EXPERIENCES OF NATURAL CLIMATE VARIABILITY IN NEWFOUNDLAND AND LABRADOR

by © Olivia Frances Vilá

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Abstract

Climate variability is the semi-regular fluctuation of climate about its mean state. Whereas there is considerable research into how daily variability and long-term change may influence attitudes and perceptions of climate change, the influence of climate variability acting over timescales between these extremes (i.e. interannual anomalies, decadal cycles) has mostly been neglected in human dimensions of climate research. This lack of consideration of long-term climate variability has limited our capacity to assess climate perceptions effectively and holistically. The goal of this research was to explore the extent to which individuals notice, interpret, and communicate climate variability. Through semi-structured, one-on-one interviews with people living in areas experiencing considerable climate variability, this research has begun to develop a baseline understanding of the weather and climate phenomena that are prevalent in participants' lives. This project also analyzes some of the language strategies that individuals use to communicate weather/climate cycles and other relevant climate phenomena. Subsequent focus group discussions were used to test tools for communicating important weather/climate phenomena. Because human values and cultural meanings are often removed from climate science, climate-related information is difficult to understand and contextualize when disseminated to the public. By focusing on the social aspects of weather and climate experiences, this research identifies the climate features that matter most to individuals in the community being researched. The results of this project can inform future research investigating perceptions and experiences of past weather and climate phenomena. Furthermore, because longer-term variability is often misrepresented as counter-evidence to anthropogenic climate change by either those who do not understand or care to understand the phenomena, the results of this research can begin to aid in reducing the potential misinterpretations between natural climate variability and climate change.

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Statement of Authorship

This thesis is the independent written work of the author, Olivia Frances Vilá. The research on which this written work is based is one part of a team project carried out by two graduate students, Marilyn Koitnurm and the author, and three supervising Memorial University of Newfoundland faculty members, Dr. Joel Finnis (Department of Geography), Dr. Mark CJ Stoddart (Department of Sociology), and Dr. Atanu Sarkar (Faculty of Medicine). The team worked together on developing the research tools used in this project, participant recruitment, data collection, and preliminary data analysis. The author was responsible for developing her specific research questions and analyzing data in response to those questions.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1: Introduction

This project was part of a larger exploratory qualitative study of local weather and climate knowledge in communities located in the Canadian province of Newfoundland and Labrador. This team-based project sought to gain insight into what individuals notice and remember about their weather and climate experiences. For reasons that will be outlined throughout this chapter, the specific focus of this thesis is the communication of natural climate variability. Below are the questions that were used to guide this portion of the research project:

1) *What are the types of weather and climate phenomena that are significant in the lives of participants?*
2) *What are the discussion strategies that participants use to communicate knowledge related to i) weather and climate cycles and ii) significant weather and climate phenomena?*
3) *What communication tools can be developed to discuss climate cycles and significant weather and climate phenomena with diverse publics?*

In the following section of this chapter, the relevant literature surrounding the topics of local climate knowledge, perceptions of weather and climate, and natural climate variability will be discussed. The chapter will then conclude with a discussion of how the research questions presented above address some of the knowledge gaps highlighted in the background literature.

1. Background Literature

1.1 Climate, local knowledge, and implicit views of the public. Research suggests that adaptive strategies to address climate change should be informed by local knowledge in order to be relevant and tailored to the needs of particular communities (e.g. Reidlinger & Berkes, 2001; Nyong, Adesina, & Elasha, 2007; Klein et al., 2014; Pearce, Ford, Cunsolo Willox, & Smit, 2014;

Reyes-García et al., 2015). If local knowledge is documented and used appropriately, it can serve as a rich source of information that accurately details the time- and space-specific lived experiences of individuals and reflects the institutions in which they operate. This can ultimately help individuals make informed decisions in their day-to-day lives, reveal changes desired by the communities, and indicate the ways in which these changes can be effectively implemented across a variety of diverse political landscapes (Wejs, Harvold, Larsen, & Saglie, 2014). It is important to note that the documentation and use of local knowledge does not necessarily mean that it must be in academic or bureaucratic terms, in order for it to be "appropriate" (Cameron, 2017).

Local knowledge is now often considered a necessary component of climate science, community adaptation planning, and mitigation-related policy (Ford et al. 2016). Despite the call for increased assessment of local knowledge and growing recognition of its importance, policymaker discourses are often at odds with local narratives (Pearce et al., 2014), and this form of knowledge remains secondary to scientific knowledge acquired from methods which emphasize standardization and quantification (Klenk, Fiume, Meehan, & Gibbes, 2017). Additionally, because local knowledge is inherently qualitative, many critiques that have historically and presently lobbied against qualitative research methods (see Whittemore, Chase, & Mandle, 2001) are also applied to local knowledge research (e.g. scientific knowledge is objective and rigorous whereas local knowledge is not) (Huntington, 2000).

Until recently, weather and climate have belonged to the realm of natural sciences, resulting in an inherent reluctance to incorporate cultural and social perspectives into weather and climate related research. Impacts from this natural science control over weather and climate topics still linger today. As Klenk et al. (2017) highlights, the prioritization of Western scientific approaches in climate change science is exemplified by the Intergovernmental Panel on Climate

Change's (IPCC) past reliance on quantitative data and expert knowledge ("expert" in this case meaning having formal scientific qualifications) over qualitative data and local and Indigenous knowledge and sciences, which the IPCC is currently moving towards. The historical dependency on the natural sciences and standardization within climate change discourse can be traced to 1985 at the World Meteorological Organization, United Nations Environment Programme, and International Council of Scientific Unions' Villach Conference, where anthropogenic climate change was formalized as a global concern which needed institutionalized mitigation and adaptation solutions (Hulme, 2008). The resulting impact has been climate change policy goals that are defined and measured in only physical terms (Hulme, 2008), often lacking meaning to those situated outside the natural sciences. For example, the European Union's policy goal of "keeping global warming below 2°C compared with the average temperature in pre-industrial times" (European Commission, 2017) is centred on 1) a global and numerically defined climate and 2) the stabilization of greenhouse gas emissions, which is a "quantity wholly disembodied from its multiple and contradictory cultural meanings" (Hulme, 2008, p. 6). Instead, social and human elements relevant to adaptation and mitigation should be at the forefront of the development and employment of policy. For example, in a study examining climate change at the local level in two Scandinavian countries, the authors found that adaptation policy implementation was perceived as less difficult when viewed as a *social* development issue, rather than an environmental issue (Wejs, Harvold, Larsen, & Saglie, 2014).

Interestingly, science is often framed to the public as objective, and without social or cultural influences (Boykoff, 2011). Similarly policy in contemporary society is presented as based solely on probabilistic and objective risk analysis and reasoning (Duckett et al., 2015). This is a misrepresentation of both scientific ways of knowing, which are "not independent of politics and

culture, but are co-produced by scientists embedded in society" (Boykoff, 2011, p. 78), and of the governance process, as policy goals and related decisions cannot be separated from "messy" social-political influences (Duckett et al., 2015).

Alongside climate change, climate in itself has been removed from its human values and cultural meanings within communication- and policy- related contexts, resulting in climate-related information that is often hard to understand and contextualize when dispersed to local audiences (Hulme, 2008). Hulme (2008, p. 7) illustrates this point by tracing the transformation of a single weather event into a "purified" number and climate description:

> *Weather is first captured locally and quantified, then transported and aggregated into regional and global indicators. These indicators are abstracted and simulated in models before being delivered back to their starting places (locales) in new predictive and sterilized forms…Through this circuitry, weather—and its collective noun climate—becomes detached from its original human and cultural setting.*

While this approach has scientific value, this purification process results in the loss of valuable information that could have been used to benefit localized contexts and a variety of audiences. As stated by Norgaard (2011, p. 72), information "cannot be thought of in generic and isolated blocks of 'facts' with universal meaning and significance" and must instead "be understood in social context." Similarly, Krauss and von Storch (2012, p. 214) point out that "scientific climate as a model and form of knowledge based on global observation has lost connection to the experience and perception of climate and weather by people in their everyday life." It is this discrepancy between scientific weather and climate discourse and the everyday experience of weather and climate that is partially responsible for the decline in climate change interest (Krauss and von Storch, 2012). Currently there is research which shows that local climate

knowledge may be perceived as, or sometimes more, accurate than scientific knowledge (Kalanda-Joshua, Ngongondo, Chipeta, & Mpembeka, 2011; Speranza, Kiteme, Ambenje, Wiesmann, & Makali, 2010). However the transmission of local knowledge, particularly to younger generations, is declining (Hiwasaki, Luna, & Marçal, 2015). This may partially be a manifestation of the preferential treatment historically given to Western science, as local knowledge becomes easier to dismiss when it is not in-line with expected scientific conclusions.

For example, in a segment on This American Life (Kestenbaum, 2017), Selena Ross describes Ian Mauro's experience with Indigenous reports of the changing Arctic sunrise. Interviewing Indigenous peoples residing in the Arctic for a documentary on climate change, Mauro came across numerous reports of the sun rising in the "wrong spot", and some speculation that this might reflect a shift in the planet's orientation relative to the sun. Accepting the claims, he then attempted to seek the input of scientific experts who could provide a physical explanation for this phenomena. Unfortunately, Mauro's acceptance of local knowledge was met with resistance, as certain experts dismissed the idea of a shifted planet as impossible, and (implicitly or explicitly) characterized Indigenous observations as a figment of the locals' imaginations or as observational mistakes. Furthermore, these same experts often urged Mauro to discontinue his inquiries, as they were damaging to his credibility and reputation. Subsequent interpretation by experts in atmospheric optics have, however, suggested that shifting temperature profiles in a warming Arctic might explain the original observation. This example demonstrates ways local knowledge can struggle to be considered seriously, and sometimes struggle to connect with compatible subfields of Western science; especially when local observation of a phenomena and 'ways of knowing' it conflict with science.

A similar example illustrating disconnect between local and scientific knowledge is provided by West and Vásquez-León (2008) concerning two diverging understandings for environmental change in southeastern Arizona. The "scientific expert" understanding of increased drought exposure framed the issue as a result of misguided ranching and agricultural practices, while the long-held local understanding (which is now being supported by seasonal rainfall measurements) attributed the issue to natural processes. Furthermore, the cause of the environmental change wasn't the only source of discrepancy between scientific and local perspectives, but also the interpretation of those changes as positive or negative and as being permanent or transitory.

There is currently a growing movement to incorporate local perspectives into weather and climate discourse, especially due to increasing climate change awareness and acceptance (Ziegler, 2017). However, simply "gathering data" from locals does not in itself serve to return cultural meanings and values to "processed" climate measures. As will be illustrated below, removing contextual information from knowledge appears to be an issue that faces local knowledge research. This may be a result of institutional pressures to standardize and generalize information in academic settings. While standardization and generalization is important in certain settings, it ultimately diffuses information which could be important in fully understanding the nuances of community specific experiences.

The removal of contextual information from local knowledge is especially evident in social science research utilizing close-ended survey methods and statistical analyses to gather information about local weather and climate perceptions. For example, Howe (2018) conducted an internet survey investigating how the general population of Norway compared two recent winters with their understandings of a 'normal' winter in their community (i.e. warmer than

normal, colder than normal, or normal). The author then correlated the resulting interpretations with the individuals' beliefs about climate change. Relevant context to understand these local experiences is missing, notably i) how individuals are conceptualizing "normal", and ii) how much conditions must deviate to be considered abnormal. In another example, a study investigating local perceptions of climate change in the Himalayas asked participants whether they had experienced an 'overall temperature rise' over the last 10 years; possible responses were "Yes, have experienced", "No, haven't experienced", and "Don't know about it" (Chaudhary & Bawa, 2011). The authors' interpretation of the 77.2% of individuals who answered "Yes, have experienced" was that 77.2% of individuals *believe* in overall warming in their communities, or as the article suggests, *believe* in *climate change*. Like the previous example, this particular method prevents elaboration which may provide relevant context to understanding the experiences of rising temperatures (e.g. the perceived cause of the warming and the degree to which warming is unusual or expected in the area). Additionally in this case, not only is context detached from what has been labelled as local knowledge, context is being artificially integrated into close-ended, three-option survey responses. As illustrated by Finnis, Sarkar, & Stoddart (2015) this type of treatment of local knowledge is symptomatic across many survey-based climate perception studies, where considerations of climate other than 'change' and 'weather' are often excluded or underdeveloped, yielding incomplete accounts of local climate perceptions.

Furthermore, these standardized surveys are sometimes used to 'confirm' local knowledge against scientific measures of weather and climate phenomena (e.g. Gbetibouo, 2009; Chaundhary & Bawa, 2011; Akerlof, Maibach, Fitzgerald, Cedeno, & Neuman, 2013; Niles & Mueller, 2016; Ayanlade, Radeny, & Morton, 2017; Howe, 2018). If from the beginning, local knowledge is undermined and understood as either 'accurate' or 'inaccurate' based on scientific assertions, local

knowledge cannot aid in a process of knowledge co-production. Instead, measuring the 'accuracy' of local knowledge, in which researchers are essentially measuring the deficit of the public's scientific knowledge, may not only deter individuals from engaging in future community research, but it may also contribute to a continued science-society strain in which institutional science propagates inaccurate and unsubstantiated simplistic portrayals of the public (Wynne, 2006).

Mauro's experience with the changing Arctic sunrise described earlier is also an illustrative example of how the local-scientific knowledge disconnect can introduce problems and impede knowledge production. Eventually, collaboration with individuals who were willing to integrate local and scientific knowledge, led to explanations for the phenomena Indigenous Arctic communities were experiencing. On a similar note, Cunsolo Willox et al. (2012) highlights that much of the climate-health related literature up to that point had been centred on the physical health impacts of climate change, i.e. the more easily quantifiable and traditionally scientific measures of health. However, as called for by the authors, climate-health research must holistically consider physical, emotional, and mental health; and to successfully do so, it must incorporate context-specific considerations of place attachment and sense of place (Cunsolo Willox et al., 2012). That is, climate-health research needs to ensure that there is a functioning relationship between local knowledge and scientific knowledge to develop effective solutions to all health related issues facing communities as a result of changing and variable climates.

