

Values and Co-production: Examining the
Interface of Indigenous Peoples'
Understandings and Scientific
Understandings

by

David Isaac

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

In this thesis I will examine the role values play in the co-production of knowledge between traditional knowledge and science. In order to understand the role values play, I will first develop clearer definitions of traditional knowledge, science, and co-production than the problematic definitions currently employed in the literature. I will also create new terms to replace the inadequate terms currently in use. “Traditional knowledge” will become “Indigenous peoples’ understandings” (IPUs), and science will become “scientific understandings” (SUs). I will show that values that underlie the concepts of IPUs and SUs are compatible, allowing co-production between the two groups to occur. The definitions of IPUs and SUs will then be held as a standard by which co-production projects can be measured. I will examine several benefits co-production projects offer, and deal with problems posed by co-production. Finally, I will briefly outline problems with current policy governing co-production in Canada.

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Chapter 1

Introduction

1.1 Outline and Goal of Paper

In this paper I seek to analyze current definitions of traditional knowledge, co-production, and science, with the goal of moving towards a clearer definition of these terms, and a better understanding of the values and ideas that underlie them. Speaking very roughly, traditional knowledge is knowledge created by Indigenous people through generations of living with the land, while science is the empirical study of nature. Co-production occurs when these two methods of studying the world are done together in a respectful, trusting way. I hope to show that the values that underlie traditional knowledge and science are compatible, and that by understanding the compatibility of these values, scientists, traditional knowledge holders, and policy makers will be able to engage in co-production projects successfully. I argue that the two values central to traditional knowledge—holism and responsibility—are compatible with the values that are central to science, which are universalism, communalism, disinterestedness, and organized scepticism. I make the general recommendation that by building trust between traditional knowledge holders and scientists, co-production of knowledge between the two groups can be done respectfully and effectively. Trust is important to co-production projects, as it engenders the relationships necessary for proper co-production to occur.

1.2 Description of my Position

While I have attempted to recognize and counteract my limitations, I acknowledge that this topic is complex, and that there are a vast number of differing views about it, even from within the various Indigenous communities, let alone outside them. I have attempted to combat this by working with Indigenous people throughout this process. This involved personal conversations, emails, and well as turning to literature written by Indigenous people whenever possible. Despite my best efforts

this paper will likely be problematic in some respect. However, I hope it is a step in the right direction.

Much of this paper deals with defining traditional knowledge (and, as we will see, coming up with a better term than “traditional knowledge”). However, given the complexity and culturally specific nature of traditional knowledge, it might be difficult to define it in English from outside a particular Indigenous culture. Despite this, it is important for people such as myself—who speak English and who are outside Indigenous culture—to learn about traditional knowledge. One of my goals for this paper is to help such people, by writing about traditional knowledge and offering better terms for the concept for those English speakers outside Indigenous cultures.

As a philosopher, I am outside the scientific community. Admittedly, I was raised mostly within a colonial scientific culture and thus am part of the settler culture, and have less exposure to traditional knowledge than to science. As such, my work will be influenced by colonialism, despite my efforts to combat it. The fact that my work is in the form of a thesis, published by a university emphasizes this point. That being said, my philosophical background involves a good deal of critical analysis of science (and of colonialism), and I will be drawing on those philosophical perspectives, especially feminist philosophy of science, in this paper. In addition, with help from Indigenous scholars, I have tried to be anti-colonial throughout this project. I spoke with Indigenous scholars and Elders at conferences, and received feedback from Kyle Whyte at several points during this project. As noted above, I am outside the community of traditional knowledge holders and to a lesser extent scientists. But this puts me in what I hope is a good position to accomplish the goal of this project. That is, as a relative outsider to both communities I am in a good position to see similarities and differences between them. To put it another way, because I am not deeply committed to either way of perceiving the world, I can see what each side has in common with the other.

Chapter 2

Traditional Knowledge

In this section, I will seek to clarify what traditional knowledge is. In order to do so, I will begin with the history of Indigenous peoples in Canada, both generally, and with special attention to the history of science and Indigenous peoples. Next, I will survey and analyze the current definitions of traditional knowledge found in the literature, with the goal of determining the useful and problematic themes found in them. From this analysis, I will develop a new definition, and a new term to replace the problematic “traditional knowledge”. Finally, I will discuss the role of values in traditional knowledge.

2.1 History of Indigenous Peoples and Canada

The history of the relationship between Indigenous peoples and settlers is crucial for understanding the current relationship, and the current attitudes towards traditional knowledge. The relationship between Indigenous peoples in Canada is troubling, to say the least. The earliest European settlers claimed the land they “found” as their own, ignoring the claims the inhabitants had. Early treaties between European monarchs and Indigenous peoples seem generous by today’s standards. For example, the Treaty of 1725 “gave” the land north and west of the Saint Lawrence River to Indigenous peoples, and forbade the settlement or clearing of the land by others. Likewise the Haldimand Treaty of 1784 gave the Six Nations peoples the land for ten kilometers on either side of the Grand River in Ontario, from near Elora to the mouth of the river on Lake Erie (Johnston, 1964). As generous as these treaties seem today, in reality, the treaties were merely “giving back” the land already used by Indigenous peoples. These land claims were later eroded, as treaties such as the Haldimand Treaty were reneged upon. For example, there are currently around twenty-nine land

claim disputes between the Six Nations and the governments of Ontario and Canada (Six Nations Council, 2008).

Problematic land claims aside, there are many other serious instances of mistreatment of Indigenous peoples at the hands of settlers. One of the most egregious of these was the Indian Act of 1876. This act sought to “do away with the tribal system and assimilate the Indian people in all respects with the other inhabitants of the Dominion” (Six Nations Council, 2008). As such, the act was immensely broad in scope. In addition to determining who was an Indian, it dealt with family structure, legal representation, culture, education, and language. However, its treatment of these topics was extremely problematic. For example, the act made Indian status contingent on men. Under section 12(1)(b), women would lose their Indian status if they married a man without status. Likewise, under section 12(2), children born to Indian women of fathers who were not Indian would not receive status, which is important as it grants various rights, such as an extended hunting season and land rights. These provisions were in effect until 1985. In 1927 section 141 of the Act was passed, prohibiting Aboriginal people from hiring legal council, effectively preventing them from fighting for their rights in the legal system. This provision was in effect until 1951. From the late 1800s until 1951, several major Indigenous ceremonies were prohibited, including the Potlatch ceremony and the Sun Dance ceremony.

One of the most horrible provisions of the Act was the residential schools program. The Act mandated that all Aboriginal children learn English, and attend school. For many students, especially in Canada’s north, this meant they were forced from their homes to live in residential schools. While one of the goals of the system was to educate children, it was also explicitly used to “indoctrinate them in to Euro-Canadian and Christian ways of living and assimilate them into mainstream Canadian society” (Hanson, 2009). As such, children did not learn about their culture, and were forbidden “to practice Aboriginal customs or traditions” (Ibid.) This involved severely punishing the children for

such “transgressions” as using their native language (Haig-Brown, 1998). As a result, many children forgot their native language, and grew up speaking only English. Living conditions were abysmal. A government report in 1907 found that 24 percent of children in residential schools died (Milloy, 1999). To put this in perspective, this is roughly the same mortality rate as the Canadian army had in WWII. Over the course of the residential school program, over 3,000 children died (The Canadian Press, 2013). Sexual and physical abuse was widespread. As British Columbia Supreme Court Justice Hogarth said “as far as the victims were concerned, the Indian residential school system was nothing more than institutionalized pedophilia” (British Columbia Legislative Assembly, 1998).

Today, the relationship between Indigenous people and the Canadian government is strained at best. While the Act has been revised several times, eliminating many of its worst parts, it is still in force today. The government officially apologized for the residential school program in 2008, although this apology was met with some scepticism (Chrisjoh & Wasacase, 2009; Harper, 2008; Miller, 2013). Since the apology, the problem of missing and murdered aboriginal women in Canada has received a great deal of national attention, but little response from the government.

To sum up, the history of Indigenous peoples in Canada is tragic, and the continued lack of meaningful action on the part of the government is deeply troubling, and belays a fundamental lack of understanding and respect for Indigenous peoples. The effects, and indeed the practice of, colonialism continues to this day, as evidenced by “poverty, loss of traditional culture, loss of language, lack of control over resource development, suicide, addictions, and physical and mental health disparities” (Cameron, 2012, p. 109, see also Cameron, 2010; Hicks & White, 2000; Kral & Idlout, 2009; Tester & McNicoll, 2004).

2.2 Science and Indigenous Peoples

The history of science and Indigenous peoples is relatively short, though unpleasant, and has resulted in justifiable scepticism about the benefits of science for Indigenous people. As part of the

residential school program, the Canadian government conducted experiments on children to inquire into the efficacy of nutritional supplements on malnourished populations (Mosby, 2013). Scientists used Indigenous populations as human subjects, rarely with anything like informed consent. The researchers were aware that the supplements would not fix the malnutrition problem, but wanted to “test their theories on a ready-made ‘laboratory’ populated with already malnourished human ‘experimental subjects’ (Ibid, p. 152). Despite the obvious poor health of students at the residential schools, researchers began a five year long experiment to “examine the effects of malnutrition firsthand” (Id, p. 161). During the first two years of the experiment, children were given deficient amounts of various nutrients to give researchers a base line. Then students were given an increased amount of some nutrients in order to determine the effects those nutrients had. One school was designated a control, with none of the students receiving improved nutrition after the first two years. During the course of the study, students were prohibited from receiving dental care as it might interfere with the results.

In another “study”, government officials wanted to determine the effect of nutritional supplements and fortified foods on populations. In order to ensure compliance with the study, “Indian Affairs officials went so far as to experiment with preventing some families from using Family Allowances [money given to parents of children starting in 1945] to purchase flour – despite the fact that it had long been a key dietary staple” (Id, p. 157). This led to many Inuit families being “forced to eating their sled dogs and boiled seal skin” to survive (Ibid.). While it is unclear exactly how many people died or were harmed as a result of these experiments, as opposed to the other horrors of the residential school system, it is safe to assume that deliberately withholding nutrients from children for a period of two to five years harmed many of them. Being used as unwitting and unwilling experimental subjects warrants the lack of trust in science felt by some indigenous peoples

(Grasswick, 2015). If one's experience with science is that scientific institutions, such as government and university researchers, are racist and immoral, then one has good reason to mistrust science.

An example of more recent mistreatment breeding mistrust in the US concerns the Havasupai people. The Havasupai had rates of diabetes much higher than average, so they had blood collected by researchers from Arizona State University to find out why. Without their permission, the researchers used the blood to study the genetic history of the Havasupai. The researcher's concluded that the Havasupai's origins were different from the origin stories they told. When the Havasupai found out about this extraneous research, they sued the university (see Sterling, 2011 for a detailed discussion of this case). In the cases above, scientists experimented on Indigenous peoples without their consent, leading to a justified lack of trust in scientific institutions.

Kyle White, in his article "Now This! Indigenous Sovereignty, Political Obliviousness and Governance Models for SRM Research" notes that

Indigenous peoples tend to experience an ironic pattern: they benefit little from the technologies, businesses, and conservation projects of members of dominant societies like the US, yet they suffer harms from the direct consequences and externalities. (Whyte, 2012, p. 173)

Likewise, the Canadian government acknowledges that

Research involving Aboriginal peoples in Canada has been defined and carried out primarily by non-Aboriginal researchers. The approaches used have not generally reflected Aboriginal world views, and the research has not necessarily benefited Aboriginal peoples or communities. As a result, Aboriginal peoples continue to regard research, particularly research originating outside their communities, with a certain apprehension or mistrust. (Government of Canada, 2015)

Small wonder, then, that some Indigenous peoples mistrust certain scientists. It is worth highlighting the qualifications in the previous sentence. Not every Indigenous person mistrusts scientists, and even among those who do mistrust some scientists, there are certainly people

who do not mistrust *all* scientists. However, the level of distrust of scientists among Indigenous peoples is justifiably high.

As we will see, trust plays an important role in science. As it stands, the history of poor treatment of Indigenous peoples by the government does not engender a trusting relationship. Moreover, the way Indigenous peoples have been exploited by scientists has, to some extent, subverted trust in science and scientific institutions.

2.3 Survey and Analysis of Traditional Knowledge Definitions

There are several key definitions of Traditional Knowledge found in literature on the topic (see Appendix A). Here we will analyze them to find common themes. I will then critically examine each theme, and determine whether that theme is useful for a definition of traditional knowledge. To find these definitions, I performed a broad survey of the literature, with advice from Kyle Whyte, one of the foremost Indigenous scholars studying traditional knowledge. The definitions I examine below (for definitions of science and co-production in the literature on traditional knowledge, see Appendices B and C) are those that inform the most influential papers on traditional knowledge in the past forty years. These definitions come from a diverse set of groups, across a broad time frame. They include Indigenous and non-Indigenous scholars studying traditional knowledge, as well as government and NGO documents. These definitions are—to the best of my knowledge—all of the definitions found in the core literature on IPUs.

Speaking generally, traditional knowledge is information about the world created and held by Indigenous peoples. It is unique in that it is created through living with the land over many generations. As we will see, traditional knowledge is important for a variety of reasons, including because it is an integral part of Indigenous societies, and because it is some of the best knowledge available about the natural world. Furthermore, it represents knowledge that comes from a

marginalized portion of society, and thereby acts as a view from which one can critically examine certain aspects of science and the position of science in society.

While the many definitions of traditional knowledge vary somewhat, they have several things in common. I have identified three major themes, common in most definitions. In addition to these, there are several more contested themes found in some definitions.

2.4 Major Themes

2.4.1 Cultural-dependence

Traditional knowledge is thought of as being developed in and held by a particular community or culture. This includes “cultural traditions, values, beliefs, and worldviews of local peoples” (Dei as cited in Agrawal, 1995, p. 8). In this way, the knowledge produced by the community is specific to that community, it is “knowledge about the environment derived from the experience and traditions of a particular group of people” (Usher, 2000, p. 185). Likewise, traditional knowledge is “limited to within a certain group/community by virtue of its value to the group/community” and is “generally regarded as pertaining to a particular people or territory” (Kalluri, 2012, p. 431). That is, a different community might have produced slightly different knowledge. It is the unique culture and geographical location (and these two aspects are closely tied) that results in a particular piece of traditional knowledge.

The cultural-dependence of traditional knowledge raises questions regarding the nature of the dependence. That is, is traditional knowledge so culturally dependent that a person outside the culture necessarily cannot hold it? Or, is it possible that, given a certain set of conditions, such a person would be capable of holding traditional knowledge, and if so, to what degree could they hold it? This will depend on how the knowledge is being created and participated in. If, for example, someone outside the particular Indigenous culture in question is curious about the spread of plants in the area,

they might ask local inhabitants for information about them. There are two ways the Indigenous people might respond to this question. They might give a “scientific” response, such as ‘there are several varieties of Saskatoon berries, which are spread through bear droppings. By the way, this is why we don’t chase bears away, because they help spread the berries we eat’ (see Armstrong, 2002). Or, they might give an answer that is more difficult for an outsider to understand. For example, “the black bear came and talked to our people” (Armstrong, 2002, p. 7). This sentence on its own is next to impossible to parse without explanation. However, with explanation, its meaning becomes clear.

