducing the power of one culture or the other and promoting cooperation and communication between them.

Curriculum reconceptualization can often be critical of current educational practices without offering tangible alternatives. However, Aboriginal people have been utilizing autobiography as a form of education and learning for thousands of years and have effectively shared critical knowledge amongst their communities in a way that is significantly different than how Eurocentric cultures tend to share knowledge. Curriculum theorists recognized autobiography as an opportunity to reform curriculum practices within Eurocentric cultures as a means to reconceptualize how we view modern education (Grumet, 1980; Pinar, 2004; Greene, 2004; Chambers, 2003; Bruner, 1986). Curriculum theory allows us to not only imagine a different future but also different strategies for looking internally and evaluating one's own method of knowledge sharing. Using Bruner's

theoretical framework (Bruner, 1986) that distinguishes different modes of thought provides us with a distinction between how two cultures can construct different mental models for the sharing of knowledge. Aboriginal science is primarily concerned with the survival of people and co-existing with nature, while Eurocentric science tends to be more with obtaining knowledge for power and the explaining of nature. As a result, when the two cultures come together borders can exist that can create turbulence between them that requires educators to take on the role of culture brokers that assist students in moving between the culture of science and the other cultures they experience (Aikenhead G. , 2001).

Turbulence is the area between the borders where unintentional conflict can be created between two groups as their cultural practices can inadvertently create difficulties that need to be navigated. Minimizing the effect of the turbulence provides a means to help cross borders in a way that maintains the integrity of both cultures. This can be achieved through the acknowledgement of the histories that led to the creation of the borders in the first place, primarily that of colonialism. Acknowledging colonialism and the impact that it has had on Aboriginal people in Canada will help individuals create a location for themselves within a curriculum that is not bounded by Eurocentric history, but can exist is an individual's location that will vary from one person to another.

The autobiographies of the Aboriginal speakers researched here show that the framework structure of autobiography itself is constructed as a cultural experience. Six distinct framework categories were found and as a result, the act of telling an autobiography becomes a mental model for how the structuring of

experience develops. The study of autobiography reveals an *other* way of knowing that at first might appear to a listener of a Eurocentric background as unsequenced talk that lacks chronological and perhaps even logical order, but when time is taken to share in the moment it becomes a consistent and thoughtful manner of knowledge sharing. The importance in understanding and embracing varying ways of knowledge sharing is critical for both Aboriginal and scientific speakers, as "Failure to match another ethnic group's standards of linguistic decorum may be fatal to individual social advancement" (Brown & Levinson, 1987, p. 33). Through autobiography, science educators and their students can begin to admit to having personal biases or doubts about certain scientific practices. They can explore interests in another culture's ideas or beliefs or even in the metaphysical realm. A truly revolutionary social change is possible and curriculum theorists have laid out the arguments for the need for curriculum reconceptualization. The Aboriginal Elders studied here demonstrate that autobiography is a cultural experience that can open one's mind to other ways of knowing.

Implications for Scientists

Historically and presently, the emphasis in education has to incorporate "traditional knowledge" into a Eurocentric scientific framework. Science needs to be recognized in all its forms, whether that is Eurocentric science or Indigenous knowledge. This research will hopefully allow the Eurocentric scientific community to see that much can be learned from other ways of knowing. While acknowledgement is polite, the turbulence between the borders can be greatly

lessened if a genuine attempt is made in understanding the mental models that exist in the minds of those that possess other scientific ways of knowing. Governments, government agencies, and resource management boards in their desire to bridge the borders between Aboriginal peoples and Eurocentric agents may find that they are better served by reconceptualizing how they view and share knowledge, rather than trying to amalgamate them together.

Curriculum theory provides strategies for looking inwards and evaluating one's own method of knowledge sharing. It is important for those with a Eurocentric perspective, whether they be scientists or science educators, to be open to other ways of knowing, not to add them into a Eurocentric curriculum, but to honour them as a personal method of currere. One of the most important goals of science education may be that "science education cannot continue to operate under the assumption that all students must adopt the perspective of "scientists"" (Brayboy & Castagno, 2008, p. 741).