In Nerlich, Koteyko, and Brown's (2010) overview of climate change communication research, the authors highlight that most research up to that point had functioned on an implicit 'public deficit model'. In its most basic sense, the *deficit model of public understanding of science* refers to the idea that individuals lack scientific knowledge, and simply providing that knowledge will lead to decision-making the scientific community considers rational (Nerlich, et al., 2010).

While filling knowledge gaps is necessary for informed decision-making, it is not sufficient for active engagement (Boykoff, 2011). Furthermore, a knowledge deficit does not explain why the many individuals who express belief, understanding, and concern about climate change fail to have a social response towards addressing climate change (e.g. through political participation or by reducing dependence on fossil fuels) (Norgaard, 2011). As Norgaard (2011, p. 67) further points out, "increased understanding has mysteriously failed to translate into either greater concern or concrete action".

In more recent research, the public deficit model has manifested itself in more discrete ways under the justification of 'public engagement', where the emphasis is on a *two-way dialogue* versus the one-way transmission of information (Wynne, 2006). While there has certainly been an improvement, as there is better consideration of non-scientific perspectives and contexts, in practice the public is still often seen as deficient in public engagement contexts, and scientific perspectives and assumptions continue to dominate (Wynne, 2006). Researchers seeking to incorporate local knowledge through a post-deficit framework should aim to develop relationships with publics as co-producers of knowledge (Davidson-Hunt & O-Flaherty 2007; Klenk et al. 2017) by challenging "entrenched assumptions, interests, power structures and imaginations" (Felt & Wynne, 2008, p. 60) at every phase of project development, execution, analysis, and reporting. Furthermore, researchers should enable and encourage that same behaviour from publics during the process of engagement (Pearce, Brown, Nerlich, & Koteyko, 2015). Lastly it is crucial that human values are re-established in climate-related discussions, such as personal values, perspectives, and experiences with nature and the environment, as well as acknowledge and accept multiple ways of knowing about the world. This could help develop more effective strategies for public engagement (Boykoff, 2011).

The move towards a post-deficit model of communication complements a suggested shift from a 'normal' science framework (Kuhn, 1962) to a post-normal framework as first outlined by Funtowicz and Ravetz (1993). *Normal science* can be exemplified as an approach that "reduces complex phenomena to their simple atomic elements which can make effective use of a scientific methodology designed for controlled experimentation, abstract theory building, and full quantification" (Funtowicz & Ravetz. 2003, p. 2). On the other hand, post-normal science approaches acknowledge that reductionist methods are less relevant for the tasks of science-related policy, and for understanding the complex interplay of social and environmental systems. In the context of policy, the reduction of complexity and uncertainty, i.e. greater certainty and reassurance that risks are controlled, is often promoted as a necessary criteria for political and policy progress (Gross, 2010; Boykoff, 2011). This is drastically inconsistent with how both science and policy work. For example, as scientific progress is made, complexity often increases as more questions tend to arise; and because of this increased complexity, policy decisions also become more difficult as a result of the greater knowledge, alternatives, interpretations (Boykoff, 2011), ignorance and potential for "surprises" (Gross, 2010). As highlighted by Gross (2010) ignorance and corresponding "surprising events", i.e. awareness of one's own ignorance, are characteristic features of both science and policy. However, contrary to the idea that better science and further research will eventually result in the absence of uncertainty for risk-free decision-making, the development of scientific knowledge instead results in surprising events, which "lie beyond the spheres of probability and risk" (Gross, 2010, p. 1).

Post-normal sciences extend the discussion beyond scientific experts to include the various publics implicated or interested in an issue, and place complexity and uncertainty at the forefront (Funtowicz & Ravetz. 2003). By adopting a post-normal approach, "facts" can not only be

expanded upon to include local knowledge, but publics can gain the opportunity to engage in the development, regulation, and evaluation of solutions. In their paper which analyzes climate services as a post-normal practice, Kraus and von Storch (2012) state that climate communication needs to be *between* scientists and the public, and it needs to address the complex interactions of meteorological and societal changes. In other words, climate communication must be done using post-normal approaches.

In a discussion of ways in which the public deficit model has recently manifested itself, Wynne (2006) points to the notion that publics often seek scientific certainty. He discusses that this notion has led to the justification of presenting climate change as a normal science issue (uncertainty and complexity minimized) in communication efforts. Another example is pointed out by Gross (2010) who illustrates that in efforts to reassure a supposedly deficient and uncertainty-averse public, funding is prioritized to the basic earth sciences for addressing known uncertainties, rather than human dimensions research which has the potential to better focus on coping with uncertainties. In addition, although human dimensions of climate change research is receiving increased attention, there appears to be a focus on analyzing *present* and *future* impacts, which once again is aimed at reducing uncertainty (Cameron, 2017). This is in comparison to analyzing the *past*, which can aid in understanding how individuals have historically coped with uncertainty (Cameron, 2017). As Wynne (2006) highlights however, research has shown that the public is not only aware of uncertainty and complexity in the scientific process, but is also skeptical of attempts at masking these characteristics through certainty claims, suggesting that current research priorities may not be as productive for public opinion and engagement as intended.

Post-deficit and post-normal frameworks are then intertwined. It isn't until the scientific community has accurate views of the public, and their abilities to understand and make sense of

complex and uncertain information are acknowledged, that effective post-normal approaches to climate science can be adopted; treating local knowledge as an equally relevant form of knowing is a potentially important move in this direction. The treatment of climate change as a post-normal issue that embraces a post-deficit view of the public relies on conveying uncertainties, while recognizing the limited role of science in complex decision processes to implicated publics (von Storch, Bunde, & Stehr, 2011). Ultimately, suggestions on how to incorporate local knowledge into climate change discourse echo the post-deficit and post-normal call to engage inclusive, open, and reflexive dialogue, based on mutual respect between stakeholders/publics and scientific experts.

1.2 Climate variability & post-deficit and post-normal science. Natural climate variability is the semi-regular fluctuation of climate about its mean state. The mechanisms that determine specific climate variability fluctuations, are highly complex, and resulting variability phenomena (often called 'modes' of variability) may vary spatially and on a multitude of timescales. Variability can be short-term (e.g. daily, seasonally, yearly) or longer-term (e.g. decadal, centennial). For example, the El Niño-Southern Oscillation (ENSO) is one of the dominant modes of interannual (short-term) variability, capable of exerting hemisphere-scale influences on weather (Holbrook et al, 2012). This influence might be best described as a recurring climate anomaly, present for a season to a year and occurring somewhere between one and three times a decade. Other well-studied modes of variability are often described as 'cycles', implying a tendency to smoothly run through a characteristic sequence over some characteristic time-scale; for example, the Atlantic Multidecadal Oscillation (AMO; Enfield, Mestas-Nunez, & Trimble, 2001), which captures a tendency for Atlantic sea surface temperatures to gradually shift between cooler and warmer periods ('phases'), which then persist for decades. Still other modes

demonstrate a combination of seemingly random anomalies with characteristics of slower cyclical changes; for example, the North Atlantic Oscillation (NAO), which captures monthly-to-decadal variations in preferred storm tracks, and exerts an influence from the eastern seaboard of the United States to Siberia, and from the Arctic to the subtropical Atlantic (Hurrell, Kushnir, Ottersen, & Visbeck., 2003). While the NAO is most associated with large changes over the course of months or seasons (like ENSO), it has also demonstrated an AMO-like tendency to prefer certain phases for periods of decades (e.g. through much of the 1980s through to the mid 1990s; Hurrell, Kushnir, Ottersen, & Visbeck., 2003).These forms of climate variability have both direct environmental impacts as well as social impacts (Holbrook et al., 2012; Hurrell et al., 2003).

Climate variability is a central concept in the natural sciences, and imperative for accurately understanding and predicting the effects of climate change on particular regions (Finnis et al. 2015; Hasselmann, 1997; Barnston, Kumar, Goddard, & Hoerlin, 2005; Hurrell et al., 2003). That is, before the influence of climate change on a specific region can be properly quantified, the influence of variability first needs to be accounted for. In climate change projections, climate variability represents a source of complexity and uncertainty (Hawkins & Sutton, 2009) which is unlikely to be reduced in future projections (Deser, Knutti, Solomon, & Phillips, 2012). However, research on physical functioning and potential impacts of natural climate variability is continually growing (see Cassou et al., 2017 and Garcia-Menendez, Monier, & Selin, 2017).

While it is given considerable attention in the natural sciences, social science studies related to climate have mostly ignored the concept, leaving the human and cultural aspects of climate variability unexplored. This is a problem for at least couple of reasons. First, the effects of climate variability may mask much of the human influence of anthropogenic climate change on regional scales (Trenberth, 2012). For example, while natural warming cycles augment the

magnitude of anthropogenic climate change (Deser et al., 2012), and in turn may be interpreted as "evidence" of human-induced climate change, natural cooling cycles reduce the apparent magnitude of anthropogenic climate change (Deser at al., 2012), providing an opening for criticism by climate change skeptics when left neglected in climate change communication. Secondly, because some forms of natural climate variability act on timescales which may be more tangible to humans than the relatively slower climate change produced by anthropogenic forcing, the localized impacts of natural climate variability may be of equal or more importance to individuals and their decision making. For example, in a study which qualitatively investigated landscape change in southeastern Arizona (West & Vásquez-León, 2008, p. 380), a rangeland extension agent brought up the concern that the lack of consideration of climate variability may result in management plans that "pushed the ecosystem in one direction" while the climate pushed it in another direction.

Studies which do give attention to natural climate variability typically limit the discussion to shorter-term variability (i.e. intra-annual or inter-annual) or discuss it in terms of changing variability (Finnis et al., 2015). Also, as noted by Finnis et al. (2015), when the subject of climate variability is broached, it is often with less detail than its climate change counter-part. For example, there are some circumstances in which the distinction between perception measures of climate variability and perception measures of climate change are unclear or undefined. This is illustrated by Ayal & Filho (2017) who used a survey to measure farmers' perceptions of climate variability in Ethiopia, and their indicators of variability include items such as "temperature increases" and "rainfall amount decreases", which offer unclear distinctions between change and variability. In some cases, climate variability is used interchangeably or confused with climate change. For example, in discussing what the authors pose as the multiple definitions of *climate variability*, Le

Dang, Bruwer, & Nuberg, (2014, p. 533) refer to an IPCC definition "any change in climate over time, whether due to natural variability or as a result of human activity"; which is actually the IPCC's 2007 definition of climate *change*, not of climate variability. The other definitions that the authors provide however do seem to be more in-line with the definition provided in the beginning of this section. The lack of adequate consideration given to climate variability in human dimensions of climate research may further reflect the exclusion of human values and cultural meanings from climate science and communication outlined in section 1.1 of this chapter. That is, research up to this point has focused on only a limited piece of the climate (i.e. primarily change), ultimately hindering the emergence of nuanced and multifaceted information that better reflects the social experience of climate.

Public communication of climate change and media representations of climate change also tend to (deliberately or not) either amplify or limit the discussion of climate variability (Boykoff, 2011). One of the arguments perpetuating limited discussions of climate variability is that such omissions are intended to emphasize core findings (Finnis et al., 2015). Furthermore, there is also the concern that the legitimacy of claims will be undermined if discussions of uncertainty are introduced (Olausson, 2009; Finnis et al., 2015) as media have in the past (mis)represented dimensions of uncertainty as scientific non-consensus surrounding the reality of anthropogenic climate change (Boykoff, 2011). Lastly, there is also the consideration that scientists don't know how to convey the confidence in anthropogenic climate change while simultaneously addressing the pronounced influence of climate variability to the public (Finnis et al., 2015). Whereas it is simple to discuss change (e.g. it once was, but now isn't/soon will not be) and easy to talk about weather because it is part of people's daily experiences, variability is more vague and difficult to discuss even within specialized science circles. Furthermore, because the concept of 'natural

cycles' has been seized by climate change skeptics to use as a counterargument against anthropogenic climate change, additional care must be taken so as not to bolster a skeptic narrative. Boykoff (2011) argues that this lack of knowing how to communicate may be further perpetuated by the unwillingness of some scientists to invest their time reaching beyond their immediate academic circles. This is highlighted in section 1.1 above, in which there is a focus on the reduction of uncertainty (research that would remain *within* the academic circle) rather than on coping with the uncertainty (research that would lie *outside* the academic circle) in science and policy settings.

There is research that not only highlights the importance of natural climate variability in understanding climate change projections, but also emphasizes the need to incorporate natural climate variability into communication efforts with the public. For example, Deser et al. (2012) illustrates the range of future outcomes in North America based on multiple climate models, while highlighting the differences in climate change predictability in regions that are more or less influenced by natural climate variability. The authors conclude by calling for a more focused dialogue between scientists, policymakers, and the public in order to avoid presenting climate change projections as "accurate regional predictions everywhere" (i.e. free of uncertainty). Similarly, Hawkins (2011) argues that understanding and acknowledging the role of natural climate variability is important for policymakers and the public, as planning decisions that are practical and relevant for society must take into consideration fluctuations within decadal timescales. This is also echoed by Hulme et al. (1999), who highlight that comparing the potential impacts from projections of climate change with those from multi-decadal climate variability is important for appropriate adaptation strategies.

As previously discussed, non-scientific publics are likely aware that climate change science is not a normal-science issue; in other words, climate change is intrinsically complex and

uncertain. Attempts to portray it as simple/certain may consequently induce feelings of mistrust (Wynne, 2006). The avoidance of these considerations in both the topics social science chooses to address as well as the communication of climate change to the public may then function more as a self-fulfilling prophecy, in which knowledge claims *have been* undermined, not because of the inclusion of considerations of variability, uncertainty, and complexity, but because of their deliberate exclusion from the conversation. Furthermore, individuals seeking to discredit those individuals and entities responsible for disseminating climate change information, may exploit this misrepresentation of climate change science and the scientific process to promote a "skeptical" perspective. For example, when skeptics seized the "climate change hiatus" (a complex and uncertain global-scale variability phenomena), and cited the phenomena as evidence contradicting climate change consensus (Morin, 2013).