What we mean [by the bear story] is that many generations ago the animal showed us its knowledge and the important things we need to know. We mean we understood and communicated and listened to what bear is saying to us every day out there, and what it’s still saying to us every day out there. Bear said “I’m your gardener for those berries you love. I go around and fertilize them, I plant them”. The bear fixes it [sic] up with sweet chemicals that allow it to grow in ground which is very difficult to grow anything. Bear gave us a gift to help and sustain us because he also likes those berries. Our bear is never chased away in our communities and killed because they come to visit us in our homes (Ibid.).

With a deep understanding of the culture, the response “the bear came and talked to our people” becomes clear, even to an outsider. But in order for it to become clear, the outsider needs to be knowledgeable about the culture and practices of the people she is talking with, and open to understanding the world from a perspective she may not be accustomed to. To put it broadly, the scientist needs to understand the relationship her interlocutors have with the natural world, and the holism that grounds that relationship. Note that this is not an easy thing to do. It involves building a relationship with the people one is talking to, and becoming familiar with their culture. If this relationship-building occurs, it may be possible to participate in traditional knowledge, at least to a limited degree.

This example shows that, at least in some cases, the cultural dependency of traditional knowledge is not necessarily an impediment to the knowledge being held by someone outside the

culture. Hart says that “individuals can adapt and use behaviors associated with another worldview” (Hart, 2010, p. 2, see also Sue & Sue, 2003). Of course, there will likely be subtleties of meaning that escape the visitor, but this is not a problem confined to outsiders, as Johnson notes that “even the younger members of an aboriginal community... may be unfamiliar with all of the subtleties and sophisticated terms of the aboriginal language” (Johnson, 1992a, p. 13). Learning traditional knowledge is not something that happens quickly. But in order for it to happen to any degree, it needs to start somewhere. With education and relationship building, it seems possible for some people outside Indigenous cultures to appropriately engage with traditional knowledge.

As we can see, cultural-dependence is intrinsically tied to traditional knowledge. This does not mean, however, that those outside that culture are necessarily excluded from it. This point will be complicated somewhat by the next major theme.

2.4.2 Tied to the Land

Traditional knowledge is closely tied to the land in which it is produced. It is “born of long intimacy and attentiveness to a homeland and can arise wherever people are materially and spiritually integrated within their landscape” (Kimmerer, 2002, p. 432). Huntington notes that traditional knowledge is “acquired through extensive observation of an area or a species” (Huntington, 2000, p. 1270; Johnson, 1992a). It arises out of a culture that has spent generations in an area, and has become intimately familiar with that land through “direct experience of the workings of nature and its relationship with the social world” (Agrawal, 1995, p. 8). Hunn says that traditional knowledge involves “enduring adaptations to specific places” (Hunn, 1993, p. 14). Because of this connection, traditional knowledge can be thought of as primarily applicable to the place in which it is produced.

Land, in Indigenous societies, is not merely the ground. Rather, it encompasses every living and non-living thing in the surrounding environment. This includes water, air, earth, language, animals, plants, and humans. As Fortier notes “we cannot separate culture, language, and spirituality

from the land... our culture and language flow from the land” (Fortier, 2002, p. 21). So traditional knowledge is holistic, as it seeks to understand the interconnected whole of nature, including humans.

This draws attention to an important aspect of traditional knowledge; namely, that of relevance. Because traditional knowledge is tied to a particular area and culture, applying it outside that area and culture is not straightforward. This can be taken both literally and figuratively. Literally, applying traditional knowledge outside the particular geographical area it comes from can be difficult, because the knowledge is to some extent only about that area. If you want to know about trends in caribou populations across the country, you may not be able to simply examine the trend in a particular area and extrapolate from that. Figuratively, traditional knowledge might be expressed in stories that are unique to a culture, and which are difficult for people outside that culture to understand. In the bear example above, I noted that certain lessons could be learned from traditional knowledge, e.g., that bears spread Saskatoon berries. There is an important qualification to this. Namely, that these sorts of lessons can be partial at best. Traditional knowledge is extremely complex, so the information it gives to those who are not fully immersed in the culture should not be treated as though it is complete. As McGregor notes “at its most fundamental level, one cannot ever really ‘acquire’ or ‘learn’ TEK [traditional ecological knowledge] without having undergone the experiences originally involved in doing so” (McGregor, 2008, p. 145-6). That is, to ‘acquire’ TEK is to actually experience the land, not just read about it in a paper. Note the qualification of “at its most fundamental level” here. It is dangerous to try to isolate pieces of holistic knowledge, as it is easy to forget that the knowledge you have is just one piece, not the whole. In such cases, perceived problems with the piece of knowledge might be seen as weaknesses with the knowledge system, instead of as the result of missing information.

Thinking back to the bear example, without the background knowledge that explains the quote, an outsider might think that traditional knowledge is incapable of explaining the role bears

play in the land, when in fact it is the outsider's lack of knowledge of the culture that prevents her from understanding the relevance of the explanation. Despite this danger, in most knowledge systems, there are some conclusions that can be teased apart from other aspects of the system. For example, certain principles of traditional knowledge, such as respect for nature, transcend location, and are common across many Indigenous cultures. Someone with exposure to traditional knowledge might come to recognize the value of respecting nature as a result of that exposure. In some sense, this is learning traditional knowledge. Likewise, in the bear example, while a non-Indigenous person might not fully understand the complexity of the relationship between the bear, people, and land, she might be able to understand a small part of that relationship. Namely, that the bear helps spread a plant that both humans and animals need.

This point is similar to the previous theme, although I wanted to include the discussion of compartmentalizing pieces of knowledge here because of the more geographical nature of this theme. The value that we see in this theme is that traditional knowledge is holistic in a very broad sense. Due to this holism, "pieces" of traditional knowledge cannot truly be broken off from the whole. However, certain lessons derived from traditional knowledge can be used by people educated in traditional knowledge.

2.4.3 Multi-Generational

Traditional knowledge is something that is passed on through many generations. It is cumulative knowledge built up over hundreds of years. For examples, Berkes et al. define traditional ecological knowledge as "a cumulative body of knowledge and beliefs, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes et al, 2006, p. 146). Likewise, the Dene Cultural Institute defines traditional ecological knowledge (TEK) as "a body of knowledge built up by a group of people through generations of living in close contact with nature..." (Dene Cultural Institute as cited in Stevenson, 1996).

Service *et al.* make a distinction between knowledge from observations over a lifetime, which they call local ecological knowledge, and traditional knowledge (Service et al, 2014). While local ecological knowledge has similar characteristics of traditional knowledge, for example, it is longitudinal, and can incorporate local culture and a broad meaning of land, it is not obtained via inter-generational transmission.

The fact that traditional knowledge is multi-generational means that traditional knowledge does not culminate in one person. This ties in with the previous points. Traditional knowledge exceeds the individual knowledge holder; the knowledge holder participates in the knowledge. This presents those wanting to use traditional knowledge with a problem of ensuring that the knowledge they are using is in fact traditional knowledge. That is, not all knowledge held by elders in an Indigenous community is necessarily traditional knowledge. As such, a scientist from outside the community who wants to engage with traditional knowledge needs to be careful about what they call traditional knowledge.

Finally, the emphasis on multiple generations transmitting and shaping the knowledge over centuries distinguishes between traditional knowledge and relatively recent knowledge held by Indigenous peoples. This distinction is important, as traditional knowledge is built from hundreds or thousands of years of observations, not just a lifetime.

2.5 Contested Themes

We now turn to the more contested themes found in the definitions in the literature. While the major themes are relatively uncontroversial and generally agreed upon in the extant literature, the contested themes, as evidenced by the fact that they only occur in a few definitions, are more contentious.

2.5.1 Need-based

Under some conceptions, traditional knowledge is developed out of necessity. This is sometimes cited as an explanation for the accuracy of traditional knowledge – if it were not accurate, societies that relied on it would not survive the rough environment in which they lived. For example, Guidotti writes that “the information gathered by successive generations on where to find foods, their relative abundance and changes over time, and the seasons of their ripening and availability has been key to their survival” (Guidotti, 2007, p. 168). Likewise, Hunn says that “traditions are the products of generations of intelligent reflection tested in the rigorous laboratory of survival” (Hunn, 1993, p. 13). Kalluri writes that traditional knowledge “has a strong practical component, since it is often developed in part as an intellectual response to the necessities of life” (Kalluri, 2012, p. 432).

Presuming this aspect of traditional knowledge is necessary is problematic, in that it seems to take an imperialist view of the conditions that generate traditional knowledge. It does this in two ways. First, the sense of necessity arises in part because of a view of the environment as particularly treacherous or difficult to survive in. This notion that Indigenous peoples think of their environments as particularly rough seems to be a reflection of the settler conception of the wilderness as untamed and dangerous. Indigenous peoples, on the other hand, conceive of the environment as deserving of respect, and something they have a responsibility toward (Johnson, 1992a; McGregor, 2004). As such, the premise for the argument that traditional knowledge is accurate because of the harsh land may seem plausible only from a settler perspective.

Second, there is a worrying difference between how people talk about science and traditional knowledge. When people talk about scientific theories, the language used is that of evolution; of theories competing, with the fittest theory surviving. When talking about traditional knowledge, the language shifts slightly. Instead of the theory surviving, it is the people who hold the theory surviving. If the knowledge is good, then the knowledge holder survives; if the knowledge is bad,

then the knowledge holder dies. It would be odd to talk of the Greeks surviving because of the accuracy of Aristotle's system of animal classification, but this is precisely the way people talk of Indigenous classification of animals.

As such, the concept of traditional knowledge being "need-based" may not be necessary to a good definition of traditional knowledge. This notwithstanding, the fact that the knowledge has stood the test of time and served the needs of those who hold it is good reason to give it prima facie epistemic standing. Any method of gaining information that has lasted for thousands of years is worth serious consideration. But non-Indigenous people ought to be careful to distinguish settler conceptions of the harshness of the land from Indigenous conceptions of the land when making claims about the need-based aspects of traditional knowledge.

2.5.2 Changing

According to some scholars, traditional knowledge is dynamic and responsive to change, whether this change is environmental, technological, or social. Johnson (1992a) says that traditional knowledge is "dynamic, building upon the experience of earlier generations and adapting to the new technological and socio-economic changes of the present" (p. 7). This is one of the more contentious claims about traditional knowledge, as other scholars argue that given sufficient changes to culture and environment, traditional knowledge becomes anachronistic (for example Dudas, 2005; for a response to such arguments see Whyte & Reo, 2012). However, due to the cross-generational nature of traditional knowledge, there is no principled reason that traditional knowledge could not incorporate contemporary characteristics. In fact, because traditional knowledge is an open system that incorporates external influences, it can change to incorporate new technology (Whyte & Reo, 2012; Menzies, 2006). Moreover, it is unjust to insist that traditional knowledge be static and fail to change over time, while allowing other forms of knowledge to change and incorporate new ideas and

technology. Thus, in order to preclude claims that traditional knowledge must be static, it is important to include the fact that traditional knowledge is capable of change in its definition.

2.5.3 Oral

While nearly all the definitions indicate that the knowledge is communicated, only a few specifically mention that traditional knowledge is passed on through generations *orally*. The oral nature of traditional knowledge is important, but fraught, especially given the discussion above of the repression of Indigenous languages in residential schools. Language is closely tied up in Indigenous cultures, and as we will see, translating ideas from some Indigenous languages to English is not easy. Complicating this further is the fact that the Canadian government has systematically attempted to eradicate Indigenous languages.

Aside from this, the fact that traditional knowledge is passed on orally is important if one wants to discuss the relation between it and other knowledge systems, such as science. Because science is recorded in journals, written communication is privileged. This puts traditional knowledge at a disadvantage, in terms of getting uptake in the scientific community. When discussing traditional knowledge, people should attempt to counteract the idea that written knowledge is privileged over orally transmitted knowledge.

It is important to recognize the importance of the medium in which traditional knowledge is passed on, given the importance of oral communication in Indigenous culture, and the distinction between oral and non-oral communication in comparing knowledge systems.

2.5.4 Rational

Kemmerer refers to traditional knowledge as “rational and reliable knowledge” (Kimmerer, 2002, p. 433). Similarly, Snively & Corsiglia refer to Indigenous science as a “rational perceiving of reality” (Snively & Corsiglia, 2001, p. 9). The justification for defining traditional knowledge as rational is

that traditional knowledge is developed through “generations of intimate contact by native peoples with their land” (Kemmerer, 2004, p. 433). That is, because Indigenous peoples have lived where they have for so long, their methods of understanding the world must be rational.

Like the point about traditional knowledge being “need-based,” rationality seems to be an unnecessary quality to add to a definition. This is because adding rationality to the definition presupposes some system to determine reliability. If this system is traditional knowledge, then the definition becomes circular. If the rationality-determining system is not traditional knowledge, it would likely involve science. This could lead to traditional knowledge being perceived as relying on science in a problematic way, as it would appear that traditional knowledge is only rational if science says it is. This would place science in a position of power over traditional knowledge. If the goal is *prima facie* equality between the systems, we need to be careful with how we determine rationality. While we want knowledge to be rational, the two systems should work together, as I will argue below. It seems prudent to avoid incorporating rationality into the definition of traditional knowledge. Notwithstanding this, traditional knowledge is still entirely capable of rationality.

Like “need-based”, defining traditional knowledge as rational is problematic. While traditional knowledge certainly can be rational, defining it as such is problematic as it has the potential to make science the standard for rationality.

2.5.5 Non-individual

As briefly mentioned above, some authors (Snively & Corsiglia, 1997; Service et al, 2014) indicate that traditional knowledge is something held by groups, not individuals. That is, traditional knowledge transcends individual knowers.

This claim is fairly unproblematic. Many knowledge systems exceed individual knowers – for example, some physics papers have dozens of authors, all of which are only experts on parts of the paper (Hardwig, 1991). Furthermore, the fact that traditional knowledge is held by groups emphasizes

the social and cultural aspects of it. When knowledge is held by groups, this can mean two things. Either that social epistemic structures are required, but that the knowledge is held by individuals within those groups, or that groups, and not individuals hold the knowledge. In the case of traditional knowledge, it is primarily the first of these that occurs. Social epistemic structures are essential for traditional knowledge, as it is passed down from elders to the youth through teaching and storytelling. In such cases, the knowledge is held by the elders and passed onto other individuals within the group. Furthermore, depending on what specifically is being taught, certain individuals may have an area of expertise. A seasoned hunter might know more about caribou populations than someone who does not hunt as much, but is well versed in the history of the group.

Given the importance of culture to traditional knowledge, emphasizing the fact that traditional knowledge is something embedded in groups of people (not to mention the land more broadly) is useful to understanding traditional knowledge.