The Aboriginal Elders speak very candidly, passionately, and emotionally about the caribou during their autobiographical narratives. The scientists' presentations however, contained none of those characteristics. This is disconcerting because it would be difficult to find government scientists, particularly those of a biological sciences background, who are not as equally passionate about wildlife. However, that passion is not shared within this public hearing environment. The scientists speak strictly from an objective point of view and display many of the stereotypical characteristics that many science educators are trying to disassociate with. Even though the reasons for wanting the caribou to

continue in a healthy, long-term manner may be different, both the Elders and the scientists are likely as equally concerned about caribou sustainability. Yet, because of the differences in how the two cultures construct oral narratives, they appear to end up on different "sides" of an adversarial topic rather than in a position of cooperation.

It is possible that the scientists might have similar framework categories in an environment that was more familiar to them. Unfortunately, in the forum of a public hearing, the scientists appear to be somewhat guarded in their discourse. For example, the six framework categories that were found in the autobiographies of the Elders (Table 11) were not found in the discourse of any of the scientists, except in statements that acknowledge the existence of traditional knowledge such as "Some of the extra funding is being used to help the Sahtu Renewable Resources Board collect traditional knowledge on hunting laws" (Ms. Marcy, November 21, page 40, line 15-17). Nadasdy (2003) points out the uneasiness and mistrust that can still exist on discussions that center around traditional knowledge sharing. He states:

> Though they very rarely do so in one another's presence, both Aboriginal people and Euro-North American scientists and resource managers are equally likely to engage in this private discourse about traditional knowledge. In these relaxed informal settings, people are more likely to give voice to their suspicions regarding the hidden agendas of others and regarding the "real" motives behind their invoking the term "traditional knowledge"" (Nadasdy, 2003, p. 118).

As a result, it is easy to see why border crossings could be very difficult for Eurocentric scientists. However, the power of autobiography can easily be seen in the narratives of the Aboriginal Elders. The Elders are not using autobiography merely as a persuasive argument, rather, their cognitive and linguistic processes are shaped by the culture that they have come to know. How their experiences are structured, how they organize memory, and how they build the very events of their lives are all constructed through autobiography as a cultural event. The six framework categories that are repeated throughout the narratives of the Elders represent deep cultural beliefs that are shared amongst the community, and they are offered in good faith, as an opportunity for the sharing of knowledge.

Using autobiography in this manner offers non-aboriginal people an opportunity to witness firsthand how autobiography could be used for a curriculum reconceptualization. By accepting that other ways of knowing are as equally valid and culturally important, educators and scientists could be exposed to an array of different learning methodologies and accept that each individual will develop their own personal method of currere. Those with a Eurocentric scientific background need to be aware that narratives constructed from folk or indigenous stories have "as much claim to "reality" as any theory we may construct in psychology by the use of our most astringent scientific methods" (Bruner, 1986, p. 49). Through autobiography, science educators and their students can begin to admit to having personal biases, doubts about certain scientific practices, interests in another culture's ideas, or beliefs in a metaphysical presence. A revolutionary social change is possible. Curriculum

theorists have laid out the arguments for the need for curriculum reconceptualization. Now, Aboriginal Elders have demonstrated (indeed, have been demonstrating for thousands of years) that autobiography as a cultural experience can open one's mind to other ways of knowing.

The results of this research are important because it shows the situation where both Eurocentric scientists and Aboriginal Elders share a common goal, that is, to serve the long term sustainability of a caribou population. Yet, the different mental models held by each of the cultures and how they construct their oral narratives can inadvertently create turbulence between them because they do not necessarily speak the same language. Although there are many scientists and science educators that embrace other ways of knowing and can easily address different knowledge systems (Aikenhead & Ogawa, 2007), the results here show that the mental models that are constructed by scientists and science educators are deeply embedded and that they can contribute to the turbulence between cultures because of how the language is constructed, how power is exhibited, and because how they see animals much differently.

Scientific English, when thought of as a register of the English language (Halliday M. A., 2004) requires particular attention by scientists and science educators that the use of it can be confusing and possibly even misleading to members outside of the scientific. If scientific English is the language of the expert it can create problems for the listener. According to (Halliday M. A., 2004), "scientific English is highly metaphorical, in the sense of grammatical metaphor, and children find it hard to deal with grammatical metaphor until they

reach about secondary school age" (Halliday M. A., 2004, p. 158). Therefore, listeners of scientific English, whether they be students or members of another culture, need to be taught how to understand the language of experts and scientists cannot make the assumption that their mental models and how they construct language is understood by all. Its use creates an exclusive social group that can be difficult for others to embrace. The language of science then, either intentionally or unintentionally, can become more than just the language used by a culturally distinct group of scientists; it can become a language of power.