The limited and unrefined attention given to natural climate variability can be interpreted as a joint manifestation of the public deficit model and a normal-science framework; in which there is an underlying assumption that the public is not capable of understanding, much less discussing or contributing to, issues that encompass variability, complexity and uncertainty. This research argues that by simply introducing natural climate variability into human dimensions of climate change research, the public is being treated in ways that embrace a post-deficit idea of the public which will in-turn allow us to treat climate change as a post-normal science issue for which knowledge is co-produced and solutions are collaborative efforts between all of those who are implicated.

2. Building on the Human Dimensions of Long-term Variability

The research questions presented in the beginning of this chapter were designed to yield results that will begin to address some of the current shortcomings in the literature and will develop

knowledge that can aid both academic and non-academic related goals.

By investigating the topic of long-term climate variability, this research will be one of the first projects to our knowledge where climate variability is the primary focus, providing rich and detailed qualitative descriptions of experiences that are in between the fleeting daily occurrence of weather and the slow-acting permanent changes in climate. This research builds on some of the earliest attempts to understand environmental change through local knowledge, which show that Indigenous Elders in the Canadian Arctic detected subtle changes, cycles, and patterns in their ecosystem structure (McDonald, Arragutainaq, & Novalinga, 1997; Bill, Crozier, & Surrendi, 1996 in Reidlinger & Berkes, 2001). Specifically related to the communities being studied, this research builds on the local knowledge of weather and climate in the province of Newfoundland and Labrador, which experiences significant long-term climate variability (further details in Chapter 2 section 2). However, more broadly, this research will begin to develop an understanding of how and to what extent individuals perceive long-term climate variability, how they talk about those experiences, and what tools can promote discussion on the topic. This in-turn can aid future research which attempts to accurately inquire about perceptions of long-term climate variability and other climate phenomena on a larger and more efficient scale (e.g. using survey methods). Ultimately, by developing knowledge and strategies related to the communication of climate variability, this research promotes the integration of climate variability discussions into public spheres which currently fail to dedicate accurate, substantial, meaningful, and necessary attention to the topics of uncertainty and complexity in climate change communication.

Efforts will be made during the analysis process to retain the "human context" in the local knowledge shared by participants. A post-normal approach will be taken when analyzing the discussion strategies that individuals use when talking about their weather and climate experiences.

This means that the focus will be on the intricate and contextual information that is provided in conjunction with the physical descriptions of climate, rather than on their physical descriptions alone. This will be a shift from much of the existing weather and climate perception research which, as described in the previous section, focuses on perceptions which are easily measured and compared against traditional scientific measures of weather and climate. This research will further integrate a post-normal perspective by directly confronting issues of climate complexity and uncertainty with the public.

Because this research is also grounded within the post-deficit model, substantial attention is being dedicated to the *general* experiences of weather and climate in Newfoundland and Labrador, rather than specifically on long-term climate variability. This was done so as not to assume that long-term variability is something that individuals notice or do not notice in their environment. Although this project does not explicitly seek to document Indigenous perspectives in isolation, this research takes lessons from Cameron's (2017, p. 472) advice to "challenge the presumption that the 'local' knowledges and concerns made legible through academic and bureaucratic knowledge production fully reflect what arctic Indigenous peoples know about and care about with respect to climate change." This is to say that although the researchers have climatological informed knowledge regarding the physical presence of long-term climate variability in the province, this may not necessarily reflect the experiences of individuals. Instead of "forcing" discussion to centre on a topic that up to this point only the researchers have considered prevalent, the researchers are providing opportunities for and facilitating the memory of climate variability, should that reflect what individuals find memorable and important. This research will yield valuable information about the nature and extent of individuals' associations with long-term variability as well as baseline information about the communication of the subject.

This research will also acknowledge important information regarding individuals past and localized experiences with weather and climate in ways that emphasize the communities' interest and priorities.

Chapter 2: Research Methodology and Methods

This chapter outlines and provides justification for the methodology chosen for the current research project (section 1). A thorough description of the study area (section 2) and methods (section 3) follows, including a discussion of the sampling techniques, research sample, research instruments employed, and data analysis approaches used. The section is divided into two separate segments that reflect the two phases of the research: Phase I (section 3.1), which consisted of one-on-one interviews intended to gain a baseline understanding of the topic of interest, and Phase II (section 3.2), which consisted of focus group discussions intended to more explicitly address climate variability with participants. The final section in the chapter (3.3) is dedicated to a discussion on the rationale for the two phases and how the resulting data were synthesized.

1. Methodology

This research project looked at the lived experiences of weather and climate in Newfoundland and Labrador, to explore the boundaries for understanding and discussing weather and climate variability as well as significant other climate phenomena in the area. Both the purpose and research questions (Chapter 1.1) of this project emphasize the importance of the subjective experiences of participants. Similarly, data collection and corresponding communication tools used in the project were designed to reflect the social constructs, meanings, and impacts of weather and climate, rather than the underlying physical processes driving the atmosphere or precise reconstructions of past conditions. Here, this entails the gathering of complex personal narratives and subsequent unpacking of connected "webs of meaning" that people attach to weather and climate phenomena; this approach is best suited to qualitative methodologies (Leavy 2017; Ritchie, Lewis, Nicholls, & Ormston, 2013; Ten Have 2004).

This project aimed to gather in-depth descriptions of local experiences and explore preliminary communication strategies informed by the local data. The flexible and bottom-up processes that are characteristic of qualitative research were necessary to ensure resulting data reflects the subjective experiences of the participants, rather than the climatologically informed expectations of the researchers. Adopting flexibility as a value throughout the research process allows the researcher to consistently adapt to information gathered from participants, and better reflect participants' lived experiences. In this same regard, the analysis of data needed to be informed by the data itself, with minimal influence of pre-established assumptions from the researchers. For this reason, a bottom-up, or inductive approach, was ideal. A flexible and inductive approach is especially important in this circumstance, because background knowledge on social perceptions of climate variability is underdeveloped, and relevant frameworks for understanding this topic have not yet been established.

Because of this knowledge gap in the literature, this research project took a primarily exploratory approach. Although on occasion viewed as less rigorous than other approaches, exploratory research is necessary for poorly understood phenomena (Leavy, 2017; Bernard, Wutich, & Ryan, 2017), and can be a systematic process that can yield rich descriptions leading to the understanding of social or psychological life (Stebbins, 2001). Given the limited prior research on variability perceptions and the lack of readily apparent vocabulary or communication strategies related to climate variability, exploratory qualitative approaches that allow for the generation of ideas and the ability to develop theory from emergent data (Stebbins, 2001) was important.

As will be detailed in the following section, this project had two distinct research phases. Phase I, one-on-one semi-structured interviews, and Phase II, focus group discussions. For the first phase of this study, it was important to investigate the local perceptions of climate variability and

the corresponding communication of those perceptions in a context where "discovery [was] possible and broad" (Stebbins, 2001). While it was important to stimulate discussions about climate variability with participants, it was not the goal to elicit conversation about thoughts and memories that were not pertinent to the participants. The exploratory approach taken during the first phase of the study promoted the natural discussion that would best highlight the significant weather and climate events in participants' lives, while eliciting responses in the natural colloquial language that the participants would regularly use to discuss weather and climate.

The second phase of the study took the form of focus groups, and combined both descriptive and exploratory approaches. Following the collection of initial 'baseline' data outlining the extent to which individuals perceive/discuss climate variability, the second phase aimed to i) explicitly address the communication of climate variability and ii) elicit more detailed climate/weather narratives. By directly addressing climate variability, participants were able to elaborate on their understandings and explanations, providing much more detail (or "thick descriptions") on the topic of interest. According to Bernard et al. (2017), descriptive research should aim to collect as much detail as possible, which was precisely one of the goals for the second phase of the research study: gain more detail in order to form comprehensive descriptions of participants' strategies for discussing climate variability, and explore their desire and need for such information. Furthermore, the second phase of the study also served as a creative space to develop and test tools for communicating climate variability or other important weather or climate phenomena.

Further discussion on the synthesis of the research phases is provided in section 3.3.

2. Study Area

The study was conducted in the province of Newfoundland and Labrador, the most easterly province of Canada. The province comprises the island of Newfoundland and mainland region of Labrador. Three different communities were sampled from in Newfoundland and one community in Labrador. Newfoundland has an estimated 478,139 residents (Statistics Canada, 2017) across a land area of 111,390 km^2 (Government of Newfoundland and Labrador, 2018). Labrador has an estimated 27,197 residents (Statistics Canada, 2017) across a land area of 294, 330 km^2 (Government of Newfoundland and Labrador, 2018).

This province was selected as the main study area because it experiences significant regional interannual and decadal climate variability (Finnis, et al., 2015; Finnis & Bell, 2015; Banfield & Jacobs, 1998). Finnis et al. (2015, p. 6) highlight that much of the natural variability in the region is strongly linked to the North Atlantic Oscillation, "a mode of atmospheric variability that represents a shift in the position of the Atlantic storm track", and the Atlantic Multidecadal Oscillation, "a regular cycling between below and above average Atlantic sea surface temperatures over the span of several decades" (p. 6). Furthermore, Labrador, as part of the Canadian North, has been documented as experiencing significant changes in climate, directly and indirectly influencing the livelihood of its inhabitants (Cunsolo Willox et al., 2013)

The communities where research was conducted in Newfoundland included St. John's, Cape Broyle, and Corner Brook. The two larger cities included in the study are St. John's and Corner Brook. Of the two, St. John's has the larger population (178,427 residents; Statistics Canada, 2017); it is the primary service centre for eastern Newfoundland and the provincial capital. Corner Brook has a population of 19,547 residents (Statistics Canada, 2017) and is the service centre of western Newfoundland. Cape Broyle on the other hand is a small, primarily fishing

community with a population of 489 residents (Statistics Canada, 2017), located 40 miles south of St. John's along the Avalon Peninsula.

Happy Valley-Goose Bay, which is within the traditional homelands of the Innu and Inuit of Labrador, was sole the community sampled within Labrador. This city is the service centre of Labrador and has a population of 8,109 residents (Statistics Canada, 2017). Nain, one of five communities in Nunatsiavut, Labrador, was originally intended to be part of the study area in an effort to broaden the potential for the recruitment of individuals living in Labrador and individuals who identify as Indigenous. Although every effort was made, the timeline of research ethics approval within Nunatsiavut unfortunately did not align with the timeline of the project, requiring adjustment of the research plan.

The cities listed above were selected because of their geographical diversity. As illustrated in Figure 2.1, St. John's/Cape Broyle, Corner Brook, and Happy Valley-Goose Bay have substantial distance between them. This physical distance means that each of these cities has their own unique climate. For example, whereas St. John's and Cape Broyle have relatively mild temperatures year-round (the average winter low is -8.6°C and the average summer high is 20.7°C), Happy Valley-Goose Bay experiences more extreme winter temperatures (the average winter low is -22.5°C and the average summer high is 20.9°C). Likewise, the snowfall in St. John's is relatively tame (335.0 cm average yearly snowfall) when compared to Corner Brook (401.3 cm average yearly snowfall) and Happy Valley-Goose Bay (428.3 cm average yearly snowfall).

Another benefit of researching these four diverse geographical communities is their unique demographic and cultural characteristics. St. John's was selected as an urban contrast with rural Cape Broyle. Corner Brook and Happy Valley-Goose Bay both have a mix of residents with lifestyles ranging from 'urban' to traditionally 'rural' (e.g. resource-based employment). Happy

Valley-Goose Bay further serves as a city with significant Indigenous representation (47.5% of the population in 2016) (Statistics Canada, 2017), providing a different cultural context from which to sample. Furthermore, each of the communities selected has unique features related to dominant outdoor occupations and outdoor recreation activities. These distinct spatial, demographic, and cultural characteristics enhanced the likelihood of attaining diverse perspectives in relation to the research questions, fitting the exploratory goal of this study.

Figure 2.1 Map of Newfoundland and of Labrador, sampling communities labelled (Map data ©2018 Google)

3. Methods

3.1 Phase 1: One-on-one interviews.

3.1.1 Sampling and recruitment. Because this research investigated perceptions of climate variability on short and long time-scales, the sampling criteria needed to maximize the potential that those recruited had lived through daily, inter-annual, and decadal climate variability, and would not confuse climate variability with spatial variability. For this reason, a purposive sampling technique was used to recruit individuals; specifically, the study only used participants who had lived in the same community for at least 15 years and were at least 30 years old.

Individuals were actively recruited from the four selected research communities. A non-random sampling technique was first used to recruit participants for the one-on-one interview component of the study. Approximately 10 participants per community were proposed, totaling 40 participants, for the first phase of the study, which according to Bernard et al. (2017) is a good sample size for non-probability samples in order to uncover core themes. Actual sample information is provided below on page 26.

Recruitment for this phase originally involved physical and digital recruitment flyers that contained information about the research topic, the incentive, Interdisciplinary Committee on Ethics in Human Research (ICEHR) approval/contact information, and researcher contact information (see Appendix 2). Physical flyers were placed on public bulletin boards and digital flyers were circulated on various social media websites. Prospective participants were prompted to contact the researcher if interested. As research has shown that monetary incentives increase recruitment rates (Bentley & Thacker, 2004), participants were offered a $10 gift card for their contribution to the research study.

Two primary issues arose from the original sampling technique. First, the recruitment response rates were low, rendering the original goal of 40 participants unrealistic had the research team continued with this approach alone. According to Patel, Doku, & Tennakoon (2003), response rates are critically dependent on the research sample. It is possible that recruitment rates were limited by sampling restrictions (e.g. residency and age restrictions), recruitment method (flyers), and recruitment locations (i.e. public bulletin boards, social media, and email). Furthermore, both individuals who engaged in the process of recruitment were international students who lacked community ties, which could have benefited recruitment. Another possible reason for the low recruitment rates was that our original expectations were overly optimistic when considering the time constraints associated with a Master's thesis project alongside the time commitment required of the interview participants. A second sampling issue that arose was obvious signs of self-selection bias emerging from the preliminary data. Those choosing to take part in the study, which was advertised as a weather and climate study, often expressed high environmental concerns or interest. This could have skewed and limited the diversity of the data.