2.5.6 Spiritual

While this theme is implicit in many definitions (inasmuch as spirituality is part of Indigenous culture, and culture is found in many definitions of traditional knowledge), spirituality is explicitly mentioned by only a few scholars in the literature. For instance Kimmerer (2002) notes that traditional knowledge “can arise wherever people are... spiritually integrated within their landscape” (p. 9). LaDuke (1994) notes that “traditional ecological knowledge is the culturally and spiritually based way in which indigenous peoples relate to their ecosystems” (p. 127).

The spiritual aspect of Indigenous cultures is important, and worth emphasizing apart from other aspects of those cultures. This is especially important in determining how traditional knowledge and science interact. This will be discussed further in a later section. Since spirituality is important in the culture of traditional knowledge, it should feature in the definition of it.

2.6 A New Definition of Traditional Knowledge

Given what we have discussed above, the previous definitions of traditional knowledge are in some way insufficient. Some of them touch on most of the important aspects of traditional knowledge, but none explicitly state all of them. Other definitions include valuable parts of traditional knowledge, but also include problematic traits. While I recognize that any definition will have problems, my hope is that the following definition will have *fewer* problems than the ones that came before.

Definition: Traditional knowledge is a body of knowledge participated in by groups of people in particular Indigenous cultures. Any one member of those groups does not hold it, rather, it is found in the culture of the groups. It is formed through engaging with the land over generations, and is often passed on orally. “Land” is defined broadly, so as to include language, people, animals, plants, water, and the earth, making it holistic in a very robust sense. The connection between these entities is often spiritual in nature. Because traditional knowledge has been successfully used for so long, it has significant epistemic authority. Notwithstanding its long history, traditional knowledge is fluid, and can change to incorporate new ideas and technologies.

This definition captures the important themes found in previous definitions, without including the problematic aspects of those definitions.

There is one further qualification to make. The term “traditional knowledge” itself is problematic for three reasons. First, it hints at homogeneity across different Indigenous cultures that may not exist (McGregor, 2008). There are variations within Indigenous cultures that are not captured by the term “traditional knowledge”. The blanket singular term does not draw attention to the fact that knowledge held by one Indigenous culture may differ from knowledge held by another.

Second, the word “traditional” is a word that roots the knowledge in the past (Ibid.). While the long history of traditional knowledge is important, some scientists have expressed scepticism about traditional knowledge because they think it “is being irreversibly eroded by the assimilation of

aboriginal peoples into Western culture” (Johnson, 1992a, p. 10). Because traditional knowledge is flexible and can adapt to new technologies, the term “traditional” has the potential to hold it back. That is, “traditional” calls to mind a relic of the past, and does not capture the flexible, responsive nature of the knowledge we wish to discuss.

Finally, the word “knowledge” does not fully capture what happens in what is referred to as traditional knowledge. Traditional knowledge involves interacting with the land, and is therefore active. The term “*knowledge*” does not translate easily into most verb-based Indigenous languages” (Aikenhead & Ogawa, 2007, p. 553). “Knowledge” in the Western tradition is typically thought of as something one *has*, not something one *does*. Because of these qualifications, I suggest using a new term: Indigenous Peoples’ Understandings (IPUs). The plurality of “peoples” avoids false homogeneity, and avoiding the term “traditional” does not confine the discussion to the past. Moreover, using “understandings” instead of “knowledge” better captures the participatory way Indigenous peoples interact with the land, and the plural form acknowledges the diversity of perspectives of Indigenous peoples. Furthermore the term “understanding” better captures the epistemic aspects of the interaction with the land. As in the definition given above, this new term is likely problematic in some respects. However, I hope it is a step in the right direction toward less problematic ways of talking about the topic.

2.7 What are Values?

We will now turn to a discussion of the fundamental values that underlie IPUs. Values, roughly speaking, are normative goals separate from a method of inquiry, which serve as guidelines regarding that method. This requires some unpacking. Essentially, values are normative expressions of things we care about. When examining inquiry, particular values are relevant. We might care about a great many things, but only some of them will influence how we go about making inquiries about the world.

There are three concepts embedded in values for inquiry. First, values are normative goals. This means that values are a standard at which something aims. In this case, we are concerned with the standard to which inquiry into nature aims. As such, this inquiry can be done well or poorly, depending on how well it meets its goal. Second, these goals are separate from the method of inquiry itself. The goal of a method of inquiry such as science is to understand the natural world, not merely to perform the action of studying the world. That is, science does not aim to achieve the criteria for their own sake; it aims at achieving the criteria for the sake of creating a good explanation of the world. Finally, these values serve as guidelines for evaluating the output of inquiry. Inquiry done well is inquiry that explains the natural world in accordance with those guidelines, and inquiry done poorly is inquiry that offers an explanation, but does not conform to them. We now turn to the values found in IPUs.

2.8 Values in IPUs

Given the definition of IPUs, and our understanding of values, what are the core values of IPUs? There are two main values that are central to IPUs: robust holism and responsibility. I should note from the outset that this list is not exhaustive, and IPUs might very well include other values. For example, it is likely that traditional knowledge should be consistent with itself. That is, it should not claim X and $\sim X$. This value is not in any way unique to IPUs, or for that matter, science, so we will not be dealing with it here. Note that this argument will not apply to my use of responsibility, as the notion of responsibility I use in this paper is specific, not generic responsibility (see section 2.8.2). There are any number of values that form a penumbra around the core values found in IPUs and science. While a discussion of such values would doubtless be interesting, it would take up a great deal more space than this paper. As such, this thesis will deal only with the core values.

2.8.1 Holism

As discussed above holism is both extremely robust, and integral to IPU. By holism, I mean the complex interconnected nature of the world, including both humans and nature. As Berkes *et al.* note, “the Cree and the Inuit are generally reluctant to make linear, well defined, cause-and-effect connections, as often done in Western science... [M]aking simplifications and generalizations of complex phenomena is ‘childish’ and without sense” (Berkes et al, 2006, p. 153). Likewise, McGregor remarks that “in the Anishinabe tradition, one of the main features of knowledge, based on thousands of years of living sustainably with Creation, is its holism: the recognition that all aspects of Creation are inter-related” (McGregor, 2012, p. 10). In the same paper, McGregor gives an example of how this works within the context of water management. She says “water is not a single, discrete aspect of the environment; it is part of a greater, interconnected whole. When one considers water, therefore, one must consider all that to which water is connected and related” (Id, p. 10). As such, holism is deeply important to IPU.

2.8.2 Responsibility

By responsibility I mean something akin to the duty one owes one’s relations. Wilson (2008) describes it as “being accountable to your relations” (p. 77, see also Latulippe, 2015). As such, the value of responsibility found in IPU should not be thought of as paternalistic, where humans dominate the land. Whyte notes that many Indigenous people view the relationship as one that “connect[s] diverse parties (from humans to forests) as *relatives* with reciprocal *responsibilities* to one another (Whyte, Forthcoming, p. 2) see also (Chiefs of Ontario, 2008). In traditional knowledge, everyone is part of the land. Because of this, no one is in a position of authority over the land. “Indigenous peoples... see themselves as belonging to [the land] rather than it to them” (LaDuke, 1994, p. 146). Rather, people work in partnership with the land to help each other. Because people and the land depend on each other, people have a responsibility to care for the land.

2.9 Centrality of these Values

These two values are central to IPU. The value of holism is deeply important to understanding Indigenous conceptions of nature. Holism is rooted in the creation stories found in many Indigenous cultures. McGregor (2012) notes that

The Creation stories of First Nations people vary from nation to nation, although there are remarkable similarities among the concepts and messages contained in these stories. Teachings that emerge from Creation stories uphold ideas of holism and the importance of inter-relationships among all elements of Creation” (p. 3).

As such, holism is one of the fundamental values to Indigenous culture, and it structures Indigenous explanations of the world. Likewise, responsibility is one of the most central values to many Indigenous accounts of the world. McGregor (2004) writes that

Traditionally, Aboriginal people in Canada understood their relationship with Creation and assumed the responsibilities given to them by the Creator. The relationship with Creation and its beings was meant to be maintained and enhanced... The responsibilities that one would assume would ensure the continuation of Creation...” (p. 389).

So responsibility for the world is, like holism, central to Indigenous stories and culture.

There are many other values that can be learned through Indigenous stories. McGregor (2004) notes that some of these include “respect, coexistence, cooperation, honor, thanksgiving, reciprocity, balance and harmony, and recognition of interrelationships among all of Creation” (Ibid.). Similarly, the Seven Grandfather Teachings of the Anishinaabe include wisdom, love, respect, bravery, humility, honesty, and truth (Borrows, 2008). While all these values may to some degree be incorporated into IPU, holism and responsibility are most central to them. Note that some of these values—I am thinking here particularly of cooperation—are important for co-production. But the goal of this section of my thesis is to show the compatibility of values in IPU with values in SU.

2.10 Conclusion

As we have seen, the relationship between settlers and Indigenous peoples is troubled, as is the role science has played in that relationship. We have seen how the current definitions of traditional knowledge are – to varying degrees – problematic, in addition to the fact that the term “traditional knowledge” is flawed. However, with the new definition and the new term “Indigenous Peoples’ Understandings”, we can move toward a better account of what was known as traditional knowledge. Finally, we examined two core values found in IPU. We now turn to a brief discussion of science, and the role values play there.

Chapter 3

Science

Now that we have a better understanding of IPUs, we ought to ensure our understanding of science is equally clear. While IPUs are discussed less in academia than science, this does not mean that science has a universally agreed upon definition. I will be using philosophy of science to critically examine the definitions of science used in the literature on IPUs. Many of the conceptions of science found in this literature misrepresent science, leading to the mistaken idea that IPUs and science might be incompatible. As we will see, there are several different definitions of science that appear in the major literature on IPUs, and several different terms used in place of “science”. Just as in our examination of traditional knowledge, I will break these definitions down into themes. Due to the smaller number of definitions available in the literature on IPUs (see Appendix B), I will not distinguish between major and minor themes. The point here is not to create a fully developed theory of what science is. Rather, it is to develop a working definition and to understand the themes that underlie science. I will also introduce a new term for science, to work in conjunction with IPUs.

3.1 Themes

3.1.1 Empirical

Scholars who work on IPUs see science as something accomplished through empirical observation of the world. Usher (2000) notes that science is “based on empirical observation” (p. 9). As such, science restricts itself to what can be empirically measured. Because science is empirical, it is open to empirical criticism. As such, it is open to criticisms from IPUs. As we will see later on, there are many cases where IPUs have shown where science has been in error. The empirical nature of science,

unlike the next theme we will discuss, is widely accepted by both philosophers of science and scientists.

3.1.2 Detached

Some of the academic literature on IPU brings up the notion that scientists ought to try to prevent personal biases from influencing their work. For example, Johnson (1992a) says that “the observer must deliberately separate oneself from that being observed” (p. 9). Likewise, Briggs (2005) notes that western science is “dependent very much on being a detached centre of rationality” (p. 9).

It is odd that this characteristic of science is found in the literature surrounding IPU, as in philosophy of science the value-free ideal is typically dismissed (Douglas, 2009; Longino, 1987). While science should be free from undue bias—for example, it should be free from deception, fraud, and wishful thinking—this does not mean that science is, or should be, free from any personal influences. Values play a large roll in nearly every aspect of scientific inquiry, as we will see.

3.1.3 Compartmentalized

Science in the IPU literature is sometimes thought of as breaking down nature into its component parts and studying them in isolation. For example, Agrawal says that “the scientific mode of thought is characterized by a greater ability to break down data presented to the senses and to reassemble it in different ways” (Agrawal, 1995, p. 7). Likewise, Johnson notes that reductionism is one of the fundamental assumptions of science, and defines reductionism as “the understanding of complex phenomena by breaking down data and reassembling it in different ways” (Johnson, 1992a, p. 12).

However, many areas of science are relatively holistic. Importantly, the branch of science which is arguably most closely related to IPU—ecology—is deeply holistic (Folke, 2006).

3.1.4 Universally Applicable

Science in the IPU literature is typically considered something that is not constrained by geographical or cultural boundaries. For example, Hunn notes that “modern science... is a system of knowledge in rapid flux that seeks universal rather than local understanding” (Hunn, 1993, p. 13). If a scientific theory is correct, it is correct regardless of time or place. Science “assumes that the universe is... a vast single system in which the basic rules are everywhere the same” (American Association for the Advancement of Science, 1989).

If the basic physical rules are the same everywhere, a scientific theory should work regardless of where it is applied. In general, science attempts to make claims with the broadest possible scope and applicability as possible. This is potentially in conflict with IPUs, which are tied to a particular location and culture. However, certain areas of science are localized to particular places and cultures as well. Importantly, ecology is sometimes contingent on specific local conditions. This could be an area where there is significant overlap between IPUs and science.

3.1.5 Open

One of the hallmarks of academic science is that it is published for examination by the broader community. While this is not stated in definitions in the literature on IPUs, it is implicit in all of them. Science is open knowledge, so when it is published, it is accessible—at least in theory—to the general population. This does two things. First, it increases the prestige of the author. But more importantly, it allows for scrutiny of the work by the author’s peers, thus promoting the accuracy of information. This theme is not explicitly found in definitions of science in the IPU literature, but it is hinted at in discussions of the oral nature of IPUs. Nevertheless, it is an important part of science, and will prove useful when we discuss power relations between IPUs and SUs.

3.2 New Definition

These themes are all found to varying degrees in definitions of science in the IPU literature. Because of that, we will use a basic definition of science that captures most of these themes. We will omit the theme of the detached nature of science, as it is inaccurate to attribute that characteristic to science. I will define science as follows

Definition: an empirical study that uses observational data, that controls for personal bias, and is published with the goal of explaining some natural phenomena.

This definition may not perfectly capture all aspects of science. However, it will suffice for the purposes of this paper.

3.2.1 The Term

In addition to a diverse set of definitions, there are several terms used for science in the literatures on IPUs. These include “wildlife science”, “western science”, and “western knowledge”. In this paper, I will use the term “scientific understandings” (SUs), as the other terms are either too specific or inaccurate. “Wildlife science” does not capture the breadth of topics on which science and traditional knowledge have something to say. For example, both science and traditional knowledge have things to say about lichens, whereas wildlife science concentrates on vertebrate animals. I avoid the terms “western science” and “western knowledge” because science is not unique to the western world. Science is done all over the world, so it is improper to label it as “western”. In the literature on IPUs, there is typically a contrast drawn between TK/TEK/etc. and Western or Modern science (see for example Johnson, 1992a and Snively & Corsiglia, 2001). This characterization of science puts it at odds with IPU from the start. Contrasting “modern” with “traditional” puts the former in a position of power over the latter. “Scientific Understandings” avoids these pitfalls.

There is a further benefit of introducing “understandings” to the term. The plural form indicates the variety of ways in which science is done. While mathematical models and fieldwork are

both science, they are very different approaches to understanding the world. Furthermore, “scientific understandings” fits with the term “Indigenous peoples’ understandings” introduced in section two. By using “Understandings” for both systems, I hope to place them on semantically equal footing. Using the same term for each system emphasizes that both IPU and SU are perspectives on the world. Each has its own methods, and is grounded in a unique history and set of values and assumptions. We now examine in more detail the values in SUs and the roles they play.