To improve communication between scientists and non-scientists it is important to understand how scientific language is constructed. The grammatical problems that can occur in scientific English can create an enormous amount of turbulence between the borders of two culturally distinct groups. Lexical density, semantic discontinuity, and interlocking definitions, all be found within the discourse of the scientists. Even though the four scientists giving the oral presentations made sincere attempts to keep the language of science to a minimum, grammatical metaphor continued to make its way into the language even though there appears to be a conscious effort to not avoid it. Thus, the mental models that the scientists possess affects their language choice when speaking with a lay audience. Grammatical metaphor was originally intended to compress and package statements by altering the grammar, but the effect it has on non-scientific listeners can create distancing between the borders of two distinct cultures.

Understanding metaphors and models and the mental models that they construct provides us with insight into how the terms evolved over time and how they function within the respective language cultures. In addition, they provide for us an ability to differentiate between how they viewed by members of different social groups. As there seems to be an apparent connection between Eurocentric science and models and a connection between Indigenous knowledge and metaphor, a deep understanding of what the terms represent is crucial. Acceptance of those differences, rather than domination of one over the other is a lesson that would be beneficial for the entire Eurocentric science community. Barnhardt and Kawagley (Barnhardt & Kawagley, 2005) show how core values and beliefs of Indigenous worldviews have survived for thousands of years and are just as valid today as they have been in the past, and because of this, Eurocentric science could learn a great deal from them.

Nadasdy's (1999) claim that collaboration with the Aboriginal people and their Indigenous knowledge results in a *distilled out* version of knowledge sharing rather than a sincere acceptance of cultural diversity appears to continue to permeate through the discourse studied here. The issues that may be creating borders between the two cultures may not be based on the differences in scientific approach whatsoever; rather, it may be deeply embedded within the power structure that exists, as Nadasdy suggests. As a result, the power of scientific thought clearly dominates the Indigenous knowledge mode of thought even though the intention of the scientists was to support the traditional knowledge.

The results of this analysis will create awareness for both scientists and science educators to be attentive of their own culture and express it in a way that not only explains, but shares their perspectives. The mental models held by respective cultures are deeply embedded and represent not only a means of communicating but a means of knowing. As a result, the mental models influence how Eurocentric scientists and Aboriginal people think about and, more importantly, *feel* about as people and the animals in which they live with. If Eurocentric scientists and other members from Eurocentric cultures were to have the same level of respect and understanding of animals, their mitigation would likely be much easier because the animals would be seen as cultural icons that commanded respect and would be treated in a ways that would ensure their existence.

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Appendix A: Scientist and Aboriginal Speaker Presenters

Scientist Presentations (Chronological Order of Appearance)

Ms. Marcy (November 21, Page 17-21)

Mr. David (November 21, Page 21-24)

Ms. Marcy (November 21, Page 24-27)

Mr. Brian (November 21, Page 27-36)

Ms. Debbie (November 21, Page 36-40)

Ms. Marcy (November 21, Page 40-41)

Aboriginal Speaker Presentations (Chronological Order of Appearance)

Elder Steven (November 21, Page 76-79)

Elder Bob (November 21, Page 79-81)

Elder Peter (November 21, Page 82-87)

Chief Michael (November 22, Page 7-11)

Elder Timothy (November 22, Page 58-68)

Elder Richard (November 22, Page 76-85)

Elder Peter (November 22, Page 88-95)

Elder Andrew (November 22, Page 96-99)

Chief William (November 22, Page 99-104)

Elder Shirley (November 22, Page 105-108)

Elder Kristina (November 22, Page 108-111)

Elder Sue (November 22, Page 111-113)

Elder Daniel (November 22, Page 113-116)

Elder Laura (November 22, Page 116-120)

Elder Ryan (November 22, Page 121-126)

Elder Bob (November 22, Page 126-128)

Elder Alan (November 22, Page 128-135)

Elder Diane (November 22, Page 135-141)

Grand Chief James (November 23, Page 27-30)

Elder Darren (November 23, Page 49-56)

Elder Christopher (November 23, Page 56-62)