To address these concerns, a more proactive recruitment method was used to gather participants. A set of telephone (landline) numbers was purchased from InfoCanada, listing individuals that met the location criteria and were an appropriate age to likely meet the residence requirement. These were then used to contact residents and request their participation. The researchers first described who they were and what they were calling about, and they followed by confirming with the individual that they met the research criteria. If the individual did meet the criteria they were asked if they were interested in participating in the research study in exchange for a $10 Tim Hortons gift card. If they didn't meet the criteria, the individual was asked if there was someone who lived in the household that met the criteria, and if so, that particular individual

was asked if they were interested in participating. Individuals had the option to schedule the telephone interview at a later date, or to complete the interview at that moment.

In total after using both recruitment techniques, 33 participants were recruited to participate in the one-on-one interviews. Table 2.1 displays the demographics of all of the respondents who participated in the interview. Most of the participants were recruited from St. John's and Corner Brook, nine and thirteen participants respectively. Only three participants were recruited from Cape Broyle, and five participants were recruited from Happy Valley-Goose Bay. The remaining four participants came from communities that were not directly sampled, however their participation was welcomed. These communities were Petty Harbour (n=2), Port Kirwan (n=1), and Eastport (n=1). Although participation from the only rural community that was explicitly sampled from was low, the participants from Petty Harbour (population 960), Port Kirwan (population 52), and Eastport (population 501) compensated with additional insight from a rural community perspective (Statistics Canada, 2017). Furthermore, the additions from Petty Harbour and Port Kirwan contributed to the fishing community perspective that Cape Broyle was originally expected to provide. The participants' ages ranged from 35 to 82 years old, and averaged 58 years old.

Table 2.1
Participant demographic information for corresponding one-on-one interview

Interview Number	**Community**	**Gender**	**Age**
1	St. John's	F	81
2	St. John's	F	69
3	St. John's	M	73
4	Cape Broyle	M	50
5	St. John's	M	60
6	St. John's	F	49
7	St. John's	M	37

8	Corner Brook	M	42
9	Eastport	M	71
10	Corner Brook	M	74
11	Corner Brook	M	68
12	Petty Harbour	M	59
13	Petty Harbour	M	73
14	St. John's	F	61
15	St. John's	F	82
16	Corner Brook	M	35
17	Corner Brook	M	69
18	Corner Brook	M	43
19	Corner Brook	M	39
20	Port Kirwan	F	61
21	Cape Broyle	M	39
22	HVGB	F	42
23	HVGB	M	53
24	Corner Brook	F	54
25	Corner Brook	F	82
26	Cape Broyle	F	44
27	HVGB	F	38
28	HVGB	F	46
29	Corner Brook	F	54
30	Corner Brook	M	62
31	HVGB	F	44
32	Corner Brook	F	73
33	Corner Brook	F	74

3.1.2 Research instruments. There were two primary research instruments in the first phase of the study: the interviewer and the interview schedule.

3.1.2.1 The interviewer. An interviewer is a key research instrument who needs certain skills in order to produce rich knowledge (Brinkman & Kvale, 2015). Interviews for the first phase

of the study were conducted with one interviewer, and interviewing responsibilities were roughly split between two researchers. In order to review their interviewing skills, researchers first read through a series of interview transcripts in order to gain a sense of researcher-participant engagement and interview flow. Following this exercise, both researchers conducted two pilot interviews each, in which the focus was the interview process. They then transcribed their pilot interviews and jointly reflected on their experiences and performances. These exercises better prepared the researchers to be effective research instruments for the project. Both researchers, who were relatively new to interviewing, recognized that their skills would continue to develop throughout the official data-gathering process.

3.1.2.2 Interview schedule. A semi-structured interview schedule was chosen for the current study. In contrast with structured interviews (with rigid, pre-set questions and little to no allowance for scheduled deviation) or unstructured interviews (with little or no direction), a semi-structured interview approach allows the interview subject to largely guide the discussion while ensuring a return to topics of specific interest. This semi-structured approach is also conducive to the exploratory goal of the first phase of the study; structured enough to adhere to the desired information (i.e. climate variability), but open enough to lead to insights about *participants'* lived experiences.

Designing the semi-structured interview schedule was a multi-step drafting and amendment process. The questions were developed as a team, which included two graduate students and three faculty investigators. The initial draft of the interview questions allowed the team to acknowledge all of their joint ideas, and resulted in a list of over 30 questions that resembled a structured format. Following this initial drafting, the questions were synthesized; this resulted in questions addressing key themes to explore with participants, each with a set of

associated prompts highlighting topics the interviewer might wish to probe or introduce. These thematic questions were better suited to the research goals and exploratory nature of the project, allowing for individuals to discuss the topics that were most important to them and best reflected their unique experiences of weather and climate. Thematic questions and corresponding prompts went through several revisions with the team, resulting in eight semi-structured questions (see Appendix 1). These questions addressed current and past engagement with the outdoors, typical seasons in the community, past experiences with weather and climate, and knowledge or opinions regarding weather, climate, and climate change. Although there was a finalized interview schedule, the interview process was continually reflected upon and adjusted to changing circumstances (e.g. research goals, emerging data).

The interviews themselves were conducted either in-person or over the phone. Although in-person interviews were preferred, logistical constraints required most interviews be conducted over the phone. It is important to note that both researchers who conducted interviews noticed that the quality of the data were substantially different between the in-person interviews and the telephone interviews. Overall, the in-person interviews were longer and more in-depth than those conducted over the phone. The length of interviews ranged from 13 minutes to 83 minutes. The average length of the in-person interviews was 60 minutes, compared to an average of 40 minutes for the telephone interviews. Because most of the interviews conducted in St. John's were done in-person versus those done outside of St. John's, it is possible that this may have skewed our data by potentially over-representing St. John's. This limits our ability to compare the results between different communities. More importantly, the inability to conduct in-person interviews in certain communities may have reduced the validity of the data obtained from those communities, as the

participants may not have felt as comfortable to share certain details or stories without getting to know the researcher in-person.

3.1.3 Analysis. Interview analysis for the semi-structured one-on-one interviews involved content analysis that was consistent with the inductive research approach discussed in the first section of this chapter. In their discussion of qualitative analysis, Bernard et al. (2017) highlight:

> *"In general, the less we know about a research problem, the more important it is to take an inductive approach, to suspend our preconceived ideas as much as we can and let observation be our guide."*

Each interview was transcribed verbatim by the researchers. NVivo Qualitative Data Analysis Software was then utilized to conduct multiple levels of coding and notation. To begin the analysis process, two researchers ('coders') used an open coding strategy in which each sentence was coded for one or more themes. Once the open coding process was completed, coders convened to discuss common themes emerging from the analysis. Data were then "defragmented" (Bernard et al., 2017) by developing categories based on the open codes, notes, and their mutual discussion points. From these categories, researchers engaged in focused coding, in which interviews were re-coded based on a preliminary codebook. All project team members then gathered to discuss the preliminary analysis. This was followed by an independent process of selective coding, in which codes were centred on core themes that were related to each researcher's unique research questions (see Chapter 1 section 1). In order to develop the codebook for selective coding, thematic categories were clearly defined and agreed upon by both coders.

3.2 Phase II: Focus group discussions. Following the initial analysis of the one-on-one interview data, focus group discussions were developed and carried out to i) gain a more holistic

understanding of experiences (Carey & Asbury, 2012) and ii) provide a creative space to test and discuss researcher and participant insights.

The specific goal of a focus group should inform its design (Fern, 2001). Corresponding decisions regarding group composition, research setting, discussion process, and moderator tasks were uniquely tailored to independent focus group goals as well as the overall goals of the research project.

3.2.1 Sampling and recruitment. Focus group discussions were conducted in three of the four study communities: St. John's, Corner Brook, and Happy Valley-Goose Bay. A focus group discussion was not conducted in Cape Broyle, as a result of the low recruitment numbers from the community during Phase I of the project; Cape Broyle residents were, however, invited to the nearby focus group in St. John's. Participants were recruited in this phase of the study from two different samples. The first sample consisted of the original one-on-one interview participants who indicated "YES" on the consent form for the first phase of the study in relation to the statement "I would like to be considered for a future focus group discussion component of this research study." These individuals were recruited with letters that were mailed out describing the details of the focus group discussion, and asking them to contact the researchers if they were interested in participating. If there was no response from those individuals, the researchers followed up with them one week before the focus group discussion to confirm that they had received the letter and inquire as to whether they were able to participate. The second sample was a non-random convenience sample in the communities. These participants were recruited with physical and digital recruitment flyers (see Appendix 2) that were dispersed in communities and circulated on social media platforms and email lists. As with the one-on-one interviews, a self-selection bias

was possible using this recruitment technique for the focus group discussions; individuals who have high environmental concerns or interest appeared more likely to self-select into the study.

Tang and Davis (1995) emphasize that above all, the size of the focus group should first be determined by the aims of the research study. For this portion of the study, anywhere from 4 to 8 participants were proposed for each focus group discussion. Larger groups can result in a variety of issues such "bandwagon effects", disorderliness, and fewer opportunities for everyone to speak (Fern, 2001; Carey & Asbury, 2012). The smaller number selected enhanced the potential that everyone would have the opportunity to speak, allowing for diverse and creative perspectives to emerge.

In total, 12 individuals participated across the three focus group. The Corner Brook focus group discussion had 2 participants, both of whom had participated in the first phase of the study. The Happy Valley-Goose Bay focus group discussion had 3 participants, none of which had participated in the first phase of the study. The St. John's focus group discussion had 7 participants, 3 of whom had participated in the first phase of the study (one from Cape Broyle, one from Petty Harbour, and one from St. John's).

The different number of participants in each focus group discussion resulted in different dynamics across the three groups, resulting in their own unique benefits and drawbacks. In the Corner Brook focus group discussion, the number of researchers exceeded the number of participants (n=2). At first the concern was that this might create an intimidating atmosphere for the participants; however the opposite was true. The interaction between researchers and participants felt more like experts-among-experts; where the researchers had academic and research expertise, and the participants had local expertise regarding their climate and experiences. However, because there were only two participants, both of who were approximately the same age

(as determined by their conversation) and had both previously participated in the one-on-one interviews, the actual diversity of perspectives in the community of Corner Brook was limited. There was greater diversity of perspectives from the focus group discussions in Happy Valley-Goose Bay (n=3), and the group itself had a similar expert-among-expert interaction. However, because of individual differences among participants (e.g. some more outgoing than others), more strategic group moderation (e.g. directly asking the input of specific participants or politely asking those who were dominating the conversation to let others have a turn) had to occur in order to encourage equal participation from all attendees. The St. John's focus group discussion was the largest of the three groups (n=7), and also required the most active moderation. Despite efforts, there were some participants who were less engaged in the discussion than others. The expert-among-expert interaction described for the Corner Brook and Happy Valley-Goose Bay discussions was not present in the St. John's focus group. This may have been the result of increased moderation from the researchers, the potential that some individuals felt uncomfortable in the larger group setting, or the fact that some individuals had already been engaged with the project from participating in the one-on-one interviews, whereas others had not and thus felt "less informed". Despite these drawbacks, the diverse group composition from the St. John's focus group directed the discussion in a unique way that was distinct from that of the Corner Brook and Happy Valley-Goose Bay focus groups.

3.2.2 Research instruments. There were five research instruments in the second phase of the study: the researchers, a presentation, question guide, variability/trend colour animations, and a Climate Autobiography Timeline (CAT). The presentation and question guide portion of the focus group discussions were used in the beginning of the focus group discussion. The animation and autobiography timeline instruments were used during the second half of the focus group

discussion and were a more unstructured activity, which is consistent with the exploratory component of the focus group discussions (Morgan, 1996). The research instruments for the focus group discussions were pilot-tested with six graduate students in the Department of Geography at Memorial University of Newfoundland. Adjustment to all instruments were made based on pilot test feedback.

3.2.2.1 The researchers. Three researchers were present at the focus group discussions. The researchers were responsible for moderating and for presenting the PowerPoint material and taking notes during the discussion. According to Puchta and Porter (2004, p. 3), "no detail of interaction can be safely dismissed as insignificant." For this reason, the researchers were also responsible for note-taking all possible details about the room setting, non-verbal interactions, and anything else which may not have been captured by the audio-recording.

One of the goals of this focus group was collaborative discussion. Because of this, it was crucial that power asymmetry between the researchers and the group members be minimized (Carey & Asbury, 2012). In order to promote a level dialogue with participants the following approaches were taken.

1. **Establishment of rapport and trust:** The focus group session began with a catered breakfast/lunch and signing of consent forms. During this time, the researchers welcomed participants, introduced themselves individually in a friendly and casual manner, and ate with the participants. As suggested by Krueger and Casey (2014), this opportunity was taken to establish the conversational approach to the focus group discussion by avoiding declarative statements and having discussions on neutral topics. During the consent process, the researchers were clear about how the data would be

stored and how it would be presented in future reports and presentations. Participants were given the opportunity to ask questions, all of which were satisfactorily answered.

2. **Researcher appearance:** The researchers dressed in casual clothing in order to match the informal and comfortable environment suggested in the literature for focus group discussions of this nature (Fern, 2001; Krueger, 1988).
3. **Room setting:** Seating in the room was arranged in a circle, which promoted a non-authoritarian climate (Gibson, 2007). The researchers remained seated alongside participants throughout the discussion. Furthermore, the researchers gave the presentation seated, which further emphasized a relaxed and nonhierarchical environment.

3.2.2.2 Presentation. A brief fifteen-minute presentation was delivered at the beginning of the focus group discussion, providing an introduction to natural climate variability and its prevalence in the province, the purpose of the current research, background information about the project, and the preliminary results of the first phase of the research study. Because the goal was an open and collaborative discussion, it was important that the researchers avoid assumptions about the knowledge of participants and/or about the participants' ability to understand or interest in any particular type of information. The presentation was given without any attempts to "simplify" the data or information. Furthermore, no information was purposely withheld to prevent "confusion" or "misinterpretation". Participants were frequently reminded that they were able to ask questions at any point of the focus group discussion.

3.2.2.3 Question guide. A question guide was developed based on the results of the one-on-one interviews (see Appendix 3). As suggested by Carey and Asbury (2012), only three guiding questions were included, as too many questions would not allow the researchers enough time to

gather rich detail. All questions were open-ended, and posed in the order of most general to most specific (Carey & Asbury, 2012). All questions were framed in a conversational manner, in order to create and maintain the informal environment desired for this phase of the study (Morgan & Krueger, 1998).