3.3 Values in SUs

For the purposes of this essay, I will be using the four values found in Merton’s 1942 work “Science and Democratic Social Structure”. These values are universalism, communism (more commonly referred to as communalism after 1945, for obvious reasons), disinterestedness, and organized scepticism. I will be using Merton’s iconic account of values as it has met with few criticisms. Some have argued that scientists do not actually hold these values while doing science, but this can be responded to easily. These values are meant as an ideal; they may not always be followed in actual practice, but remain ideals towards which scientists strive. We will examine each of Merton’s four values in order.

3.3.1 Universalism

For Merton, universalism is not a matter of the scope of science. Rather, it has to do with the treatment of people and theories regardless of where they come from. He says that “truth claims, whatever their source, are to be subjected to *preestablished* [sic] *impersonal criteria*: consonant with observation and with previously confirmed knowledge” (Merton, 1942, p. 607, emphasis in original). Both theories and people ought not be excluded from science as a result of “particularistic criteria of validity” (ibid.). “To restrict scientific careers on grounds other than lack of competence is to prejudice the furtherance of knowledge” (Id., p. 609). That is, the only criteria that should judge

whether a theory or a person is admissible to the institution of science are those which are impersonal and universal.

3.3.2 Communalism

Communalism is the value that says that knowledge should be propagated and held by communities, not individual scientists. As Merton notes, “the substantive findings of science are a product of social collaboration and are assigned to the community. They constitute a common heritage in which the equity of the individual producer is severely limited” (Id., p. 610). When a piece of scientific information is discovered, it needs to be communicated: “secrecy is the antithesis of this norm; full and open communication its enactment” (Ibid.). That is, science should be open to public scrutiny.

3.3.3 Disinterestedness

Disinterestedness flows from the scrutiny discussed above, and has to do with the public character of knowledge within communities. Within scientific communities there are a “wide range of motives which characteriz[e] the behavior of scientists” (Id., p. 613). Because of these diverse and impersonal interests, “fraud, chicanery and irresponsible claims” are unlikely to occur. That is, science as a discipline promotes disinterested pursuit of knowledge. So cheating to serve personal interests is discouraged by “the scrutiny of fellow-experts” (Ibid.).

3.3.4 Organized Scepticism

The final value central to the ethos of science Merton discusses is found interrelated throughout the previous values to some extent. This is the value of institutionalized scepticism. Scientists ought to be sceptical of most claims. This scepticism involves “the suspension of judgment until the ‘facts are at hand’ and the detached scrutiny of beliefs in terms of empirical and logical criteria...” (Id., p. 614).

So far we have described the values that are central to science. We now turn to the role that values play in science.

3.4 Categorizing Roles for Values

Now that we know the values found in IPU and SU, we can examine how those values influence inquiry into nature. While there has been a great deal written about values in science, I will only be dealing with a small portion of the literature, specifically, Heather Douglas' direct and indirect roles for values. The goal of this section is understand the role values play in both IPU and SU.

Douglas distinguishes between two different roles values can play: direct and indirect. It should be noted that she is discussing all values, not just the constitutive values for science discussed above. Values should directly influence science only in certain decisions, while they can legitimately play an indirect role throughout science. When values play a direct role, they “determine our decisions in and of themselves, acting as stand-alone reasons to motivate our choices” (Douglas, 2009, p. 96). Values play a direct role in choosing which scientific projects to undertake, in choosing which projects receive funding, in deciding which methodology to use. Note that this means that values can legitimately restrict methodological choices. However, values should *not* be used to interpret evidence or accept theories in a direct way. If this were the case then “the value the scientists placed in the theory could override the evidence” (Ibid.). So in such cases, values should only play an indirect role.

In the indirect role, values serve to assess the sufficiency of evidence for a claim, rather than as a reason for the claim. This indirect role allows values, particularly social and ethical values, to legitimately permeate science, as they “serve a crucial role of helping us determine whether the available evidence is sufficient for the choice and what the importance of the uncertainty is” (Id, p. 97). An example of this is determining what “level of statistical significance is... need[ed] before deciding that a result is ‘significant’” (Id, p. 104).

We can use this distinction to see how the values listed above influence inquiry into nature. “Inquiry” here is meant as a general term, to include both IPUs and SUs, inasmuch as both of these seek to understand nature. Douglas’ account of the role of values, while developed for science, is applicable to inquiry into nature broadly construed. That is, it can be applied to both IPUs and SUs. The importance of a clear account of the role of values is that values ought to influence science only in certain ways. When used inappropriately, values can impede scientific inquiry. But this is not limited to science, as values can appropriately or inappropriately inform other types of inquiry. For example, let’s say I value my health. The value of health tells me that I should look for nutrition information. The relative unimportance of uncertainty—I am unlikely to be seriously harmed if there is .1 more grams of fat in chicken than the box says—tells me that I shouldn’t spend a fortune on laboratory testing to see if what is written on the box is true. That is, the available evidence (the nutrition information on the box) is sufficient for my choice of food. So Douglas’ account of values is applicable to other forms of inquiry besides science. Likewise, her account of the role of values can be applied to IPUs. For example, the value of responsibility to the land can play a direct role in what people wish to study. It can guide people, whether they are traditional knowledge holders, non-Indigenous scientists, or Indigenous scientists, toward asking certain questions rather than others. Someone who understands their responsibility to the land would likely rather research the harmful effects of arctic oil drilling, rather than looking to find oil for the purposes of drilling for it.

Douglas talks about how values can influence science, but as we will see, this conceptual structure can be useful beyond the discussion of science as such. The value of holism can play a direct and indirect role in inquiry into nature by determining how much and what kinds of evidence are sufficient. If one treats nature as a whole (in the robust sense), then one will require a greater variety and breadth of data before claiming understanding about nature. For example, say a scientist is studying the population of caribou in an area of the arctic. Without holism playing its indirect role,

she might be satisfied with a survey of the population over five years, and note a general trend. However, with the temporal aspect of holism playing its role, such a short time might not be enough. Likewise, merely counting the caribou might not be sufficient. Because caribou are part of the land, someone who subscribes to the value of holism might decide that in order to make a claim about the trend in caribou populations, we ought to also look at the wolf populations, lichen health, weather patterns. That is, if one subscribes to the value of holism, merely counting animals may not be sufficient evidence to make a claim about that animal's population trends. As such, holism directly influences what counts as sufficient evidence.

3.5 Compatibility of IPU's with SUs

Now that we are clear on what values are central to IPU's and SUs, and the roles values play in inquiry, we should discuss the compatibility of those values. To recap, the values central to IPU's are holism and responsibility, and the values central to science are universalism, communalism, disinterestedness, and organized scepticism. We will look at each of Merton's values, to see in what ways they are compatible or incompatible with holism and responsibility. Although universalism, communalism, and organized scepticism have *prima facie* little to do with holism and responsibility, they are plausibly shared by IPU's. However, disinterestedness is directly compatible with responsibility.

Universalism neither conflicts with nor is shared by either holism or responsibility. However, it is worth noting that it is compatible with IPU's, as it says that truth claims ought to be subjected to impersonal criteria and fit with previously confirmed knowledge, no matter what their source is (Merton, 1942, p. 607). In this way, both truth-claims from IPU's and SUs are on a conceptually level playing field. The source of the claim should not preclude it from discussion. As such, any scientist who mistrusts IPU's as a source of information ought to be careful about the criteria she uses to make

that judgment. However there is one way that universalism could conflict with IPU's. This stems from Merton's idea that truth claims are subjected to "previously confirmed knowledge". The question is, who confirmed this knowledge? If it is only scientists who decide which knowledge new truth claims must fit with, there is a risk that marginalized knowledge will be ignored. That is, if IPU's make a claim about some feature of the environment that does not fit with what scientists believe, they will reject it because it does not fit with their worldview. As we will see, this is why it is important to include Indigenous peoples in projects from the beginning. If both views are given equal weight from the start of a project, such problems can be avoided.

Communalism, holism, and responsibility are similarly not directly related, although they are relevant to the discussion of IPU's and SUs. As we have seen, IPU's are developed and held by communities. Merton notes that "the substantive findings of science are a product of social collaboration" (Id., p. 610). This quote could easily be changed to be about the findings of IPU's. IPU's are generated over time by communities, and are spread throughout those communities. Interpersonal and intergenerational communication within Indigenous groups is an important part of IPU's. As such, the value of communalism supports the theme of community in the definition of IPU's. However, this brings up a possible area of tension: notwithstanding the openness within communities, IPU's are not always unproblematically shared with outsiders. This will be discussed further in chapter 4.6.4.

Disinterestedness and responsibility are compatible with one another. Recall that disinterestedness has to do with how the social character of knowledge prevents fraud. This is analogous to how the social character of IPU's prevents false information from spreading. Recall also that the responsibility central to IPU's is like the responsibility one has to one's relations. Fabricating false stories about the land is therefore akin to fabricating false stories about one's relatives. This sort of treatment would likely result in censure from one's community, just as fabricating results in a study would result in censure from one's colleagues.

Organized scepticism, like universalism and communalism, is not directly related to the values of holism and responsibility. That is not to say that it is incompatible with them, or that it has nothing to do with them. As we will see, relationship building is important for Indigenous peoples and scientists to work together well. In order for this to happen, it is important that Indigenous peoples are aware that this organized scepticism is part of what it is to do science. That is, they should not necessarily view scepticism as an attack on their worldview. On the other hand, scientists should do their part to ensure that scepticism is equally distributed across both IPU and SU. They should be willing to admit the places where SUs struggle, and be open to new solutions.

As we can see, the values central to IPU and SU are either not *incompatible*, or are compatible with each other. In the cases where the values have little to do with each other *qua* values, they are nevertheless important to the broader discussion of IPU and SU. As such, these two sets of values can be used to inform a single project.

Chapter 4

Co-production

Co-production is, speaking broadly, the collaborative creation of a piece of knowledge between Indigenous people who hold IPUs and scientists who hold SUs. Despite the fact that there are a great many papers that discuss both IPUs and SUs, there are very few definitions of co-production found in the literature. As such, some of the definitions discussed below are partial. However, even these partial definitions point us toward important points, and a more fully developed definition. Co-production is a normative term, that is, it can be done well or poorly. As it stands now, IPUs are primarily used to inform science, and as we will see this counts as poorly done co-production. Co-production done well would put traditional knowledge and science on equal footing. This could include using IPUs to inform SUs, but it would also include SUs informing IPUs. I will first describe the main themes found in the definitions of co-production. I will then analyze the roles for values in co-production, and assess the possible benefits co-production offers, as well as the tensions between IPUs and SUs in the co-production process.

4.1 Themes

4.1.1 Informing vs. Interacting

In many discussions of co-production found in the literature on IPUs, it is implied that IPUs primarily function as something that supplements SUs. For example, Riedlinger and Berkes say “There is room for more progress in accepting traditional knowledge as a source of knowledge” (Riedlinger & Berkes, 2001, p. 326). Berkes also says that “Inuivialuit observations cannot replace scientific measurements, but they can contribute to the overall understanding of the phenomena of change and its impacts *by complementing scientific approaches*” (Berkes et al, 2006, p. 157, emphasis mine). Likewise, McGregor (2008) notes that “The field to date has focused more on gathering and

documenting, using social science methods, those aspects of the knowledge base that are considered of value to external non-Native interests” (p. 146). So as it stands now, IPU are typically used to inform SUs. While IPU have a great deal to say about a variety of topics that scientists are interested in, it is dangerous to think that IPU informing science is the *best* way that the two bodies of knowledge interact. Descriptively, IPU informing SUs is how they interact, but this is not ideal, as I will argue. There are several reasons that mutual interaction between the systems is better than merely using IPU to inform SUs.

Let me first sketch why a mutual interaction is preferable to unidirectional informing. The first reason interaction is better than informing is that IPU offer valuable criticisms of certain biases found in SUs. We will see examples of this below. Second, SUs have value for IPU. That is, as it currently stands, science develops hypotheses, and sometimes uses traditional knowledge to support or falsify them. However, insofar as traditional knowledge develops theories of how the world is, science can be used as pieces of knowledge to support or refute certain ideas traditional knowledge puts forward. That is, science can be a tool in the hands of Indigenous people. Third, using IPU to inform SUs is dangerously close to appropriating IPU, which is problematic given the troubled history of Canada and Indigenous peoples. As it stands “a level of trust sufficient to make Elders and other TEK holders comfortable sharing their knowledge does not yet exist between First Nations and various government agencies” (McGregor, 2008, p. 148). These ideas will be developed more fully in the section below entitled “Three Ways of Co-Producing”.

IPU *can* inform SUs, so including this as part of the definition is unproblematic, so long as it is understood that this is only a limited part of co-production, and the co-production done well will include traditional knowledge and science as *prima facie* equals. Mutual interaction between the two methods is one of the most important parts of legitimate co-production.

4.1.2 Pluralism

For the purposes of this paper, I will define pluralism as different perspectives on the world caused by different experiences. Since IPU and SU offer different perspectives on the world, the use of these two viewpoints in a single project is pluralist. As Service et al. note, “indigenous knowledge and western science [offer] multiple lines of evidence” (Service, et al 2014, p. 7).

The different cultural backgrounds and methods used by practitioners of IPU and SU offer unique ways of engaging with common issues. These ways compliment each other, leading to a more complete picture of the issue. For example, from 2002-2006, researchers in Alaska joined with the local community to study bidarkis (also known as chitons), which are small marine mollusks. Scientists worked alongside Alutiiq residents in the “design of the research questions, selection of the survey sites, and the actual fieldwork” (Huntington et al, 2011, p. 439). By using traditional knowledge about aspects of the project such as the history of the bidarkis and the effect new technology had on harvesting techniques alongside field ecology techniques, the project gained a “more complete picture of the history and social-ecological context of recent field results” (Ibid.).

In *Subjects, Power, and Knowledge* Helen Longino examines the notion of objectivity in relation to pluralism (Longino, 1993). She argues that the best science is that which occurs within a pluralist framework. Only when fundamental assumptions are questioned can problematic assumptions be avoided. This sort of questioning requires a plurality of perspectives. She suggests that “scientific knowledge is constructed not by individuals applying a method to the material to be known but by individuals in interaction with one another in ways that modify their observations, theories and hypotheses, and patterns of reasoning” (Longino, 1990, p. 111). If people from different points of view—that is, if people from both traditional knowledge and scientific backgrounds—do not work together, the values and background assumptions that shape science will not be revealed (Ibid.).

However, when diverse groups do work together problematic assumptions can be brought to attention and dealt with, making the project more objective.

While Longino's work was primarily concerned with including women's voices in science, we can draw a connection between the need to include women's voices and the need to include Indigenous people's voices. Both women and Indigenous peoples have been—and are—marginalized in the creation of knowledge that the scientific community accepts. For example, a report found that Canadian women are “much less likely to choose a career in STEM areas” (Hango, 2013). Hango hypothesizes that this is because of social reasons, not due to ability (Ibid.). Likewise, Williams et al (2014) identified four patterns of gender bias that affect women of colour in science. Compared to men (especially white men), women of colour have to provide stronger evidence that they are competent, balance between being too feminine, or not feminine enough, they must fight stereotyping about motherhood, and must avoid conflict with other women (p. 3). These factors must be overcome by marginalized women working who wish to contribute to science. In the Williams et al study, a Native American women scientist was interviewed about her experience working in science:

She likened her experiences communicating with members of the dominant culture to ‘two aliens meet[ing].’ ‘There’s no room for common understanding...’ To be a scientist who is also a Native American, ‘You have to be okay with being totally ostracized in every way... You have to be willing to continually confront that. (Williams et al, 2014, p. 48; ellipses in original).

In Western society, SUs are privileged by most people as the best source of information about the natural world, so women and Indigenous people have been to some extent excluded from fully contributing to discussions involving nature. Longino argues that by including women's voices, science can be improved, as women have a different perspective that can identify and critique assumptions men make. Likewise, Indigenous peoples have different fundamental assumptions that allow them to point out problems with SUs.

Longino (1990) notes that there are four criteria that are necessary “to achieve the transformative dimension of critical discourse” that makes pluralism epistemically valuable (p. 112). If these criteria are met, then an “interactive dialogic community” that “facilitates transformative criticism” can emerge (Ibid.). The first criterion is that there must be “publically recognized forums for the criticism of evidence, of methods, and of assumptions and reasoning” (Ibid.). This sort of forum exists in the interviews, meetings, and fieldwork that are involved in co-production. Longino had in mind a somewhat formal definition of “forum”, such as a conference or published papers and responses. However, the interviews, meetings, and fieldwork that occur in co-production, despite the apparent lack of formality, are sufficiently public to count as a forum in the relevant sense. In fact, they are often more likely to be recognized by Indigenous peoples than publications in journals or academic conferences. During a co-production project, members from both groups meet to discuss what they want to achieve with the project, how they will go about achieving it, and what problems they might encounter. This discussion often occurs in interviews, but can also occur in the field.

The second criterion is that “beliefs and theories must change over time in response to critical discourse taking place” (Ibid.). There is evidence of this occurring in at least some cases. Robert Stephenson, for example, over the course of his studies on wolves, changed his way of understanding as a result of the time he spent with the Nunamiut people. “Later, his wolf work would reflect an appreciation of the animal that was a blend of his academic knowledge and a primitive [*sic*] sensitivity that had been awakened, nurtured, and formed by his association with the Nunamiut” (Lopez, 1978, p. 79). That is, Stephenson’s way of understanding wolves was changed through prolonged interaction and discourse with people who had a different background from him.

The third criterion is that “there must be publically recognized standards by reference to which theories, hypotheses, and observational practices are evaluated” (Longino, 1990, p. 112). Longino notes that although some shared ground is needed, there does not have to be a single

common standard across communities, and that the standards will likely involve such values as “accuracy, coherence... fulfilling technical or material needs or facilitating certain kinds of interactions between a society and its material environment or among the society’s members” (Ibid.). Co-production done well will likely involve both groups meeting these standards. The accuracy of information created through co-production will likely be high, as co-production involves two groups of experts collaborating on a project. Proper co-production will benefit both groups in some way, so some technical or material needs of both parties will be fulfilled. Finally, because co-production will involve discussion and interaction among groups of people, co-production is likely to facilitate interactions between a society’s members.

Before shared standards can be developed, there must be some form of common ground between the two groups. The example of the bidarkis study above shows that in co-production both groups need to have similar goals. By goals here, I mean similar, or at least compatible, hopes for the outcomes or result of the project. Ideally the result of the project—that is, the piece of knowledge that comes from the project—is useful to both groups. But it is possible for the goals to be slightly different, so long as they are similar enough that the groups can work together productively. In the bidarkis study, both groups might have wanted to understand the animal better, but the scientists may also have wanted to learn about how modern technology was affecting harvesting techniques, while the Indigenous people may have wanted to learn about how SUs can help them understand the effects an invasive species might have. Despite the fact that these goals are slightly different, there is nothing contradictory about them, and there is overlap. This overlap is important for co-production to function well. If the two groups have different goals, they are unlikely to be able to co-produce coherent knowledge. But once goals are established, standards can be agreed upon to accomplish those goals. So with some common ground, common standards—and therefore Longino’s third criteria— can be met.

The last criterion is that there must be equal intellectual authority between the groups. This criterion is slightly more complicated, as SUs are generally believed to have extremely high intellectual authority. However, we must remember that IPUs are located in a particular place and in a particular culture. Indigenous peoples have a special relationship to the land that gives them intellectual authority, making them experts in matters related to their land. So there is at least a *prima facie* reason to think that in co-production projects IPUs and SUs can be on equal authoritative footing. In the course of co-production projects, IPUs need to be treated as equals if the project is to count as legitimate co-production.

So co-production meets the four criteria, and co-production projects are capable of joining diverse perspectives on the world. To sum up, our understanding of the world improves when there are different background assumptions that inform our study of it. The differing assumptions allow people to see how their assumptions influence their inquiry. As such, different background assumptions leads to a better understanding of the world. The fact that the two ways of understanding the world offer different but, given the common areas of focus, equally relevant and authoritative perspectives is an important part of co-production.

4.1.3 Meta-Knowledge

The knowledge of what one knows, and the limits of what one knows are extremely important to good co-production. “Only when both groups [Indigenous peoples and scientists] develop an appreciation of, and sensitivity to, the strengths and limitations of their respective knowledge systems can integration begin to occur” (Johnson, 1992a). This includes knowledge of one’s own discipline, and of the other discipline one is working with. It also includes the knowledge of the strengths and limitations of one’s own discipline.

Understanding the limits of one’s discipline is important for working with complementary disciplines. Out of this flows another concept: respect. Epistemic humility allows people to recognize

the value that other views bring to the table. By recognizing the limits of one's knowledge, one can more easily appreciate the value of solutions to those limits that others can provide. Recognizing this value in others is important to co-production.

4.2 A New Definition

Definition: Co-production of knowledge between IPUs and SUs is the creation of new information by working together to understand the world. It involves mutual understanding, interaction, and respect, as well as the recognition that each party brings something important to the discussion.

Note the use of the word “information” here. This is deliberately thin, in order to not limit the sorts of things that can be created by co-production. While “knowledge” might seem to fit better, it does not accurately capture the participatory aspects found in IPUs. Using “information” as a general term allows different co-production projects to create different sorts of information, that might be excluded by using a word such as “knowledge”.

4.2.1 Normative Term

The definition of co-production given above is normative. That is, any particular instance of scientists and Indigenous peoples working together is *not* necessarily co-production. In order for such a collaboration to count as legitimate co-production, it must meet the conditions set out in the definition. If, for example, scientists pay “lip service” to Indigenous input, while making no real effort to understand that input, such a collaboration would not count as co-production. Or, if the scientists were not forthright about the reasons for wanting to collaborate – if everyone agreed to study whale populations for conservation purposes, but the scientists used the data to say that drilling for oil would disrupt only a few whales, this would not be co-production. This is because co-production is deeply social. It is not just the creation of a piece of information (although creation of

information is a large part of it). Rather, co-production involves relationship building across cultures. Honesty and trust are a large part of that.

In addition to only certain instances of collaboration counting as co-production *at all*, proper co-production can be done well or poorly. That is, we can say that once a certain level of collaboration is reached, a project counts as co-producing knowledge. But if the participants work together beyond that threshold—a sort of supererogatory co-production—then we might consider the project to be a very good example of co-production. One example of a particularly well-done case of co-production can be found in a paper called “Traditional Knowledge of the Ecology of Beluga Whales (*Delphinapterus leucas*) in the Northern Bering Sea, Chukotka, Russia” (Mymrin, Communities of Novoe Chaplino, & Huntington, 1999). The methodology of the study involved a great deal of input from local people, who had the opportunity to review and correct the paper.

The participants in the project were selected with the help of the community council and elders in each village. Mymrin began the research with group or individual interviews, recording them on tape. Later, he prepared printed reports and returned these to the participants for corrections and additions. Following this review, he again conducted individual interviews, asking questions to clarify and expand what was in the report. During this stage, some of the hunters wrote to him and submitted additional notes. This information has been added to the relevant sections of the report. Huntington and Mymrin (1996) include the text of these contributions along with descriptions of the participants and their experiences. (Mymrin, Communities of Novoe Chaplino, & Huntington, 1999, p. 63).

Beyond these inclusive methods, the communities Mymrin sought feedback from are cited as authors of the paper.¹ This is important, as the knowledge in the paper is presented as that of the Indigenous

¹ Oddly, when I was looking at papers that cited this one, two papers (of nine) did not include the communities in their citation. In “Who Knows? On the Importance of Identifying “Experts” When Researching Local Ecological Knowledge” the author portion of the citation reads “Huntington, H. P., and Mymrin, N. I.”, with no mention of the communities. Another paper, “Enterotoxemia Caused by *Clostridium perfringens* Type C in White Whale (*Delphinapterus leucas*)” has the same citation. This

community, rather than belonging to the outside author (Smith & Sharp, 2012 see also Turner & Clifton, 2009). So not only is there a threshold to meet before a project can be considered co-production, but beyond that minimum threshold co-production can be done well or poorly.

There is a further way in which co-production is normative, which comes out of the reasons why we ought to do co-production. This will be dealt with later on in this chapter.

In sum, good co-production involves input from both parties from the start of the project. This includes input on methodology and the purpose for which the research is being done. Co-production must be done with respect for alternative views, and recognition that each approach brings something useful to the table, otherwise it will not meet Longino's four criteria described earlier in this chapter.

4.3 Three Ways of Co-Producing

We will now examine three potential ways co-production can occur. The first is when IPUs inform SUs. This will be divided into two types: the first is where there is minimal interaction between Indigenous people and scientists, and will not count as co-production. The second is where there is appropriate interaction between the groups, and will count as co-production. The second way co-production can occur is when SUs inform IPUs. Finally, the third form of co-production is when both IPUs and SUs inform each other.

4.3.1 IPUs Inform SUs

One way co-production can be done is when IPUs inform scientific approaches. That is, scientists are studying a particular phenomenon, and use data gathered from an Indigenous group to support their conclusion, or to provide evidence for their claims in some way. Sometimes, this is done with little interaction between the groups. A scientist will interview a few people, get a sense of what she is

may very well not be the fault of the authors of those papers, but rather a fault in the constraints of citation. Either way, it is deeply concerning that community input is not recognized.

looking for, and be on her way. For example, Natcher *et al* note that Indigenous recommendations are “often treated as anecdotal accounts that, while perhaps interesting, have little relevance” (Natcher et al, 2005, p. 247). There is little or no mutual interaction, and the interviewees rarely get the chance to make sure what they said was understood correctly before the article gets published. For co-production to occur properly, input from IPU must be present *throughout* the process, and *not* merely used to supplement already existing scientific programs. Ryan notes that mere notification of the fact that a study is being done does not mean there has been Indigenous involvement. “Having members from the community as members in the process, not commentators after the fact is important” (Ryan, 2015). IPU are “considered a ‘tool’ that can help ‘revamp’ environmental management” (Latulippe, 2015a, p. 2 quoting Shackeroff & Campbell, 2007, p. 344). In cases where IPU are only used after the fact, or are treated as tools, I would argue that co-production has failed to occur. The definition of co-production I gave above stipulates that it involves “mutual understanding, interaction, and respect”. In these cases, there is interaction, insofar as the two groups are communicating, but there is no mutual interaction. Rather, scientists are merely requesting information. This use of IPU propagates colonial attitudes through appropriating knowledge held by Indigenous peoples, and therefore also fails the respect criterion of the definition. As such, this sort of knowledge transfer is *at best* merely SU making use of IPU, and is not co-production. This type of knowledge transfer does not have a recognized forum for transformative criticism. Because there is unlikely to be space for such criticism, the benefits of pluralism will not accrue to projects that do not have good interaction. However, I think it may be possible for IPU to inform SU in a better way, and for this to count as legitimate co-production.

There would be at least three conditions that would need to be satisfied for unidirectional IPU to SU knowledge transfer to meet the definition of co-production. First, the scientists’ goals would need to be explicitly communicated, and would likely need to be roughly in line with the goals

of the Indigenous people they want to work with. This would include disclosing relevant funding. For example, a project such as counting seal populations might appear to be in line with the goals of the Indigenous group. But if an oil company that wanted to do drilling in the area funded the project, this would likely influence the decision of whether or not the Indigenous people wanted to participate. It may be that the groups' goals are aligned, and the question is simply a matter of both groups coming to an agreement about where the best place to drill is. However, *not* disclosing the source of funding erodes trust. This condition would help ensure that there was appropriate understanding and interaction.

Second, the findings of the project would need to be shared with the community, and should be useful to them in some way. Some scholars disagree, and argue that IPU's are merely something useful to scientists. Latulippe notes that "Berkes... dismisses the need to produce research findings that are intelligible and relevant to the community from which information has been drawn" (Latulippe, 2015b, p. 120, see Berkes et al, 2000). However, given the need for trust and equality, using IPU's in such a way would not count as co-production. As Latulippe (2015b) says "who ultimately benefits from research is one of the most important questions one can ask" (p. 127). Likewise, Ryan notes that scientists "need to break down information so it is meaningful to our people" (Ryan, 2015). Note that it is at least possible for this type of co-production to be indirectly useful to the community involved in it. For example, scientists want to know how many wolves are in a particular location, so they ask for help from the Indigenous people who live there because they have a good idea of the answer (see, for example Stephenson, 1982). The resulting paper may not be particularly useful to the community, because they already knew how many wolves were there to begin with. However, the project can be useful to them in other ways, for example by introducing them to new animal tracking technology. This condition promotes the "working together" portion of the definition. In such cases, the two groups are (or at least can be) *prima facie* equals.

Third, as stated above, there would need to be a chance for feedback. One of the best things about the Mymrin et al study was that the groups he consulted had a chance to correct the draft of the paper. Because IPUs are complex and difficult for an outsider to understand, this step is important in ensuring that the scientist is accurately communicating what the Indigenous people told her. Because of the history of science and Indigenous peoples, it is especially incumbent upon the scientist to understand what she has been told. This condition supports the “working together” and the “interaction” portion of the definition, by ensuring high-level communication between groups. It will likely also promote respect and recognition of importance, as there will be a chance for misunderstandings to be cleared up. If these three conditions are met, and assuming the project meets the definition of co-production in all other relevant ways, it seems possible for IPUs informing SUs to count as legitimate co-production according to my definition.

4.3.2 SUs Informs IPUs

The reverse of the above could also count as co-production. In some cases there are things that science can offer to supplement IPUs. For example, if Indigenous people want their knowledge to get uptake by scientists, they will likely need to be published in a journal. By partnering with a well-known scientist, they are more likely to get their work seen by members of the scientific community. Or if an Indigenous group wants to use scientific data to supplement their own understanding of the world, they may want to work with a scientist.

The conditions that should be met in order for this to count as co-production are the same as the previous way of co-producing. The goals of each party should be stated, should be in line with each other, and there should be a chance for feedback. Both parties should be upfront about what they can offer, and what they hope to accomplish by working together. Moreover, the scientists working on the project would have the chance to make sure that the science is used correctly.