3.2.2.4 Variability/trend colour animations. Six short colour-animations were created to visually display 1) linear change 2) annual variability 3) decadal variability 4) centennial variability 5) daily variability (weather) and 6) a combination of 1-5. The colour-animations varied/changed between different shades of the colours blue and red with a white transition colour (see Figure 2.2). The animations spanned a 30-year time period, and the passing years were displayed on the upper left corner of the animations. This 30-year time span allowed for the animations to be brief, in order to maintain the attention of participants, and for the annual cycles to be more easily noticed by participants. Line plots exhibiting the corresponding climate phenomena for animations 1-5 are presented in Appendix 3.

Figure 2.2 General example of the transitional frames that were used in the colour-animation activities

Each animation was shown three times. At the beginning of the activity, all six animations were shown consecutively so that participants knew what to expect. For this first showing of the animations, participants were instructed to "just watch" the animation. Each animation was then played two additional times. During the second showing, participants were asked to write words that described the animation. The animation was played a third time in case participants needed more time to examine the animation or to write down their answers. After all of the animations were shown, participants were asked to share their answers.

The main purpose of this was to use a visual tool for eliciting words or discussions related to particular climate phenomena. According to O'Neill and Smith (2014), images have the potential to transcend linguistic and geographical barriers. Furthermore, in the context of climate change, the authors state that visuals can be a key communicative tool for visualizing past, present, and future climates (O'Neill & Smith, 2014). Through use of these colour animations, the opportunity is provided to "view" different climate cycles. By asking participants to write down words or associations that come to mind when watching the animations, the results may highlight common words or phrases that reflect different types of climate cycles, or illuminate existing linguistic barriers that exist around the communication of climate variability.

3.2.2.5 Climate autobiography timeline (CAT). The CAT was developed for this project in order to enhance recollection and discussion about weather and climate memories and experiences. This tool was inspired by the Life History Calendar (LHC) method and its qualitative adaptation, which are discussed below.

LHCs developed as a tool to conduct life course research, which itself seeks to investigate the dynamic interactions and influence of ever-changing social, historical, biographical, and geographical contexts on the life pathways of individuals (Elder, Johnson, & Crosnoe, 2003). This type of research emerged in the 20th century in response to rapid social change, shifting demographics, and a growing interest in longitudinal research across social and behavioural science disciplines (Elder et al., 2003). Currently, life course research is considered to be entering a state of methodological maturity (Mayer, 2009), and the volume, quality, and sophistication of research has increased dramatically since its initial emergence (George, 2003).

The LHC as a method was developed to address concerns associated with life course research (Nelson, 2010) that were centred on the failure of human memory (Giele & Elder, 1998).

By prompting the use of retrieval cues, enhancing cognitive abilities, and encouraging conversational engagement with a topic (Belli, 1998; Nelson, 2010), LHCs are intended to ease recall and make inconsistencies in recollections easily recognizable (and hence amendable) (Freedman, Thornton, Camburn, Alwin, & Young-Demarco, 1988). The LHC is an interdisciplinary tool that has been used with success across a wide range of topics. According to Belli (1998), the effectiveness of LHCs may be attributed to the fact that they reflect the structure of autobiographical memory.

Belli (1998) summarizes the literature around memory retrieval and highlights that memory is organized along temporal and thematic pathways, and that three different types of memories (extended events, summarized events, and specific events) emerge from the two different pathways. Extended event memories are associated with extensions across time (e.g. a really cold year) and are retrieved via the temporal memory pathway. Summarized events on the other hand, are retrieved via the thematic pathway and reflect typical aspects of similar events (Belli, 1998). For example, "I usually had to wear a lot of layers" is a memory referring to similar events (i.e. an individual choosing her clothes), and the typical aspects associated with those events (i.e. wearing many layers). Lastly, specific events are the most vivid type of memory. These memories are recalled both via the temporal and thematic pathways, and they contain enough perceptual and episodic information to elicit a sense of "reliving" a particular experience (Belli, 1998, p.386).

LHCs are a printed matrix with temporal cues running horizontally and domain cues running vertically (see Freedman et al., 1988, p. 43 for a visual example). The structure of this tool encourages the retrieval of autobiographical knowledge from both the temporal and thematic pathways in a way that mimics the various processes of memory retrieval, i.e. top down retrieval, sequencing retrieval, and parallel retrieval (see Belli, 1998 for further detail). This type of design

is in contrast to standardized survey methods, which tend to only encourage retrieval via top down processing, failing to prompt the recollection of events which may have been associated with a continuous stream of time and with other interconnected themes in one's life. The assumption behind the LHC method is that our experiences are dynamic and multifaceted. The tool encourages memory retrieval through an approach that treats memory as something beyond an oversimplified or segmented data source.

A variety of modifications to the traditional LHC have been made to address limitations of the tool or to make the tool more applicable to the subject of interest. Recently, Nelson (2010) developed a qualitative version of the LHC by foregoing the highly structured design in exchange for a more open design that emphasized breadth and depth of narratives vs. the specific timing and sequence of events. The design used by Nelson (2010) began with a blank page in which the research and the research participant jointly develop temporal and thematic cues to include on the qualitative LHC. The participant is then instructed to begin mapping out their life from any time point or from any theme they want to. The researcher then asks probing questions to further extend the content included in the LHC by the participants. Aside from the quality of the information that results from the qualitative LHCs, Nelson (2010) highlights that the qualitative design also allows the researcher and participant to build rapport, the participant to have ownership over her narratives, and for emotionally sensitive topics to emerge.

The CAT tool designed for this study is intended to elicit lifelong memories associated with weather and climate. Participants were given coloured-makers, pens, and a large piece of paper that had a generic "timeline" drawn on to it and was labelled *First Day in Community* at the beginning of the timeline and *Yesterday* at the end of the timeline (see Appendix 3). Participants were asked to think about their memories of weather and climate in their community, and to

write/draw these memories alongside an approximate time frame (e.g. a specific day, a specific decade) and any associations they had with that particular weather/climate memory (e.g. financial impacts, vacation, life-milestone). The memories could be either a specific event (e.g. 2016 wind storm) or a general description of a particular time-frame (e.g. exceptionally warm summer). Participants were free to fill-out the timeline in any way they felt was most meaningful to them. A discussion followed the activity, in which participants were encouraged to share their experiences and reflect on the activity

The development of this tool began with a pilot test of the materials which were created during a brainstorming activity between the two graduate student researchers who were involved with this project. Conversations between the pilot test participants revealed that individuals were limiting the content of information they were providing on their CAT because they believed that the information was not relevant for the activity. Furthermore, direct input from the pilot-test participants informed us that extra time to work on the activity would have been beneficial. The feedback from the pilot test resulted in the allocation of additional time for the CAT activity during the focus group discussion, as well as an emphasis during the activity instructions on the relevance of contextual information.

3.2.3 Analysis. The open discussions that occurred during the focus group process were transcribed verbatim and coded using the same approach employed for the one-on-one interviews. The handwritten data that resulted from the variability/trend colour animations and the CAT activity were inputted into digital documents that could be easily analyzed using NVivo. It is important to note that because of the fairly open and unstructured nature of both the variability/trend colour animation activity and the CAT activity, as well as the limited number of individuals who completed the activities (n=12), the content analysis will be primarily descriptive.

Increased standardization of the tools and a larger sample would be required to extend the analysis potential of the data.

3.3 Phase I and Phase II synthesis. There were two primary reasons for using this two-phase approach in the research project. The first reason was to be able to open the opportunity to community members to provide feedback on the research project and emerging data analysis while it was still in progress. Because our research took a post-deficit approach, it was important to ensure that the community being researched had the opportunity to be involved throughout the research process, and this two-phased approach provided that opportunity. Furthermore, because of the lack of prior research on the subject of climate variability in the social sciences, the two-phased approach allowed us to first gather baseline data from the first phase (one-on-one interviews). This better informed the development of discussion tools which would be tested in the second phase of the research project (focus group discussions).

Other benefits from using the two-phased approach was that the two phases treated natural climate variability differently (i.e. the one-on-one interviews did not directly ask about the topic and the focus group discussions did explicitly address the topic). In addition, because participants were in a private setting with the researcher during the one-on-one interviews in comparison to the focus group discussions, the data had the potential to provide insight regarding individual and group attitudes on the subject.

Brannen (2005) warns against assuming that different methods will corroborate with each other. This was taken into consideration when jointly analyzing the data gained from the one-on-one interviews and the focus group discussions. The analysis of different methods can lead to any one of four possible outcomes: corroboration, elaboration, complementarity, or contradiction (Brennen, 2007).

The data for the different phases were first analyzed separately for common and unique themes across the data, and then analyzed jointly. The joint analysis was done through discussions amongst the researchers in which the focus was the comparison and integration of results. When the data from one phase corroborated, elaborated, or complemented the data from the other phase, which was most often the case, the researchers discussed how and to what extent the data did this. If the results from one phase of the results appeared to contradict the results from the other phase, careful attention was given to understanding how the data showed this and *why* this may have been the case (e.g. were contradictions more likely the result of methodological differences, or something else?).

Chapter 3: Results

This chapter describes the results from both phases of the research study, highlighting emergent themes from the interview and focus group data. In section 1 of this chapter, results from one-on-one interviews are discussed. These results cover a range of topics from perceptions of daily variability to attitudes about climate change. This is followed by results from focus group discussions in section 2. The results in this section have been separated by research instrument used, i.e. variability colour animation, CATs, and the open discussion.

1. Phase I: One-on-one Interview Results

1.1 Short-term cycles are more noticeable than long-term. For this study**,** long-term variability was considered to be at least a decadal (10-year) shift. The interview schedule used in this part of the study was intended to prompt discussions of weather and climate at all possible timescales, but with a specific focus on eliciting discussion of long-term variability in the province of Newfoundland and Labrador without explicitly asking about the phenomena. Despite this focus, as well as efforts by the interviewers to prompt discussion about long-term variability, only 5 of the 33 (15%) participants engaged in some form of discussion that at least implied long-term anomalies or cycles in the province. This is in contrast to short-term variability, i.e. daily or interannual variability, which was discussed by almost all of the participants who were interviewed. Potential reasons that may explain this are included in Chapter 4 section 3.2.

The few examples provided by the participants who did discuss long-term variability were either general, or related to events that were extreme or unusual. In most cases participants were using the word “cycle” to describe the long-term variability. For example, one participant referenced the ice pack in the harbour:

It happens in cycles. I can remember growing up there were some years that the harbour was completely jammed with ice. They were completely jammed in this year with ice… and last time that happened was probably a decade ago maybe… to that degree.

Furthermore, participants did not appear to be as confident in their recollections of long-term variability as compared to short-term variability. This was assessed based on the language participants were using. For example, a retired teacher who has lived in Corner Brook for 50 years, uses the word "probably" implying that he is estimating the timing of the cycle:

I do remember back 30-40 years ago we had seven school holidays. There was so much snow there was a wall on the side of the road. Now I've been retired for a few years, but I think recently again, this year, I don't know if they hit 7 school holidays but they certainly hit 5 or 6. So it's probably cycling around again.

In the case of short-term variability, most participants appear to be in agreement that they live in a province where daily, and sometimes even hourly variability (in the St. John's community) is expected, and rarely were these fluctuations considered an unusual occurrence. Some participants (n=4; mostly within St. John's) used a common weather saying to illustrate their experience of short-term hourly variability for example: "*if you don't like the weather, wait ten minutes*". Another relevant saying that was used to articulate short-term variability (in this case yearly variability) was about the presence of dogberries. A few participants (n=4) highlighted that in Newfoundland and Labrador, the presence of dogberries indicates whether or not the winter is going be "hard", reflecting awareness and understanding of interannual variability. These observations are also predictive: the local folkloric explanation for this phenomenon is that long, cold, and snowy winters required birds needing additional nourishment from dogberries to get

them through difficult winters. That is, more dogberries the preceding autumn is providence for "hard" winters.

Based on the narratives, daily variability was discussed most by participants and had the greatest impact on their activities and decision-making. This included things such as influences on clothing choices, the ability to engage in a variety of outdoor activities (e.g. gardening, hiking), being able to go into work, or having to deal with school closures. Although sometimes discussed in a negative context, none of the impacts of daily variability appeared to influence participants in ways to which they could not adapt. This is exemplified in the quote from a 61 year old woman who lives in St. John's:

> *You go out one day and you have a heavy pack on you and you're warm and you're just exhausted. And the next day, you think, well it was warm yesterday, I'm going to put on lighter coat. Then you go out and when you get home, you're frozen!*

Most participants also acknowledged that they experience yearly variability in the province, and many participants expressed it as being a normal feature of their climate. Multiple participants expressed difficulties adapting to yearly variations, especially when those variations were out of the range of what they would consider ideal. For example participants mentioned seasonal affective disorder from lack of sunlight, financial impacts as a result of their work being weather dependent (e.g. fish harvester), and uncertainty as to when to engage in seasonal activities (e.g. when to go on a trouting trip, when to cross-country ski).

Some participants also discussed or alluded to short-term variability anomalies that with recurrences slightly longer than yearly variability. For example, one participant discussed "cold snaps" that happened approximately every couple of years. However, in most cases participants

didn't have clear sense or memories of these phenomena, as illustrated by the following quote by a 44 year old woman who has lived in Happy Valley-Goose Bay her entire life:

> *You'll say 'this year we didn't have much of a summer'…And someone else might say… 'well you know, 6 or 7 years ago we had a pretty similar summer', and you'll think 'Really? I don't remember that.' So it's kind of all over the place.*

It is possible that individuals are able to recognize certain events as being anomalies, and relate them to similar past anomalies after the fact. This then provides an opportunity for individuals to recognize recurrent events or cycles, though from the data it is unclear how often individuals infer it as such.

Overall however, participants generally seem to be able to perceive and articulate short-term cycles. This is in contrast to long-term variability, for which there is less "climate literacy", or ability to articulate narratives of long-term cycles. From the data it seems that as the cycles become longer, there is a decreased ability to identify them.