Note that this condition is slightly different from the feedback condition above. When IPU's inform science, there are two reasons feedback is important: first, because of the history between Indigenous peoples and non-Indigenous peoples in Canada, and second, because it is important that scientists do not publish incorrect things. When science is informing IPU's, only the second of these conditions obtains. It is important for everyone, not only scientists, to hold correct beliefs. As such, when consulting scientists, it is important for Indigenous peoples to make sure they understand correctly what the scientist tells them. This does not mean that they have to *accept* what the scientist tells them as the truth, but they do need to make sure they do not misunderstand or misrepresent what the scientist says. This is where the feedback condition is useful, as the scientist has a chance to make sure that their work is represented correctly. However, there is no history of knowledge found from IPU's being used against scientists, or of Indigenous peoples being disingenuous in their dealings with scientists. So, the issues of trust are not as fraught in this type of co-production.

Just as before, if these conditions are met, then it is likely that the definition for co-production will also be met. These two types of co-production count as the minimal threshold for a project to count as co-production. The final type we will deal with is the best type of coproduction that goes beyond that threshold.

4.3.3 Mutual Informing of IPU's and SUs

Both IPU's and SUs can inform each other. This is the “golden mean” of co-production. In the previous two types of co-production, the primary benefit from a project will go to one group rather than the other. A scientist may have an idea for research, and request assistance and input from Indigenous peoples. If there is no conflict between the goals, and if there is genuine interaction, then this is co-production. However, just because there is no conflict between the goals does not mean that the project is particularly useful for the Indigenous peoples involved in it. For example, if scientists are studying wolf populations, and get input from Indigenous people, this is co-production. But the

Indigenous people may well already know the wolf population, so the paper published by the scientists would be of little use to them (Stephenson, 1982). Such cases can still be co-production, but they are limited in that the exchange of perspectives has not occurred to the fullest extent, reducing the number of people who can learn and benefit from the co-production project.

The best form of co-production is one where both groups benefit equally from the resulting information. Outside researchers need to benefit the community proportionally to the amount of work the community invested in the work (Hunn, 1993). In such instances of co-production, there is a better balance between the groups. Each group needs something, and can offer something in return. The resulting piece of information is useful to a wide range of people across cultures and has input from those cultures, assuming it meets the other conditions for co-production. This type of co-production at a fundamental level supports the creation of new information through the two groups working together, an important part of the definition of co-production. Through working together in a substantive way, this form of co-production maximizes the objectivity that can arise from a robust pluralism.

SUs can be useful, both practically and politically, to Indigenous peoples. In the Caribou Co-Management Crisis of 1993 Kofinas notes that community members thought science was useful “in managing a caribou herd in the face of unknown contaminants” (Kofinas, 2005, p. 187). One of the chiefs involved in the process “concluded that he was ‘convinced’ science would provide his community with a ‘bigger hammer’ in its efforts to lobby against proposed oil development” (Kofinas, 2005, p. 188). That is, whether or not SUs are the best way to understand certain parts of the natural world, science has a great deal of political power, which can be used by Indigenous peoples to their advantage.

Good co-production incorporates both approaches from the start, rather than involving Indigenous peoples as “commentators after the fact” (Ryan, 2015). This is important for several

reasons. First, including both parties in designing the project from the start avoids propagating colonial attitudes. These sorts of attitudes are often characterized by the idea that the colonial government knows best. If the government already knows all it needs to, then input from Indigenous peoples is a sort of “lip service”, not a meaningful contribution. This is seen in cases where Indigenous people are brought into a project late, and not given the chance to make real contributions to the outcome. As such, it is important for governments and scientists to include Indigenous people in their work as early as possible. By including both groups from the start, the “respect” portion of the co-production definition is supported. Moreover, it supports the recognition that each group contributes valuable information to the discussion.

Second, involving both parties at the start ensures that they are equally involved in determining the goals of the project. If the project is going to be equal, each needs a chance for their value system to provide input into the reasons for pursuing the project.

Third, it ensures equality in determining the choice of methods. Some SU methods, such as tagging animals, can be seen as disrespectful to them. And values such as respect can legitimately restrict methodological choices, as is common across science. Examples of this can be found throughout the field of bioethics. Recognizing that some values from IPUs may require such restrictions is important before beginning a co-production project. Again, this type of co-production supports the respectful interaction that is part of the definition of co-production.

Fourth, as Stephenson learned when he lived with the Nunamiut people, sometimes scientific methods can be a waste of time. Stephenson brought tracking collars to learn about wolf movements. The Nunamiut hunter he talked to said that *Stephenson* would learn a lot that way, but “he did not think the biologist would learn much more about wolf movements than Eskimos already knew” (Lopez, 1978, p. 80). By including both parties at the start of the process, these sorts of problems can be avoided.

So while unidirectional informing between IPU and SU can meet the definition of co-production, when both IPU and SU inform each other, co-production is at its best. We will now examine the benefits in engaging in co-production projects.

4.4 Benefits of Co-production

So far we have determined what co-production is, and how it can best be done. What remains to be seen is how co-production—in particular, co-production done well—benefits those who participate in it. This section will outline the main benefits of co-production. I will argue that there are three main benefits of good co-production. It builds trust, makes science better, and makes society better.

4.4.1 Helps Build Trust

Co-production projects can lead to building trust—epistemic and otherwise—between Indigenous and non-Indigenous peoples. Grasswick notes that epistemic trust is developed through “sharing appropriate knowledge” between scientific and non-scientific communities (Grasswick, 2010, p. 389). Importantly, in order for scientists to know what information is important, they need to understand the culture with which they are sharing that information.

“If scientific communities need to filter knowledge and share with lay communities knowledge that is significant *for them* (the lay communities) in order to be worthy of their epistemic trust, the scientists need to have an understanding of what those lives are like, and what their interests and needs are. ...[H]aving scientific communities take up questions of direct relevance to marginalized communities and successfully employ such knowledge has the potential to increase the trust of those communities.” (Grasswick, 2010, p. 407, emphasis in original)

So scientists need to understand the communities they are working with in order to build trust, as trust is built through sharing knowledge that is important to that community. In order to understand what knowledge is important, scientists will need to become acquainted with the culture and the needs of

the community. Note that this is referring to the particular community, not some homogenous group of Indigenous people. The needs and cultures of individual communities will be different. So in order to get a sense for what a particular community needs, scientists will very likely need to spend time there, talking to elders and other community members. By spending time in the community, the community members will likewise get a chance to understand the culture and needs of the scientists. So, through understanding each others culture and needs, both Indigenous people and non-indigenous people can get a sense of what information is important to each other. This mutual understanding can then be used to develop a research program that is beneficial to both groups. If each group is “explicit about the assumptions, interests, and claims driving research” then there is room for trust to build (Latulippe, 2015). By sharing goals, data, and methods, diverse groups can build trust by working together. So building trust involves both understanding one another’s cultures, and participating in projects that are useful to both communities. Again, this will require input and interaction early on in the process, in order to accurately understand what sort of projects are useful.

4.4.2 Makes Science Better

Science is an endeavor that is rooted in society. As we saw, values—including societal values—play a role in science. As many philosophers of science have noted, science improves with input from diverse groups. (Code, 1981; Longino, 1990; Page, 2008; Fehr, 2011). Longino points out that science becomes more objective with the inclusion of diverse viewpoints. Each researcher brings a set of assumptions to her work. These assumptions can go unchallenged, unless someone with differing set of assumptions challenges them. A diverse group of researchers will be able to identify and correct problematic assumptions better than a homogenous group (Longino, 1990, 2002). Longino was primarily talking about including women in science, but the same lesson applies to including other marginalized groups, such as Indigenous peoples. By including the viewpoint of Indigenous peoples, we can produce more robust science.

A good example of pluralism improving science can be found in Stephenson's study of wolves done with the Nunamiut people in Anaktuvuk. Stephenson

...stayed for almost three years to study wolves with the Nunamiut people. He learned *Inupiatun*. He ate what the Eskimos ate. They liked him... the Nunamiut were telling him things about wolves that no one, no biologist at least, had ever written about—not because they were odd or singular or mysterious things, but because they were things biologists were not interested in. Or never saw. As Stephenson grew closer to the Nunamiut, as he gradually took on their sense of time and space... his reflections on the animal led him toward a different understanding. Later, his wolf work would reflect an appreciation of the animal that was a blend of his academic knowledge and a primitive [sic] sensitivity that had been awakened, nurtured, and formed by his association with the Nunamiut. (Lopez, 1978, p. 79)

We can see here how by slowly building a relationship with Indigenous peoples, a western-trained researcher was able to gain a new and richer understanding of the animal he was studying that incorporated a plurality of perspectives. This bringing together of new perspectives makes science better by incorporating information that a scientist who did not have those perspectives would not have been privy to.

4.4.3 Makes Better Societies

The two benefits listed above show an interesting feature of co-production: it benefits both those who co-produce knowledge, and those who live in societies that co-produce knowledge, but do not participate in the co-production of knowledge. Strong relationships between Indigenous peoples and other peoples in Canada lead to a better functioning society. Borrows (2008) notes that “we [Indigenous peoples] need to build stronger relationships outside of our reserves, across the country and world. This is necessary to create and consume resources to flow back to the reserves for their support” (p. 24). Working with scientists is one place this relationship-building can start. If science is done better, it will produce more accurate data for use in policy, which benefits everyone affected by

that policy. By including input from IPU in policy, Canada can ensure that it includes marginalized voices. This will be taken up in more detail in chapter five.

To sum up, if, as a society, we want to build trust between different groups, want better science, or want better policy, we *should* engage in co-production.

4.5 Problems for Co-Production

Despite the promise of substantial benefits from co-production, there are four main obstacles to implementing co-production. The first of these is the current lack of trust between Indigenous peoples and scientists. Second there is reluctance on the part of some scientists to accept that IPU have something to offer SUs. Third, and related to the second problem, there is an important spiritual aspect to IPU. Fourth, there is a problem of methodology. Finally, there is a problem of whether co-production can successfully contribute to IPU. I will show that each of these problems can be overcome.

4.5.1 Overcoming Lack of Trust

As I have mentioned before, the history of the interaction between scientists and Indigenous peoples is fraught, and “deeply intertwined with colonial histories” (Shackeroff & Campbell, 2007, p. 345). Given these histories, it is completely reasonable that Indigenous peoples are wary of working with scientists (Grasswick, 2010, 2015). As a non-Indigenous person, I do not think I can make recommendations for whether or not Indigenous people should work with scientists to build trusting relationships. However, the fact that there is a fair amount of research done that involves both groups indicates that some Indigenous people want to build trust. Moreover, in his paper “Seven Generations, Seven Teachings”, Borrows writes that

Wisdom would dictate that we cooperatively seek knowledge from other traditions. We need access to the world’s sciences, economics, and mathematical insights... Lessons can be learned from other’s experiences that have application to our lives and communities.

Indigenous languages and traditions will not be diminished if they remain at the heart of inquiry into this vast web of knowledge. (Borrows, 2008, p. 11)

On the other side of the coin, there are certain actions scientists can take which will promote the growth of trust. While the purpose of this paper is not to create specific recommendations for research, I will outline three practices for epistemological transparency. Given the discussion above about knowledge sharing and trust, these recommendations will hopefully lead to greater trust between groups.

As mentioned before, scientists should be forthcoming and honest about their intentions. Honesty and communicating all the relevant information the other party might need to know is important for trust. Second, scientists need to work toward understanding and respecting Indigenous culture and needs. In order to do this, researchers will need a very robust understanding of the culture they are working with. As Latulippe says “those pursuing research with Indigenous communities must be prepared to ‘do the work’ required to honor tribal knowledges” (Latulippe, 2015a, p. 10), quoted section from Kovach, 2009, p. 38). Third, this robust understanding requires mutual respect (Ford & Martinez, 2000). There is a tendency among some scientists and government officials to mistrust value systems that they do not understand. Some scientists, because they do not understand IPUs and the values that underlie them, do not trust them as a source of knowledge about the world. But “the knowledge systems of both local people and state bureaucrats are based on particular sets of values” (Houde, 2007, p. 11). As such, scientists should be aware of their own limitations and the way their approaches are formed by their background. By recognizing that different backgrounds lead to different insights, and by recognizing that simply because such insights are not immediately clear does not mean that they are wrong, scientists can begin to build trust between cultures (Lertzman, 2010).

4.5.2 Overcoming Lack of Expert Status

Some scientists are reluctant to view IPUs as capable of offering a viable alternative to science. That is, Indigenous people who do not have a formal background in science are thought of as not expert enough to be able to contribute meaningfully to science. While this is relatively uncommon, it is not unheard of. For example, Ortiz (1999) writes that scientists should educate Indigenous people when their information does not accord with the prevailing scientific opinion. While there is nothing wrong with disagreeing about how the world is, using SUs as the standard to which IPUs are measured is inappropriate, as it makes SUs the norm, and marginalizes IPUs. In a related thought slightly different situation, Riemer (2004) documents a case study on public opinion surrounding conservation and fishing rights. He found that non-Indigenous people were unwilling to accept the knowledge provided by Indigenous people regarding the population of fish in northern Wisconsin. Nadasdy recounts several instances where scientists expressed scepticism about the usefulness of IPUs.

I have heard it expressed more than once by scientists and resource managers that ‘traditional knowledge’ is simply a political ploy invented by aboriginal people to wrest control of wildlife from ‘qualified’ scientific managers. On one occasion a biologist told me outright that the only value she sees in consulting with native elders is that she must do so in order to secure community support for her projects. (Nadasdy, 1999, p. 118)

So we can see that at least some scientific experts think non-experts are not capable of providing useful information to scientists. The response to this is that Indigenous people who are not formally trained in science *can* be experts in a different knowledge source, but these sorts of non-traditional experts often get overlooked. This is often because they are outside the apparatus that allows for easy identification of experts. That is, because they do not often, or ever, publish papers and are not affiliated with a university, they

...may be overlooked simply due to the lack of cognitive tools for identifying, articulating, or noticing them. Whyte and Crease (2010) label these “Unrecognized Contributor” cases, where groups or

individuals with scientifically relevant knowledge are ignored or dismissed because they lack the formal education or credentials by which scientists, or contributory experts more generally, might have realized that they had specialist knowledge to contribute. (Plaisance & Kennedy, 2014, p. 63, see Whyte & Crease, 2010)

Likewise, Wynne notes “how easily lay public authorship of knowledge is deleted from social recognition” (Wynne, 1998, p. 49). He points to a case where people living near a nuclear processing plant noticed that there were an above-average number of childhood leukemia cases occurring in the area. A government committee was formed, and discovered that what the locals had noticed was correct. However, “the excess cancers around the Sellafield plant were almost routinely referred to as having been *discovered* by the Black Committee” (Ibid.). Even in cases where lay publics make outright discoveries, the fact that scientists confirm them erases the contribution by the public, at least to some extent. So despite that fact that Indigenous people untrained in science might not be experts in the sense that they are scientists, they can be experts in the sense that they can make valuable contributions to understanding the world.