1.2 Narratives focus on recent years and childhood. Across the interview data, participants' longer-term thinking about climate tended to focus on their childhood and recent experiences of weather and climate, often dedicating limited attention to their experiences in between those two timeframes. The interview schedule was structured in such a way that participants were first asked to describe the typical seasons in their communities, and were then asked to discuss how previous years compared to that idea of "typical". Previous years could have meant anything from childhood to that most recent year, and participants were free to discuss any point of their past in that community they considered memorable. The interviewer was then responsible for prompting conversation about the timeframes which had not been discussed by the participants. For example, if a participant's references to weather and climate were limited to their

recent experiences or about their experiences as children, the interviewer would specifically ask about particular decades (e.g. what about the weather and climate in the '90s?) or particular life phases (e.g. what about the weather and climate when you were raising your children?), in an attempt to gather a more holistic picture of their full life experiences.

When initially asked the question about typical seasons, participants' responses had a tendency to contain less contextual information and focused on particular weather features. The climatological features participants tended to focus on were usually related to precipitation (i.e. rain and snow) and wind. Below is an example of a participant describing a typical fall in his community of Eastport:

> *In the fall we get more wind, more depressing weather in sense of rain, not vertical rain, horizontal rain!*

Once the less structured question about *how* other years compared was broached, the information provided by participants was almost always blended with biographical detail, often using personal narratives to illustrate recollections. For example, when asked about typical winters, a man who had lived in St. John's since 1965 used the word "snowy" to describe the season. However, when he was describing previous years, the participant told a story about the death of a friend to convey a measurement of winter precipitation:

> *I had a friend of mine, a close friend, the snow was up to the tops of the poles, and the wires were down. And his dog stepped on one of the wires… and he went to get the dog, and he got killed.*

Participants often referred to their memories of most recent years, i.e. within the last 10 years, when they were asked how previous years compared to their descriptions of typical weather and climate in their community. Most participants discussed how recent years have been different

than their idea of typical. Participants were able to provide rich detail about the most recent years, often citing exactly what made them different from their descriptions of typical climate. For example, a 44 year old woman who has lived in Cape Broyle most of her life, pointed out the following about recent years as compared to the past:

> *One thing I have noticed over the past few years is our winters… half the time our winters are incredibly windy. I mean, in the winter here we're used to northeasterly winds….And one thing I have noticed the past few years is a hell of a lot of westerly winds in the winter. And extremely, extremely, heavy westerly winds.*

Almost equally as detailed were participants' narratives of the weather and climate from when they were children/youth living in the same community. Participants would often compare descriptions of their most current experiences of weather and climate with childhood memories. With few exceptions, participants' memories of childhood weather and climate was expressed as different from their current experiences, such as the references from this long-term St. John's resident:

> *We would go and spend the day over the hill you know. We'd go and spend the day there, we had all our preparations made, we had cooked our meals, and it would be really, really nice weather. Summer weather in fall. Really nice. But now most of the time, fall is cool and you know that winter is in the air.*

A comparable occurrence was also noted for participants who had moved to their respective communities during adulthood. Participants would often contrast their memories of weather and climate during their initial years in the community with their current experiences, usually with the point of highlighting some distinction between the two time periods. For example, below is a quote from a 49 year old woman who moved to St. John's in the early two-thousands:

Like I said… it took me 5 years to get used to the weather here. Even in the summer I didn't find it warm, because I was so used to the extreme temperatures in Toronto. But now I find we've caught up to Toronto's heat and sometimes surpassed it. Each summer does seem to be getting hotter and more humid.

The level of detail provided by participants of both recent years as well as childhood or initial years vastly outweighed the level of detail provided for the "in-between" timeframes. When participants concluded their discussions about recent years or their childhood/initial years, the interviewer attempted to gain detail about the timeframes which hadn't been discussed. Even with these prompts, responses covering these in-between timeframes were often limited (or even non-existent), general, and brief. This time period between childhood/initial years and recent years, in which there is a tendency to recall limited detail about weather and climate phenomena, is hereafter referred to as "black-out dates".

The notable exception to these black-out dates was an event that participants considered extreme or unusual, which were often remembered because they had some sort of personal impact in the individual. Even so, most extreme or unusual events that were discussed were from participants' childhood/initial years or within recent years.

1.3 Participants note changes in their communities. Although the interviews intended to elicit discussion about cycles, not change, the results from the interviews overwhelmingly centred on discussions of change within the community. It is possible that because of the black-out dates, even though the impacts of cycles have been perceived, the tendency to compare childhood with recent years results in an interpretation of change. Oftentimes, participants would compare their memories of childhood weather and climate with the present conditions when

communicating their perceptions of change within the community. For example, a 43 year old man who lived in Corner Brook for all but six years of his life noted the following:

> *When I was younger and had to shovel the snow, it was always slushy, heavy, dense. Now when I shovel snow it's light and powdery.*

The changes participants most frequently noted were changes in temperature, precipitation, and wind. However, participants would often discuss their perceived changes in weather and climate in terms of the way it has influenced their day-to-day lives (e.g. buying air conditioners because of increased summer heat), their livelihood (e.g. if/when the a specific fish species arrives), and their environment (e.g. destruction of trees from increased wind).

Another frequently perceived change from participants was the perception of decreased predictability in daily or yearly conditions, i.e. increased short-term variability. One lifelong resident of Happy Valley-Goose Bay highlighted how this change in the predictability of days/seasons has influenced the life experiences of her children:

> *With kids today, it seems that my kids, the range is so different, it is more unpredictable. It's like they don't adjust to it the same way. The winter comes and they don't think "well, okay, this is winter, this is how we live, we got to deal with it'. It's almost like that we get a nice day and then a bad day. Their habits are not the same because they don't learn to adjust to the cold or high amounts of snow the same as I did when I was a kid because it is not as predictable for them.*

When participants would discuss this short-term variability, it was typically referred to as a chaotic or random phenomenon versus one characterized by cycles or patterns. It is uncertain and beyond the scope of this research to determine if participants perceive these changes to be permanent changes, or whether these participants expect these changes to continue along the same

trend line. It also beyond the scope of this research to determine if participants' comparisons are "accurate" or logical. One of the primary themes to acknowledge from these findings however, is that in their narratives, participants are using a *then and now* frame, which ignores the points in-between, to describe their weather and climate memories. This is illustrated below:

> ***Interviewer:*** *Have you noticed any patterns in the climate in your community? Or do you feel that some years are more similar than others?*
>
> ***Respondent:*** *Well…if you look from point A, sixty years ago, to point B, now…*

Attempts were frequently made to expand the point A-point B frame, for example, point A-point B-point C-point D. As discussed in section 1.2 however, these attempts were most often fruitless.

It's important to note that participants would often acknowledge the potential fallibility of their memories and reason, and provide alternate explanations as to why they may have been perceiving those changes. A 39 year old man who has spent most of his life in Cape Broyle, illustrates an example of this:

> *I'm not really sure if I can trust my memories from my childhood, you know, because I was so young and a snowdrift as a child can seem quite tall, for an adult it can seem pretty small.*

Other alternative explanations for perceived changes included things such as being able to tolerate extreme conditions less as one got older, being more sensitive to temperature when concerned about children's safety, and changing infrastructure and technology.

1.4 Prevalent weather and climate phenomena. Word frequency analysis was conducted to examine which weather and climate phenomena were most frequently discussed among individual interview participants. Table 3.1 displays the 10 most frequently mentioned weather and climate words used, along with the precise word counts, across all 33 one-on-one

interviews. The weighted percentage per word (including stemmed words) is also included in the table, which is the frequency of the specific word and stemmed words relative to the total number of words across all interviews. The first notable finding is that *winter* is the most frequently discussed word and approximately 45% of the most frequently mentioned phenomena are related to the winter season. This is consistent with the interview data which revealed that participants were more impacted by winter weather than any other season. In the interviews, participants tended to place less emphasis on the spring and fall seasons than the winter and summer. It is possible that this may be because fall and spring are transition seasons which exhibit characteristics from both winter and summer.

Table 3.1
Top 10 weather/climate phenomena words used across all 33 interviews

Word	**Count**	**Weighted Percentage**	**Stemmed Words Included**
Winter	654	1.00%	winter, winters, winter’
Snow	512	0.79%	snow, snowed, snowing, snows
Wind	500	0.77%	wind, winds
Summer	440	0.67%	summer, summers, summer’
Cold	247	0.38%	cold, coldness, colds
Rain	238	0.36%	rain, rained, raining, rains, rain’
Fall	231	0.36%	fall, falls
Spring	217	0.33%	spring, springs
Ice	186	0.29%	ice, iced
Warm	167	0.26%	warm, warmed, warming, warmly, warms
Storm	157	0.24%	storm, storms

Another finding from the word frequency analysis was that *wind* was the third most frequent weather and climate phenomena word used. This was particularly interesting because wind was not explicitly asked about, but was a recurring theme in the interviews. Participants often stated that weather conditions were tolerable as long as wind was not involved. Furthermore, when discussing memorable events, participants often had detailed memories of the impacts of extreme

wind events. For example a woman who is a lifelong resident from Happy Valley-Goose Bay provides this descriptive and visual narrative:

> *About 5 years ago I was at a yoga class, and the wind came up. A couple of the ladies in attendance, their phones went off and they had to go home because things just toppled in their yard, or something went through their window, or their child was upset. I'll never forget that because like I said, it was so out of the norm to have the high gusts of wind like that.*

Based on the word frequency analysis and the themes which emerged from the interviews, it appears that individuals tend to remember the weather and climate phenomena which has a concrete impact on their lives. This was explicitly stated by one man living in Cape Broyle:

> *To me, I don't observe the weather in that kind of way, I observe it by the effect it has on the things around me*

For example, participants were often able to cite explicit impacts of snow, winter weather, wind and rain on their daily lives. This was less common in the case of summer weather or discussions of hot weather. However, when summer, hot or warm weather was discussed, participants often cited the impacts on their lives or the lives of others, such as their ability to engage in outdoor activities or their need for an air conditioner. For example a woman from St. John's who moved to the community from outside of the province points out:

> *When I moved here, there wasn't a house I would go to that had air conditioning, because there wasn't a need for it. But that is changing. The summers here are getting hotter and a lot more humid. It's a beautiful time of the year. I love it.*

In this quote, the participant is noting the recently hot summer weather through her recognition of the impact it has had on the houses in the community.

1.5 Concerns about climate change and pro-environmental actions. The final questions that participants were asked touched on climate change and related topics. Because our inquiry into the perceptions of weather and climate is ultimately intended to inform climate change communication and discussion strategies, it was important to ground our data and practice through an understanding of the relationship people currently have with climate change in their communities. These questions were asked at the end so as not to prime participants to focus on change in relation to their memories of weather and climate.

Participants were asked about their level of understanding with regard to climate change, and the responses varied. Multiple participants felt that they had a "basic level" of knowledge, some participants felt they knew "quite a bit", and others felt that they didn't know very much. Although these answers varied, there was less variance with regard to what participants actually knew. In many cases, when asked *what* they knew, participants often highlighted common climate change knowledge misconceptions (e.g. confusion between stratospheric ozone depletion and climate change) which is consistent with literature about public climate change knowledge (e.g. Leiserowitz, Maibach, Roser-Renouf, & Smith, 2010). Another consistency among most participants was their sources of climate change information. Most participants said that they got information about climate change from print, television, or internet news sources. Additional sources included social media, books, government websites, documentaries, and specific individuals (e.g. David Suzuki). When asked if there was anything about climate change they would like to know more about, a little under half of the participants (n=14) responded *no*. Some participants did request more localized information, for example local impacts or local ways to get involved as an individual.

Most participants (n=30) expressed some degree of concern about climate change. These participants were mostly certain that climate change was currently influencing the world on a global scale. However, participants diverged with regard to whether or not they perceived climate change to be currently impacting their communities. Seventeen participants were certain that it was, six were unsure, and ten were certain that it was not. Whereas there were diverging opinions within St. John's, Cape Broyle, and Corner Brook, about the impacts of climate change in those communities, all five participants from Happy Valley-Goose Bay agreed that climate change was influencing their community. Despite the differences across all 33 participants, there did not appear to be a difference with regard to the level of involvement most participants had in addressing climate change. Most participants' engagement with addressing the issue was limited to seeking education and acknowledging that it is an issue; however, some participants mentioned that they addressed climate change through recycling, composting, monetary donations, and using reusable shopping bags.

With regard to responsibility, most of the participants believed that the government was the most responsible for addressing climate change. Participants often highlighted the importance of science and communicating science to governments, but argued that without government intervention, behaviour change would be stagnant. With frustration, a couple of participants discussed their perceived discrepancy between Canada's reputation for environmentalism and their current environmental policies.

> *Canada is being touted as being this great place for respecting the environment, but then there are cases where you see that capitalism trumps the environment.*

Whether individuals believed Canada's reputation was a result of self-promotion was not clear, however in most cases participants held the government responsible for living up to that reputation.

Exactly how the government should intervene was not discussed in detail in the interviews, however some participants expanded on the idea that policy platforms or decisions cannot be single-sided, which emphasizes the importance of acknowledging and incorporating multiple perspectives for effective policy.

> *We have green parties here, and green parties are talking about green things mostly. Their whole political basis is green. They should be a little less green, paler green in my opinion. Then we would get more people on board. Because they're so green that they are forgetting that there are businesses that are trying to make money and so on. They lose the people who are keeping the world going.*

Multiple participants highlighted the complexity of the issue and emphasized the difficulty of the task facing the government. Some participants also discussed the overwhelming nature of the problem, which for some of the participants prompted disengagement from climate change discussions and action. Upon discussing the global, complex, and daunting nature of the problem, multiple participants brought up their interest in issues and solutions that were smaller in scale.

> *It is such a difficult thing to get so many people in the world to address this one problem together in a productive way. So I feel like I'm more interested in addressing localized issues. I feel that I can accomplish something locally, but accomplishing something globally seems beyond my sphere of activity.*

From the interviews, the sense of being able to globally adapt and mitigate climate change seems less doable than adapting and mitigating climate change locally.

2. Phase II: Focus Group Discussion Results

Three focus groups were conducted and each was distinctive in the way the discussions progressed. While generalizations will be made across the different focus groups, interesting and

unique information that arose from specific discussions will be highlighted. In total, 12 individuals participated across the three separate focus group discussions.