4.5.3 Overcoming Different Approaches to Spirituality

Part of the reticence some scientists might feel about working alongside IPUs stems from the importance of spirituality to IPUs. As we saw in the discussion about the centrality of the values of holism and responsibility, spirituality structures Indigenous accounts of the world. These values, along with many others, can be found in Creation stories in many Indigenous cultures. SUs typically avoid any mention of spirituality, and mentioning it might prevent a paper from receiving good uptake in the scientific community. Yet spirituality is an important part of IPUs. As a result, one could argue that the two approaches are fundamentally different. This makes co-production particularly challenging. For example, Latulippe notes that some people reject IPUs because of the spiritual component. “[Berkes et al] criticize traditional practices that fail to conform to Western standards of “wise” resource management, dismiss the cosmology—the belief or spiritual component

of traditional knowledge’—that gives rise to how people relate to the world” (Latulippe, 2015b, p. 120, see Berkes et al, 2000). Similarly Howard and Widdowson (1996) argue that spiritualism is obviously inconsistent with scientific methodology” (p. 34). By dismissing the broader spiritual context of IPU and focusing on the pieces of information that can be extracted, scientists run the risk of overlooking the connections that information has to other areas, as well minimizing the relationship between nature and Indigenous peoples. That is, they risk marginalizing the values of holism and responsibility that are central to IPU. If these values are marginalized, it is difficult to see how true co-production could occur.

There is a further reason to include discussion of spirituality in co-production projects that outweighs the reason to omit it. As argued earlier, the best co-production is that which benefits both parties equally. While getting uptake in the scientific community is important for the scientist, getting uptake among Indigenous peoples is likely to be important to the Indigenous members of the group. A co-production project that is ignored by half of its intended audience is a poorly done project, and may not even count as legitimate co-production. In proper co-production, which must balance the spiritual aspects of IPU with the non-spiritual character of SU, omitting discussion of spirituality makes SU the “default”, and this runs counter to the equality that must be at the heart of co-production. As such, when co-producing information, omitting discussion of spirituality is not an agnostic or neutral stance. That being said, there needs to be balance between the value of organized scepticism and spirituality. Indigenous peoples who engage in co-production ought to expect scepticism from their scientific colleagues, just as those scientists ought to expect spirituality from their Indigenous colleagues. From this starting point, and working with mutual respect, the two groups can discuss how to work through these issues in a way that is appropriate for the topic at hand, and that is respectful of both groups. The outcome of this may not be agnostic. Stephenson did not come away unaffected by his time spent with the Nunamiut.

Snively and Corsiglia point out that there is another way to reconcile the spiritual base of IPU with SUs.

Criticisms of the validity and utility of indigenous science misapprehend the structure and mechanics of indigenous oral information systems. These systems do not simply assert that mythic-magical forces cause and control events. Large numbers of indigenous peoples observe, interpret, and orally report nature exhaustively. Rather than writing about their findings, they may use metaphoric stories to compress and organize important information so that it can be readily sorted and accessed. (Snively & Corsiglia, 2001, p. 23)

Likewise, Pierotti and Wildcat say that

...though the idea of a cycle, or circle, of life is an integral part of Native spiritual beliefs, this is not a mystical concept based upon great mysteries, but a practical recognition of the fact that all living things are literally connected to one another. (Pierotti & Wildcat, 2000, p. 1336)

That is, some references to spirituality contain empirical observations expressed in metaphor, and these observations and metaphors are difficult for outsiders to interpret. “When speaking with an elder, a non-Aboriginal person may not know how to ask the proper question to obtain specialized knowledge of the ecology, medicines, and spiritual matters” (Snively & Corsiglia, 2001, p. 24, see also Colorado, 1988; Johnson & Ruttan, 1991). That is, spiritual stories that might appear to an outsider to have little relevance to the project at hand might only appear that way because of their inability to interpret those stories. As such, “local people must become directly involved in the research” (Ibid.). Without deep involvement, outsiders will not be able to understand or interpret the spiritual aspects of IPU. But in a legitimate co-production process that involves mutual interaction and understanding, metaphors and stories that are opaque to outsiders can be made clear.

Douglas’ account of values helps solve the problem of spirituality. Recall that acceptable direct roles for values are in deciding which type of project to take on, how to go about the project, and what to do with the information after it is produced (Douglas, 2009). It is possible for the spiritual

aspects of IPUs to take a direct role in determining whether, how, and for what reason to scientists and Indigenous peoples might want to learn about nature, without being problematic for scientists who are uncomfortable with spirituality. That is, spirituality can inform the reasons for wanting to partake in a co-production project, and in determining what is done with the science without too much difficulty. For example, an Indigenous person might want to participate in co-production because of his spiritual connection to the land and his feeling of responsibility towards it, whereas a scientist might want to participate in co-production because she wants to help prevent climate change. These reasons are compatible, and in fact somewhat similar, but only the first involves a spiritual aspect.

It is worth noting that opening the door to spirituality does not mean opening it to *all* spirituality. The importance of including spirituality is that it furthers the goal of equality, and because it is important to understanding IPUs. As such,

acknowledging [the spiritual aspects of] TEK does not mean opening the doors to all and sundry. TEK is valuable precisely because it is refined over time with careful observation; it cannot arise spontaneously in modern imaginations. Thus no itinerant creationist or messianic breatharian may arrive in a new neighborhood and spontaneously generate authentic local TEK. (Snively & Corsiglia, 2001, p. 24)

That is, IPUs, as we have seen, are developed over a long period of living with the land (land here understood in the broad context). Spirituality is connected to the land, for example, through creation stories and the relatedness of all of nature. Other religions in North America do not have this same connection to the land. So it is possible to recognize the importance of Indigenous spirituality to IPUs without having to recognize the importance of all varieties of spirituality. So while a scientist who wants her paper accepted by her peers may be hesitant to grapple with spirituality, there are a number of very good reasons to include such it in co-produced papers.

4.5.4 Overcoming Differing Methodologies

One of the major concerns with co-production is the fact that, in general, IPUs involve qualitative data, while SUs involve quantitative data: “TEK is mainly qualitative; Western science is mainly quantitative” (Johnson, 1992a, p. 9). As Nadasdy puts it “The assumption is that since traditional knowledge is expressed in a form that is vastly different from, and largely incompatible with, that of science, there are a whole host of essentially technical problems that accompany the effort to integrate them” (Nadasdy, 1999, p. 2). There are two problems with these sorts of claims. The first is that this is an oversimplified and inaccurate account of science. Certain branches of science such as the social sciences use a great deal of qualitative data. As such, the divide between IPUs and SUs may be more apparent than real. And even if this divide was real, IPUs can be quite useful in grappling with quantitative data. Nadasdy recounts a case of failed co-production where biologists were attempting to determine the sheep population in a particular area. The Kluane First Nation who lived in the area worked with them to count the number of adults compared to the number of yearlings, with the goal of determining the rate of lamb survival.

On the face of it, there seemed to be little room for disagreement about the data. Everyone agreed on the two numbers generated by the study: the overall sheep count and the yearling count. Yet, later it became apparent that biologists and community members had interpreted these numbers very differently....The total sheep count, however, had been very low (approximately 45). According to the biologists, this represented too small a sample from which to derive a reliable figure for lamb survival; thus, all of the day’s data were useless. The community members understood the desire to get a yearling count, but they were more interested in the overall number of sheep. Several of them said that in the past they had counted hundreds or even thousands of sheep in that place at that time of year. For them, the low count was clear proof of the drastic decline in the population... The biologists dismissed this interpretation, saying that a ground-based survey is useless for determining the total number of sheep in the area, since for all anybody knew, most of the sheep could have been on the other side of the mountains. The community members in turn disagreed with the biologists, saying that in the past there had *always* been many sheep visible from the

lake in the early spring and that the mountains had had two sides then too. (Nadasdy, 1999, p. 9)

The disagreement here is not about the numbers, but about the background assumptions. The biologists went into the study expecting that there would be enough sheep to generate a statistically significant result. The Indigenous people expected there to be hundreds or thousands of sheep, but were not concerned with whether there were enough to get a statistically significant sample of lambs. As a result, the data collected was useful to them, as it supported their claim that sheep populations were declining. This example shows three things. First, it shows that quantitative data can be generated by IPUs. Second, it shows the value of IPUs to those using quantitative data. The value lays not so much in collecting the data, as in determining what makes a good hypothesis to begin with. The study Nadasdy mentions was organized by scientists, who only incorporated Indigenous input late in the process. If input was received at the start—that is, if the co-production was mutual instead of just IPUs informing SUs—the scientists might have developed a different hypothesis. Starting with the idea that there used to be thousands of sheep in an area, and only finding dozens is useful. If consultation occurred earlier, the study could have counted as genuine co-production.

There is another important problem related to methodology that occurs in the context of co-production. This is that science is typically “open” – when a piece of scientific information is created, it is published so it is accessible to the scientific community and general population. For science, this is important because of the fact that science should be reproducible by other scientists. However, this is complicated by the relationship between Indigenous peoples and other groups. As a marginalized group, information about the land Indigenous peoples live on can be appropriated or used against them. “Particularly vulnerable to western appropriation is indigenous cultures’ knowledge of local biological resources” (Folkins, 2004, p. 341). Stavenhagen (2013) argues that

as pressures on the Earth’s resources intensify, indigenous peoples bear disproportionate costs of resource-intensive and resource-

extractive industries and activities such as mining, oil and gas development, large dams and other infrastructure projects, logging and plantations, bio-prospecting, industrial fishing and farming, and also eco-tourism and imposed conservation projects.” (p. 116)

There is always a risk that the discovery of a resource will prompt industry and government to violate prior agreements. For example, in 2000 the government of British Columbia attempted to reallocate “the timber rights in the Carrier Sekani peoples’ traditional territory to large corporate logging companies” (Anaya & Williams, 2001, p. 40). This case was taken to the UN Inter-American Commission on Human Rights, through which “British Columbia was forced to engage in discussions of interim forestry measures with the Carrier Sekani” (Getches, 2005, p. 293). This shows that governments are willing to break the law in order to extract resources on Indigenous lands. As such, it is often in the best interests of Indigenous peoples to not make their understandings public.

In order to help combat this problem, scientists need to take responsibility for the effects of their research. In 2002, a scientist studying fishing in Norway encountered such a situation. She had been working with fishers to map where the best cod fishing was, according to the local specialized knowledge.

[As these maps] would reveal enough information to give away the fisher’s specialised knowledge, she concluded that publication would put fisher livelihoods in jeopardy, and maps showing fishing grounds would also overturn the norms ordering behaviour in their society. While her ultimate decision *not* to publish her maps left her without funding, Maurstad’s ethical obligations to her research subjects were too compelling to be overlooked. (Shackeroff & Campbell, 2007, p. 350, see Maurstad, 2002)

While such sacrifices will hopefully only need to occur infrequently, Maurstad’s example shows the type of responsibility scientists need to take for their research. Scientists need to understand the negative effect the publication of their work can have on Indigenous peoples, and they need to take steps to prevent such effects. Douglas (2014) notes that science “exists because it is valued by the broader society and functions within that society. It is also not the only human endeavor that is valued

by society... The issue, then, is how to respect the other values in society while also respecting the value of science” (p. 965) This means that we can “allow the value of a particular piece of research to be outweighed by other societal values, as long as doing so does not undermine the value of science to society” (Ibid.). As a society we value the protection of vulnerable and marginalized groups. As such that value must be balanced with the value science provides. In cases where publishing data is harmful to Indigenous people, such data should not be published. Suppressing data publication already occurs in other areas, for example where privacy issues are concerned. As such, there is precedent within scientific practice for this sort of thing. Whether or to what extent data is harmful to Indigenous people will be decided on a case-by-case basis. Note that determining this will involve deep collaboration and relationships between groups, as openly discussing potential harms is likely best done within the context of trusting relationships.

There are several things Indigenous peoples and scientists can do to protect knowledge holders while still participating in co-production. The first is sharing the results of studies, but not sharing the raw data. This way people outside the community can benefit from the information without having access to data that could be used against the knowledge-holders. By only sharing the results, the Indigenous peoples control the interpretation of the data as well as the data itself. A second way is for the Indigenous people to retain the rights to the study, and archiving it in the community. This makes it easy for the community to restrict access to the data to those who they trust. Thirdly, as discussed earlier, if the information is published, Indigenous communities and elders should be given full credit for their work as authors of the paper. Finally, if necessary, scientists should be willing to forgo publishing or reporting the findings altogether. It is important for scientists to recognize this troubled history of science and Indigenous peoples, and actively work to combat it. Scientists who wish to engage in co-production might be hesitant to not publish the raw data, but they should remember that they are guests on Indigenous land, and that trust is needed before potentially

damaging information can be shared. Douglas (2014) notes that scientists have a responsibility to society. And since Indigenous peoples are part of society, scientists have a responsibility towards them. So if scientists think their knowledge could be used for harmful purposes, and is likely to be used in such ways, they should have second thoughts about publishing it.

4.5.5 IPU's using Co-produced Information

As noted above, IPU's are created through a process that involves an intimate connection with the land over generations. However, the product of a co-production project does not at first glance meet this criterion, as co-production projects do not occur over such long time spans. However, if co-production is done well, it will involve the direct and meaningful involvement of people who are part of a group of that has spent generations in close contact with the land. Moreover, IPU's are adaptive, and can incorporate new technologies and information. In this way, co-produced information does participate in a generations-old tradition, and even if it did not, it could still be incorporated into IPU's.

It is interesting to note how by engaging in the best form of co-production helps solve some of the conceptual tensions discussed above. If the project is meant to be equally beneficial, then it makes sense to recognize Indigenous people who are not academic scientists as experts. Without such experts, determining what is beneficial for each group is impossible. Projects that are mutually beneficial should get uptake in both communities. As such, there is even more reason to include reference to spirituality in the project. Likewise, if during the course of the project it is discovered that the findings could be harmful to the Indigenous peoples, the value of openness can be constrained without too much complication.

We have now critically analyzed definitions of co-production, and created a new definition. This definition emphasizes the importance of equality and genuine collaboration between groups. We have also seen how co-production is a normative term – it can be done with varying degrees of

success. While something akin to co-production occurs when knowledge is transferred unidirectionally, these methods are problematic and in many cases fail to be genuine co-production at all. Rather, co-production meets the definition to the fullest extent when knowledge (and the benefits from knowledge) is shared equally. This involves incorporating both views from the start of the project, and giving equal consideration to both sides throughout the duration of it. Finally, we outlined several benefits and responded to several potential problems with co-production.

4.6 Conclusion

We began this thesis by briefly examining the colonial history of Indigenous peoples and Canada, and more specifically, the history of science and Indigenous peoples. We saw how this history engendered rational mistrust of science among people who science working with colonial power has harmed. This has led to the marginalization of IPUs alongside the marginalization of Indigenous peoples. Next we surveyed the definitions of IPUs found in the literature, and identified several themes found in them. The most important of these themes were cultural-dependence, association with the land, multi-generational, changing, oral group-based, and spiritual. From these themes, we developed a new definition, as well as a new term: Indigenous Peoples' Understandings.