2.1 Variability/trend colour animations. The variability/trend colour animation activity was intended to elicit words and thoughts associated with particular cycles by presenting them visually in six short videos. Each represented one of the following: 1) linear change, 2) annual variability, 3) decadal variability, 4) centennial variability, 5) daily variability, (weather), and 6) a combination of 1-5 representing something comparable to real observations. On a piece of paper, participants wrote words and phrases prompted by each animation. They worked independently on this activity, and discussed their responses and impressions following the conclusion of the activity.

The words and associations that participants used to describe each of the six videos are presented in word-clouds and can be found in Appendix 4. Individuals varied greatly on the types of words and associations used. Some used weather- or climate-related words (e.g. long-term cycle, summer, hot), some used words that described the colours themselves (e.g. bright, dull, red), some wrote down associations (e.g. ocean, wall paint, earth), some wrote down emotional responses (e.g. cheerful, irritating, alarming), and some wrote down phrases that indicated some form of transition (e.g. desaturate to saturate, sudden change to neutral, plateauing at warm stage). For the most part, there was no consistency with regard to the words and associations used in each video.

Although the words themselves are not revealing, the number of spaces that were filled by participants per animation is of note. Each participant had 6 blank spaces on which they could write down responses, however they were not required to fill all of the blank spaces. Table 3.2 shows the total number of spaces filled per animation across all focus group discussions. As

displayed, the animations that portrayed long-term change as well as short-term variability (both yearly and daily), had relatively larger quantities of spaces filled in comparison to decadal variability, which had the least amount of spaces filled. This is consistent with the one-on-one interview discussions during the first phase of the research study in which both change and short-term variability were discussed much more frequently than long-term variability.

Table 3.2
Total number of spaces filled on colour animation activities during the focus group discussions across all participants.

Animation	**Spaces Filled**
Change	37
Centennial Variability	30
Decadal Variability	26
Seasonal Variability	37
Daily Variability (Weather)	36
Combination	27

It is also interesting to note that some of the same words were used to describe the long-term change animation as were used to describe the centennial variability animation. This can be related to a comment made by a man in the St. John's focus group during the discussion following the activity:

> *I guess where you're watching one right after the other, it makes it harder to distinguish the differences right away, without repeating yourself. Because they're different, you just need to figure out what is different.*

These results indicate that although something may be immediately discernable as different, understandings or descriptions of how it is different may not come as easily. From a lived experience point of view, centennial, or one-hundred year cycles and long-term change would generally be indistinguishable over a human lifespan.

Overall, participants were not receptive to this activity. There appeared to be two main reasons why this was the case based on participant feedback. First, individuals were not sure what was expected of them. Prior to the activity, the focus group moderator and co-moderators emphasized that nothing in particular was expected of them, that they were free to write down anything that came to mind, or conversely, leave the page blank if nothing came to mind. Despite these instructions, participants still appeared to hold back as a result of uncertainty as to what was "correct" or not.

Responses may reflect the fact that the simple animations were not immediately familiar to them, or necessarily what they had anticipated. For example, a couple of individuals felt that it was similar to a psychology experiment, which was a stark contrast to the open, free-flowing discussion that had preceded the activity. Several individuals also mentioned that "they were expecting something to happen" or that the activity felt like "nonsense". This discrepancy in expectations may be a result of the way the activity was presented to participants. For example, calling the videos "colour animations" may have implied something educational, or a more sophisticated animation than ultimately presented.

Although most of the 12 respondents shared similar sentiments, there were two who diverged. One individual from the Corner Brook focus group discussion left a comment on his paper stating "Interesting test!", and in the discussion about the activity highlighted how it was an interesting presentation for graphic information. Although less about his opinion of the activity, when a man from the St. John's focus group discussion was asked what he thought of the activity he stated:

It seems to suggest weather patterns to me. Like shifts in temperature or shifts in severity of weather events. That's what came to mind. And I guess how erratic or how quickly those changes were taking place.

Out of all of the responses, this participant's word associations were most aligned with the weather and climate data that the animations were based on.

Both of the participants highlighted above participated in the first phase of the research project. Also, one of the individuals was someone who kept personal records of the climate and the other came from a professional university background.

2.2 Climate autobiography timelines. The CAT was an interactive activity in which participants reflected on their experiences of weather and climate and developed a physical timeline of those memories. A detailed description of the timelines and the instructions that were provided to participants for completing the timelines can be found in Chapter 2, a large example of a completed participant timeline is displayed in Figure 3.1, and the remaining completed timelines are displayed in Figure 3.2 4. In the following pages, the results from analyzing the timelines and the impressions of the activity are discussed.

Figure 3.1 Climate Autobiography Timeline filled out by a focus group discussion participant

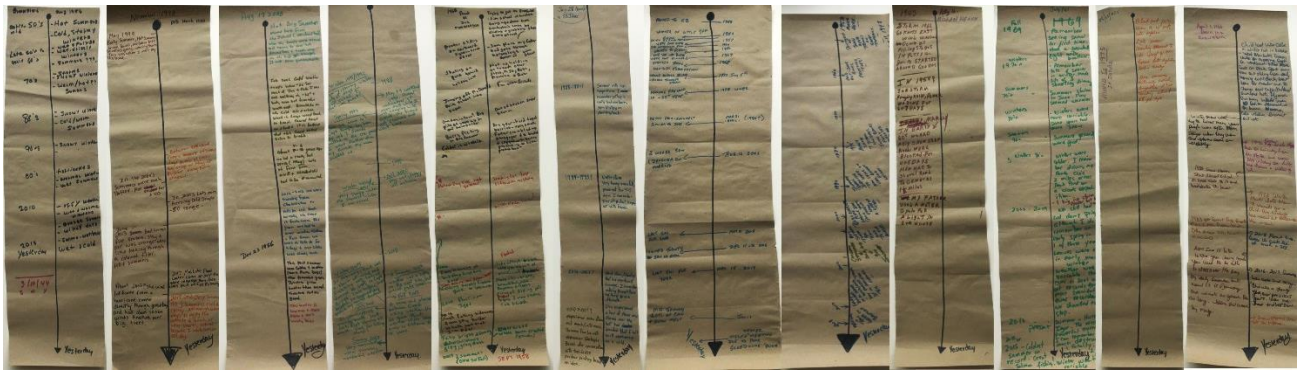

Figure 3.2 All Climate Autobiography Timelines completed by focus group participants

Two main themes emerged from the CAT data and are discussed below. These themes are similar to some of the results that emerged from interviews during the first phase of the research study. Because of this, this section will occasionally refer to the results presented in section 1 of this chapter. A comprehensive discussion of the relationship between the results of interviews and CAT data will follow in Chapter 4 section 2.

The first main theme that emerged from the analysis of this activity was recurrence of black-out dates, or a tendency to recall limited detail within the period between childhood/initial years and the most recent past. When filling out the CATs, participants were instructed to include a "time-stamp" next to each event/experience/memory entry they included in their timeline. The time-stamp could have been anything between a specific date (e.g. April 1st, 1972) to a general timeframe (e.g. 1960s), depending on what they were able to remember. These timestamps were used to categorize particular events as either "childhood/initial year events", "recent years", and "in-between years" during analysis. These categories were not provided to participants during the focus group discussions, so as not to influence the type of information they included on their CATs. If a particular entry on a participant's CAT did not include a timestamp, or if the category the entry belonged to was not immediately clear from the timestamp, the content of the entry was used to determine entry category.

It was clear that recent years dominated a substantial portion of the recorded data relative to the distribution of time on the twelve CATs collected. For example, one participant who had lived in his respective community his entire life had a total of nine entries from 1961 to present, three of which were in relation to the most recent 10 years. Similarly, participants' childhood years or initial years in community also took up a substantial portion of the CATs. For example, that same individual's first three entries were in relation to his childhood years. That means that 66% of the CAT entries provided by this particular person were in relation to his first 10 years of life and his most recent 10 years, with only 33% covering the intervening 30-40 years.

Most participants exhibited a similar pattern, and the average across all timelines of childhood/initial, black-out years, and recent year coverage was 30%, 37% and 33% respectively; while these proportions are similar, it is important to note that an individual's black-out period usually covers more years than their early or recent recall (e.g. 30-50 years, compared to 10 or so), implying lower recall relative to time. This tendency to remember the details about childhood/initial years and recent years was a theme that also emerged in the one-on-one interviews during Phase I of the research study. These Phase I findings were shared with participants during the initial presentation portion of the focus group discussion. Then, because individuals were aware of this concept, respondents were asked directly if they had noticed black-out dates on their timelines. A few participants initially confirmed this pattern. For example, a woman in the Happy Valley-Goose Bay focus group highlighted the exact times she is missing, and provides an explanation for why that may have been the case:

> *I moved here in '99 and I remember that summer. But then after that I had my kids, and I don't remember much. You're inside more, especially in the winter… so you don't notice*

the day to day differences or the year to year. Now that mine are teenagers, I notice things more because they're not around.

A man in the Corner Brook focus group said the following upon the immediate conclusion of the activity without being asked:

I've got the black-outs I think. I've got the early and I've got the late. What happened to those 50 years?

Alongside the number of entries, the content of the entries also appeared to vary depending on the timeframe being discussed. Overall, the most detailed memories were associated with childhood or initial years in community entries. An example of the level of detail for these entries is provided below from one of the St. John's focus group timelines:

June 1968: Dry year, hard to get berries. Very small. Father crumbled up newspaper in bucket and topped it with berries to pretend he had picked a lot.

Oftentimes, the content of the in-between year entries were related to extreme or significant events. For example, fire evacuations, hurricanes, death of a family member, health issues, and holidays. This finding was also consistent with the Phase I interview results.

The second theme that emerged from the CAT activity, and consistent with the interviews, was a focus on winter-related weather and climate on the timeline entries. To analyze the prevalent weather and climate phenomena discussed in the CATs, each entry was analyzed for its content and categorized based on season: summer, fall, winter, and spring, as well as an "other" category for entries that did not have a discernable season. Across all 12 interviews, 32% of the entries were in relation to the summer season, 42% in relation to the winter season, 12% in relation to the spring season, 5% in relation to the fall season, and 10% were categorized as other or indeterminable.

As highlighted by the percentages above, the results from this activity are consistent with the results from one-on-one interviews, in which words related to the winter season (e.g. winter, snow, ice) were the most frequent weather and climate words used in the interviews. Furthermore, the lack of attention dedicated to the spring and fall seasons by participants in the timeline data is also reflected in the word frequency analysis for the interviews.

Upon further analysis of the CAT data in this context, it appears that in many cases in which seasons other than winter are discussed, they are still discussed in relation to winter-related weather. For example, many of the spring entries are in relation to snow, ice, and cold weather, as shown below from one of the CAT entries of a Cape Broyle resident who attended the St. John's focus group:

> *Spring 1992: Me and three friends walked on the ice pans. I went further than my friends. My mom scolded me.*

The same is noted with many of the entries related to the summer season. For example, one participant's entry referred to "*snow in June",* similarly others highlighted cold or cooler summers. When asked during the discussion following the activity if they noticed any similarities between their own timelines and their peers, one participant said "cold", highlighting the immediately recognizable focus on cold, or winter-related words. There were two cases in which participants discussed "warmer" winters; however for one of those entries the focus was on the resulting increased snowfall. These results highlight not only the conditions associated with the winter season in the province, but more uniquely, how early it comes and how late it stays. Cases in which summers are included in the timelines with reference to heat are typically in relation to a significant event. For example, all focus group participants in the community of Happy Valley-Goose Bay included entries about forest fires and community evacuations.

In general, participants were focused and engaged throughout the CAT activity. Most were still writing when they were asked to stop due to time restrictions. Participants were open to sharing during the discussion that followed the activity. Even during the time in which individuals were independently working on their timelines, non-facilitated discussion was initiated by the participants themselves who looked to their peers for confirmation of their experiences or for assistance in recalling details about specific events.

While most were able to work through the activity without any visible struggle, a couple of the participants either explicitly stated having difficulties with the activity or displayed evidence of having struggled. For example, a woman from the St. John's focus group who only included three time points in her timeline said:

I'm just lost! I can't remember anything. When I go home I'll remember everything

This illustrates an important point about the results of this activity: the time and location restrictions that were given to participants may have had an influence on both the amount of weather and climate events they were able physically write down, as well as their ability to reflect on their memories and experiences. As a man from the St. John's focus group participant said during the discussion following the activity:

We're talking about things happening years ago. You don't remember unless things start popping up. You remember, things just come to you.

These time and location restrictions may be a limitation of the activity. However, it is also possible that the time restrictions illuminate details about participants' lives that are most immediately associated with weather and climate (e.g. the stories they most frequently tell to others, the memories they most often think about).

2.3 Open discussion. Each of the three focus group discussions progressed differently depending on what the participants found interesting or important. As a result, there is a variety of unique data that emerged from the open discussions during this phase of the study. The results presented in this section will address the goals outlined for the focus group discussions, which were to validate the preliminary analysis of the one-on-one interviews, and to explicitly address long-term climate variability.

2.3.1 Agreement and consistency with analysis. In order to validate researcher interpretations from the first phase of the research study, the goals, methods and preliminary results of the one-on-one interviews were shared with the focus group participants. Throughout the three focus group discussions, only one individual explicitly expressed disagreement with one of the results presented. That respondent disagreed with the result that highlighted that individuals perceived changes in wind within their communities. The participant elaborated that "*there has always been wind"*. However, upon further inquiry, the participant stated that he *has* noticed change in wind *intensity*. This was consistent with what some of the interview participants expressed during the one-on-one interviews.