In chapter three we performed an analysis of the themes found in definitions of science, and introduced the term "Scientific Understandings" to work alongside IPUs. We explored the role of values in SUs, and ways to categorize values

In chapter four we turned to co-production, and found the important themes to be that proper co-production involved interaction rather than merely informing, that it is pluralist, and that one should recognize the limits of one's knowledge. From these themes, we developed a new definition of co-production. The definition of co-production is normative in two ways. That is, instances of activities similar to co-production can do a better or worse job of being proper co-production, but also that we ought to co-produce knowledge, and we ought to do so in the best way possible. The best way

to co-produce makes full use of the “interaction” theme: it involved both IPU and SU working together, and it benefited both groups equally. This type of co-production does the best job of building and maintaining trust between groups. Moreover, it maximizes the benefits of pluralism, and helps solve some conceptual tensions. Trust-building was one of the main benefits of good co-production, alongside improving science and policy. Next, we examined several potential problems for co-production, as well as solutions to those problems. Current lack of trust can be overcome through mutual understanding and respect, especially through non-Indigenous people taking the time to get to know the people and the culture they are working with and in. The lack of expert status can be overcome through understanding interactional expertise. Overcoming the problem of spirituality can be done by recognizing that in co-production, omitting reference to spirituality is not a neutral position, through understanding the metaphorical nature of some spiritual stories, and through understanding that opening the door to Indigenous spirituality does not mean opening the door to all spirituality. Finally, we ended chapter four by showing how the differing methodologies of IPU and SU can work together.

Chapter 5

Epilogue: Prospects for Policy

So far we have discussed the general benefits of engaging in co-production. We now turn to a brief discussion of complications with implementing co-production into real-world projects. As this implementation will likely occur through the use of government policies, we will start by outlining some of the current policies governing co-production.

At the outset, I will note that to some extent, there are policies in place that support co-produced projects. One of the earliest and best Canadian policies comes from the Government of the Northwest Territories (GNWT), which created a government-wide policy for implementing IPUs in government decisions. Under this policy

The Government recognizes that Aboriginal traditional knowledge is a valid and essential source of information about the natural environment and its resources, the use of natural resources, and the relationship of people to the land and to each other, and will incorporate traditional knowledge into government decisions and actions where appropriate. (GNWT, 1997, 50.03)

Past versions of Canada's Oceans Strategy have discussed the connection Indigenous peoples have to the land, though the current version does not (Department of Fisheries and Oceans, 2002, 2009). Section 19(3) of the Canadian Environmental Assessment Act (CEAA) allows for the use of IPUs: "The environmental assessment of a designated project may take into account community knowledge and Aboriginal traditional knowledge" (Government of Canada, 2012). The Interim Principles guiding IPUs for the CEAA do emphasize the importance of collaboration and obtaining the support of the community. However, they fall short when it comes to promoting equality in terms of who benefits from the knowledge. The discussion is always around how IPUs can be incorporated

into environmental assessments, which in this case mean SUs. In the section titled “Bring Aboriginal traditional knowledge and western knowledge together”, the principles note that

“Environmental information (such as ATK dealing with wildlife migration patterns), can be readily integrated with other environmental knowledge. Knowledge about, or based on, values and norms, is not as readily integrated with scientific data sets. Thus the main role [of] EA practitioners is to collect and organize any ATK that is provided, and bring to the attention of decision makers that ATK has been considered and how it has been considered” (CEAA, 2013).

Based on what we have discussed in this thesis, it should be fairly clear what is wrong with this policy. What is described in the above passage is not genuine co-production, but rather unidirectional knowledge transfer from IPU to SU. Moreover, both IPU and SU are based in values, and it is these values that allow them to work together well. This principle demonstrates the problem with co-production in policy: namely, that it is not understood, and therefore is not supported. While there may be some co-production projects engaged in by government scientists, the policies surrounding such projects are out-dated, not only in their understanding of IPU, but also their understanding of science. Currently, the approach to IPU in policy does not reflect the norms of co-production, and aims at integrating IPU into SU. At best, this results in what is likely the weakest form of co-production, and at worst, it is not co-production at all. As such, the policy governing IPU is inadequate.

There is a further nuance that should be emphasized, given what we have discussed so far. This is the fact that there is a gap between the policies (such as they are) and the application of those policies. In an abstract sense, the policies outlined above acknowledge that IPU ought to be used in studying nature and in environmental policy. While this is not co-production, it is a step in the right direction. However, the concrete application of this acknowledgement is more complicated. This is because in a practical sense, individuals, not governments, put policies into effect. As such, policies

are only as good as how well they are implemented. “Each principle of the policy remains to be ‘unpacked’ and interpreted by the public service staff who must turn general principles into action” (Abele, 1997). This unpacking and interpreting does not always have the effect the policy is meant to have. Armitage *et al* quote an Inuit person who discusses one way policies can break down:

...when an Inuit name is being used, they put it in the report and say that they included the Inuit knowledge, but it’s not really that because the Inuit employees are only following the guidelines or policies of the Department, or whoever is doing the study, so it’s not really [Inuit knowledge], because they are only using the person’s name to say that Inuit were involved. (Armitage *et al*, 2011, p. 999).

Likewise, Houde notes that

In Québec, for instance, whereas consultations with a generic *Autochtones* (Indigenous) category of actors are mandatory for forest planners, consensus on logging plans is by no means required (Government of Québec 2006). The next time the company has to plan, it may not even consider it useful to return to consult with the family because it already has its “TEK” in storage. (Houde, 2007, p. 40).

Despite the good intentions of policy requiring Indigenous input, the policy can break down when it is applied in real-world situations. Note that in the two examples above, the breakdown of the policy involves a non-genuine co-production. In the Armitage *et al* example, IPU’s are apparently defined by the person collecting data in an overly-minimal way: IPU’s there seem to be defined as any information whatsoever given by an Indigenous person. This certainly does not count as high quality interaction between IPU’s and SUs. As such, it does not meet the stronger definition I have given, or even most of the definitions given in the literature.

So what can be done to help prevent this? There are two prongs to the approach. The first involves ensuring non-Indigenous people are aware of what IPU’s and SUs actually are. Recognizing and understanding the importance of diverse perspectives, and understanding the values that underlie other perspectives will likely help prevent cases described above, or at least cases like those that stem

from misinformation. The second prong is, as we have discussed before, relationship-building and trust. Lack of trust hinders co-management (Olsson et al, 2004). A good policy for co-production would, first and foremost, be developed through meaningful collaboration with Indigenous peoples. This policy would emphasize and encourage the building of trusting relationships between groups, and recognize and respect the different, but equally valuable things each party brings to the table. Such a policy would lead to better outcomes for the environment, Indigenous peoples, and Canadians.

Appendix A

Definitions of IPUs

Source	Definition
Agrawal, 1995	Indigenous technical knowledge... is scattered and associated with low prestige rural life; even those who are its bearers may believe it to be inferior.
Agrawal, 1995	Indigenous knowledge includes the cultural traditions, values, beliefs, and worldviews of local peoples as distinguished from Western scientific knowledge. Such local knowledge is the product of indigenous peoples' direct experience of the workings of nature and its relationship with the social world. It is also a holistic and inclusive form of knowledge.
Berkes et al., 2007; 1999	We use traditional ecological knowledge to mean "a cumulative body of knowledge and beliefs, evolving by adaptive processes and handed down through generations by cultural transmission."
Convention on Biological Diversity, 1993	Indigenous knowledge as a form of rational and reliable knowledge developed through generations of intimate contact by native peoples with their lands that has equal status with scientific knowledge.
Usher, 2000	TEK refers specifically to all types of <i>knowledge about the environment</i> derived from the experience and traditions of a particular group of people. (Emphasis original)
Johnson, 1992	TEK is a body of knowledge built up by a group of people through generations of living in close contact with the nature. It includes a system of classification, a set of empirical observations about local environment, and a system of self-management that governs resource use. The quantity and quality of traditional environmental knowledge varies among community members, depending upon age, gender, social status, intellectual capability, and profession. With its roots firmly in the past, traditional environmental knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new

technological and socio-economic changes of the present.

Huntington, 2000	I use TEK to mean the knowledge and insights acquired through extensive observation of an area or a species. This may include knowledge passed down in an oral tradition, or shared among users of a resource.
Kalluri, 2012	... tradition based literary, artistic or scientific works; performances; inventions; scientific discoveries; designs; marks, names and symbols; undisclosed information; and all other tradition based innovations and creations resulting from intellectual activity in the industrial, scientific, literary or artistic fields.
Kalluri, 2012	TK is all tradition based intellectual creations and innovations, in the very broadest sense, which are constantly evolving in response to a changing environment and are generally regarded as pertaining to a particular people or territory.
Kalluri, 2012	Essential elements of TK are <ol style="list-style-type: none">1. Creation of a novel process/method to meet a need2. Transmission of the process/method through generations by virtue of tradition3. Development/adaptation of the process/method by future generations4. Limited to within a certain group/community by virtue of its value to the group/community
Service et al., 2014	TEK is transmitted through generations and revolves around a cumulative body of knowledge, practice, and belief surrounding the relationship of living and nonliving beings with their environment and one another
Service et al., 2014	Local Ecological Knowledge is gained from observations over lifetimes, and not via inter-generational transmission
Snively & Corsiglia, 2000	Indigenous science is a culture-dependent collective rational perceiving of reality where collective means held in sufficiently similar form by many persons to allow effective communication, but independent of any particular set of minds.
Kimmerer, 2002	Traditional ecological knowledge refers to the knowledge, practice, and belief concerning the relationships of living beings to one another and to

the physical environment, which is held by peoples in relatively nontechnical societies with a direct dependence upon local resources... It is born of long intimacy and attentiveness to a homeland and can arise wherever people are materially and spiritually integrated within their landscape. TEK is rational and reliable knowledge that has been developed through generations of intimate contact by native peoples with their lands.

Johnson, 1992a	In contrast to Western science, TEK is more holistic than reductionist, subjective rather than objective, and experiential rather than positivist (Wolfe et al. 1992). Because it is an oral-based knowledge system, it is often difficult to transmit ideas and concepts to those who do not share the tradition and the experience... Often, TEK is shared through stories and legends, making it difficult for nonaboriginal people to understand.
Gervais, 2004	<p>Characteristically, traditional knowledge is thus knowledge that:</p> <ul style="list-style-type: none"> - is traditional only to the extent that its creation and use are part of the cultural traditions of a community---“traditional,” therefore, does not necessarily mean that the knowledge is ancient or static; - is representative of the cultural values of a people and thus is generally held collectively; - is not limited to any specific field of technology or the arts.
NWT Traditional Knowledge Policy, 1997	Knowledge and values which have been acquired through experience, observation, from the land or from spiritual teachings and handed down from one generation to another
LaDuke, 1994	Traditional ecological knowledge is the culturally and spiritually based way in which indigenous peoples relate to their ecosystems. This knowledge is founded on spiritual-cultural instructions from "time immemorial" and on generations of careful observation within an ecosystem of continuous residence.
Shackeroff & Campbell, 2007	Traditional ecological knowledge is a culturally developed framework (Wenzel 1999) involving people, their beliefs about the world, and their cultural means of collecting, processing and transmitting information about

the environment.

Miraglia, 1998 ...not just a system of knowledge and practice; it is an integrated system of knowledge, practice, and beliefs. The social context of TEK includes such aspects as:

1. Symbolic meaning through oral history, place names and spiritual relationships.
2. A distinct world view; including a view of the environment different from that of Western science.
3. Relationships based on sharing and obligations toward other community members and other beings, and community resource management based on shared knowledge and meaning.

Appendix B

Definitions of SUs

Source	Definition
Service et al., 2014	Wildlife science uses a variety of empirical techniques that span differing temporal and spatial resolutions and can provide detailed and quantitative information on populations and individuals
Snively & Corsiglia, 2000	By science, I mean a rational (i.e., purposeful, good, directed) explanation of science of the physical world surrounding man. ... Western science is only one form of science among the sciences of the world.
Johnson, 1992a	Western science has the following fundamental assumptions (Wolfe et al. 1992): <i>Reductionism</i> : the understanding of complex phenomena by breaking down data and reassembling it in different ways; <i>Objectivism</i> : the belief that the observer must deliberately separate oneself from that being observed; and <i>Positivism</i> : the belief that what is measurable is scientifically real and what is scientifically real is measurable.
Agrawal, 1995	The scientific mode of thought is characterized by a greater ability to break down data presented to the senses and to reassemble it in different ways. Western knowledge is supposedly guided by empirical measurements and abstract principles that help order the measured observations to facilitate the testing of hypotheses.
Riedlinger & Berkes, 2000	Scientific monitoring techniques often focus on individual environmental phenomena in isolation from other factors, and are best suited for synchronic (simultaneously observed) data collection.
Berkes et al, 2006	The scientific objectives were about conserving populations and species
Briggs, 2005	Western science is seen to be open, systematic and objective, dependent very much on being a detached centre of rationality and intelligence

Usher, 2000 Science combines a particular set of values with systems of knowing based on empirical temporal observation, rationality, and logic, as opposed to received or felt truths... or lived experience

Lertzman, 2002

- Science Is a systematic process whereby ideas about the nature of the world are challenged by observations
- The focus is on rejecting hypotheses using carefully collected and controlled data
- Scientific knowledge is dynamic and changing as we learn more about the world around us

Appendix C

Definitions of Co-production

Source	Definition
Armitage et al., 2011	...knowledge co-production, which we define as the collaborative process of bringing a plurality of knowledge sources and types together to address a defined problem and build an integrated or systems-oriented understanding of that problem.
Cited in Pohl et al., 2010	Co-production as a simultaneous production of knowledge and social order
Service et al., 2013	Coupling indigenous knowledge and western science offer[s] multiple lines of evidence...
Tsuji & Ho, 2002	TEK might complement of supplement conventional scientific approaches in addressing complex environmental issues. Utility may be related to taxonomic, spatial, temporal, and social/cultural frames of reference. These frames of reference... may enhance or even be the sole source of baseline data, from which scientific approaches may base its research.
Johnson, 1992a	Only when both groups [Indigenous peoples and scientists] develop an appreciation of, and sensitivity to, the strengths and limitations of their respective knowledge systems can integration begin to occur.
McGregor, 2008	The field to date has focused more on gathering and documenting, using social science methods, those aspects of the knowledge base that are considered of value to external non-Native interests. These TEK fragments, where they are used at all, are frequently applied with minimal if any Aboriginal involvement.
Riedlinger & Berkes, 2000	For many scientists, their knowledge already incorporates what has been learned from Inuit communities. ...There is room for more progress in accepting traditional knowledge as a source of knowledge and understanding, not in the abstract, but in practice.
Berkes et al., 2006	Inuivialuit observations cannot replace scientific measurements, but they can contribute to the overall understanding of the phenomena of change and its impacts

by complementing scientific approaches.

Cobb et al., 2005 The concept of mutual learning rather than attempting to “integrate” local knowledge into science might provide a “weight of evidence” approach to environmental change. Collaborative or participatory approaches to setting ecosystem objectives, selecting indicators, and monitoring are likely to provide the best path forward.

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