Aside from this case, focus group participants resonated with the preliminary analysis disclosed during the presentation portion of the discussion. This was the case for both the individuals who participated in the first phase of the study as well as those who did not. Immediately following the conclusion of the presentation, a man from the St. John's focus group said the following:

> *I'm not sure if we can add anything different to these themes you've developed here. I'm looking at it and that's exactly the way I would have visualized the weather. If you would have interviewed me, that's exactly what I would have said.*

Throughout the open discussion portion of the focus groups, the insight and narratives provided by individuals was often in-line with the insight and narratives provided by individuals during the one-on-one interviews. This was most prevalent with regard to i) participants noting changes in their communities and ii) narratives focusing on recent events and childhood/initial year events. Discussions from participants in both the Happy Valley-Goose Bay focus group and the St. John's focus group almost completely revolved around perceived changes in their communities. Furthermore, as was the case with the one-on-one interviews, these changes were often in reference to individuals' childhood/initial years compared with their recent experiences. This is illustrated by the following quote from a man who participated in the Happy Valley-Goose Bay focus group:

> *I've noticed that since I came to Goose Bay, in 2000 there was very little wind in winter time and now almost every day there is wind.*

A unique theme that emerged in the context of discussing perceived changes in communities, which was not as prominent in the one-on-one interviews, was the use of personal artifacts as a method of recognizing change. Examples of different sources of historical records included photos, family stories, weather logs, activity logs, social media, and newspaper articles. In the Corner Brook focus group, the two participants who attended brought in the same newspaper article from a recent publication. In the Happy Valley-Goose Bay focus group, a woman highlighted how certain features of social media helped her recognize the variance between different years:

> *In my Facebook memories I will go back and see the days where I've posted when it's been really, really cold. One post had 'it's -50 out, school is cancelled today', and that was just*

a few years ago, but now it is rare to see a -50. School is hardly ever cancelled because of cold.

In the St. John's focus group, a man communicated a story he had heard from a family member to illustrate change:

My wife's cousin… he said that when they were about 13 or 14 going to school, they would go down to the marina centre. They would walk to school right across the ice…. Haven't seen that all this time.

Alongside these findings, some participants expressed interest in using non-traditional means for noticing and measuring changes in the weather and climate within their communities. For example a woman who participated in the Happy Valley-Goose Bay focus group highlighted that she kept logs of the days her and her family were able to travel to and from their cabin. However, as noted by the participant, she never thought to use these logs to recognize change, but rather to highlight differences between recent years (i.e. yearly variability):

It would be interesting to see… because my family has had a cabin for almost 20 years now and we've always tracked the last time we'd go in the spring on skidoo and when we'd go back on boat in the summer time and in the fall on skidoo… you usually just glance at it and say 'oh yeah, we were able to come over May fourth last year and this year we never got over till June.

As indicated by the first part of the quote, alongside additional clarification, this participant is interested in using the data as an alternative means for recognizing potential change. Similar sentiments were expressed across the two other focus group discussions as well.

2.3.2 Explicit discussions about long-term variability. In order to have discussions about long-term climate variability with participants, the first part of the focus group discussion was

centred on defining and providing examples of climate change, short-term variability, and long-term variability. This way, the moderators and the participants were all on the same page when talking about these key terms.

The first notable finding was that individuals were not able to refer back to their experiences and memories to recognize the presence of long-term variability in their communities. Following the explanation of what long-term variability was, participants were asked if any of their experiences indicated the presence of long-term variability. Interestingly, when responding to this question, all three focus groups immediately referred to experiences of *change* not of *long-term* variability. Below is an example from the St. John's focus group of this type of conversation:

> ***Moderator**: Can you think of anything from your experiences that might indicate the presence of long-term variability in your community?*
>
> ***Participant 1**: Harbours freezing over. You don't see that.*
>
> ***Participant 2**: It wasn't just the harbour, it was the ocean. It would take an hour maybe two hours to walk across. It's insane.*
>
> ***Moderator**: So you all remember the harbour freezing over or the ocean freezing over. If it's long term variability, that would imply that maybe you'd expect it to freeze over again?*
>
> ***Participant 1**: Yes if it's a cycle. That's correct.*
>
> ***Moderator**: Have you seen it go in any sort of cycle? Where it didn't freeze over, and then it does, and then it doesn't? Or has it been something that you just noticed that it has changed?*
>
> ***Participant 1**: It just changed. It used to freeze over, and that was in the 50s and 60s. And I haven't seen it since.*

Equally as important was the finding that long-term variability is not important in the daily lives of participants. There were no occasions in which participants were able to express ways in which knowledge about long-term variability would matter to the way they lived their lives. On

multiple occasions participants expressed that it was not useful information to know. For example, a man in the St. John's focus group expressed the following:

> *I find that thinking about information about long-term cycles, it seems like in a way it's less relevant to my life. And I think maybe to people in general. Because I think people tend to think a little more short term, just in terms of what they're going to do day to day. I guess I would wonder if I was being told that there was a longer-term sort of cycle taking place, and that I may expect some changes down the road, I'm not sure what I would do with that information.*

The quote above also illustrates the temporal distance of long-term cycles from the statement "changes down the road". The quote below from a man in the Corner Brook focus group shares a similar temporally distant sentiment:

> *So when you're stuck in the cold, that's what you're dealing with… you're not really thinking much ahead thinking "this will pass".*

The use of the phrase "thinking much ahead", implies a certain distance in-time that is not practical to consider for that particular individual.

Consistent with these findings, individuals often stated that the information that was most important to them was information that would help them prepare for current weather or dangers (e.g. improved daily weather forecasts). A common theme across all focus group discussions was the desire for weather and climate information that was temporally close. A man from the Corner Brook focus group expressed that this was a result of a need to survive:

> *Now people of course are preparing for tomorrow. For whatever may be coming next. You know, you focus on the recent, for survival purposes.*

Although participants did not feel that information about long-term variability would be useful to them personally, a couple of conversations developed with regard to circumstances where it would be of use. For example, in the St. John's focus group, participants had a conversation about how it could be useful to farmers, investors, and recreational industries. Likewise, in the Happy Valley-Goose Bay focus group, participants highlighted that information about long-term variability would be important for people who depended on the land for their livelihoods.

Individuals' attitudes about the utility of information about long-term variability was consistent with discussions about their personal adaptations to weather and climate. Participants frequently noted examples of ways in which they adapt to their present environment. In most cases, these adaptations were in response to extreme or unusual events, or events that influenced the individual in some way (e.g. a flooded basement). Participants also noted ways in which their community was adapting to current environmental issues, for example a man in the Corner Brook focus group expressed the following:

> *Out in Grand Falls, years ago, somebody drove out on that high road going into Grand Falls and drowned. So they raised the road. You know there in Grand Falls where they have water on both sides of the highway… a wrestler drowned there I think.*

It is important to highlight that although individuals are discussing adapting to *present* conditions, their adaptations often serve to protect the individual from future, long-term shifts.

The final finding pertains to participant attitudes about long-term variability predictions. On three separate occasions, individuals directly questioned the reliability of long-term forecasts. On one particular occasion, a participant was reluctant to accept the moderator's statement about the historical presence of long-term variability in the province. Comparable skepticism was present

in comments such as "*there is no guarantee they're going to be right*" which was said in reference to both short-term and long-term forecasts.

3. Results Summary

This chapter outlined the results obtained from Phase I and Phase II of the research study. The first phase, which consisted of one-on-one interviews, highlighted that the individuals interviewed primarily discussed weather and climate memories that were either recent or from their childhood. Furthermore, these individuals focused mostly on short-term variability, change, and winter-related phenomena in their narratives.

The second phase of the study, which consisted of focus group discussions, allowed the researchers to engage research participants in the process of knowledge production, which was a post-deficit and post-normal science goal of this study. This was done by sharing the preliminary analysis of the one-on-one interview data with the research participants and asking them to provide their feedback about the analysis. Overall, the participants agreed with the analysis and contributed further insight on the topics. The results from the open-discussions and the CAT activity complemented the data from the first phase of the study. The open-discussions were also an opportunity to directly ask the participants about their experiences of long-term climate variability. It emerged that none of the participants noticed long-term climate variability in their communities, and discussions around the topic were limited. Complementing the results of the one-on-one interviews, focus group open-discussion, and the CAT activity, which show an emphasis on the perception of weather and change, the responses from the variability/trend colour animation activity highlighted that individuals had less associations with long-term climate cycles in comparison to short-term variability and change.

In the following chapter, results from across both phases will be interpreted, yielding valuable lessons that may inform public climate change communication and specifically the treatment of climate variability in climate communication.

Chapter 4: Discussion

Centred on the results presented throughout Chapter 3, the first section of this chapter will present lessons that were learned from engaging with community members about their local experiences of weather and climate and analyzing the language used throughout interviews and focus groups. Section 2 will discuss the potential of a new discussion tool based on the results from the climate autobiography timelines. The chapter will conclude by addressing what was learned around the subject of natural climate variability, which was the original motivation for this research.

1. Communication Lessons

1.1 Climate communication should be centred on concrete phenomena. The first question this research addressed was with regard to developing an understanding as to what weather and climate phenomena were significant in the lives of the participants. The results suggest that there are weather and climate phenomena which tend to be remembered by individuals, and this appeared to be dependent on whether a particular weather or climate phenomena impacted the lives of participants in any significant way. For the purposes of this project, phenomena which had a perceived tangible influence on participants were labelled as concrete. On the other hand, phenomena which lacked a perceived influence was labelled as abstract. The labelling convention was based on both explicit statements from the research participants as well as interpretations from the interview and focus group discussion content. This research highlighted that it was the concrete phenomena which individuals frequently remembered, adapted to, and about which they desired further information.

There is extensive research that investigates the "psychological distance" of climate change (e.g. Jones, Hine, & Marks, 2017; McDonald, Chai, & Newell, 2015; and Spence, Poortinga &

Pidgeon, 2012), however to our knowledge none that has examined the psychological distance of climate phenomena on shorter-timeframes (e.g. long-term climate variability). Spence et al. (2012) specifically highlight four dimensions of psychological distance in relation to climate change: spatial distance, social distance, hypothetical distance, and temporal distance.

Temporal distance refers to the perceived distance in time of some future event (Spence et al., 2012) and is of particular relevance to our findings. Early research on the psychological distance of climate change illustrated that climate change is perceived to be a temporally distant phenomenon (e.g. Leiserowitz, 2006; Leiserowitz, Maibach, Roser-Renouf, Feinberg & Howe, 2013). An individual experiencing temporal psychological distance from climate change acknowledges that 1) the event will occur and 2) that it will have significant impacts, however will still feel removed from the issue because the impacts are a long way in the future (McDonald et al., 2015). Temporal distance, as well as the other forms of psychological distance, can systematically change the way people respond to certain events (Liberman, Sagristano, & Trope, 2001). For example, in the case of climate change, peoples' willingness to engage in environmentally responsible behaviours (e.g. Haden, Niles, Lubell, Perlman, & Jackson, 2012) are often examined in relation to psychological distance. The results of this project add to this literature by highlighting how the temporal distance of certain climate phenomena influences individuals' adaptive behaviours in their communities.

Long-term climate variability, which was the primary climate phenomena that was investigated, was one of the main climate phenomena categorized as abstract. The results suggest that this may partially be a result of the perceived temporal distance. As discussed in section 2.3.2 in Chapter 3, participants explicitly stated that information about long-term variability would not be useful because it doesn't help them prepare for more current (temporally close) concerns. The

relative temporal distance is accentuated by participant impressions that information about long-term climate variability could be useful for *others* who already depend on long-term future planning (e.g. agriculture sectors, tourism sectors) for the success of their businesses or industries.

The results of this research suggest that decadal climate variability may also be perceived as a temporally distant phenomenon. Interestingly, although the effects of decadal climate variability are relatively closer in time than the effects of climate change, it still appears to be a temporally distant climate phenomenon that participants feel unwilling or unable to address, as highlighted by statements from research participants in Chapter 3 section 2.3.2.

Although long-term variability may not be important to individuals in their decision-making, it does not mean that individuals do not accurately understand the concept or that it should be avoided in discussion; this is demonstrated by reflections on utility to others. As participants themselves identified, there are certain people who would be likely to use information about long-term variability (e.g. agricultural and Indigenous communities). Interestingly, past studies have demonstrated that similar communities can display acute awareness and detailed recall of long-term variability (e.g. Mertz, Mbow, Reenberg, & Diouf, 2009; Ford, Smit, Wandel, & MacDonald, 2006; Sánchez-Cortés & Chavero, 2011).

This illustrates that what may be concrete (i.e. having perceived influence) for one community, may not be concrete for another. For example, during the research project, participants living on the island of Newfoundland revealed that temperature rarely influences their decisions to engage in outdoor activities. Temperatures in Newfoundland range from 16°C in the summer, to around 0°C in the winter. Participants from Newfoundland often highlighted that it was never too hot or too cold to go outside, but that it can be too windy or too rainy. There were also occasions when participants expressed that weather forecasts in their communities would still be useful if

only wind was reported (excluding temperature). This is further reflected in the overall content of the data, in which temperature was not discussed frequently by this project's participants living in Newfoundland. In communities where temperature frequently threatens the health and safety of individuals, the opposite may be true; for example, Arizona, Texas, and California, which together account for 43% of the 658 mean annual heat-related deaths in the United States (Centers for Disease Control, n.d.). Among our participants, it did appear that individuals from Happy Valley-Goose Bay in Labrador had more narratives related to the influence of cold temperatures within their community (e.g. school closing from -50°C temperatures, Chapter 3 section 2.3.1). This is consistent with the more extreme winter temperatures in the city of Happy Valley-Goose Bay, which average -17.6°C in January. Overall, this means that for climate and climate change communication, strategies that are localized and context specific may be more beneficial to community members in comparison to strategies attempting to provide a more global message. This suggestion is consistent with the post-deficit approach outlined in Chapter 1 section 2.1, which emphasizes the integration of local knowledge and perspectives, rather than assuming the public is deficient of relevant knowledge for effective action.

The second question this research sought to address was in relation to documenting strategies that participants used to discuss significant weather and climate phenomena. The corresponding results indicate that individuals discuss concrete phenomena. These findings resonate with the recommendations from Corner, Shaw, and Clarke (2018, p. 8) who make the suggestion to "talk about the real world, not abstract ideas" when discussing climate change. Our results suggest that a useful approach for engaging in a collaborative and productive climate dialogue with stakeholders is to centre the discussion on topics that are relatable to those stakeholders. This may mean that for some communities in which climate change concerns lag

behind more immediate concerns, it may be best to move the spotlight off future effects of climate change in climate discussions. Instead, climate discussions could turn to weather and climate concerns which are already influencing the community. This doesn't mean that climate change stops being addressed, but rather that climate adaptation and mitigation strategies first prioritize issues the public has determined to be of primary importance, while more subtly incorporating defenses for a distant future climate.

In some cases, making climate information more relatable has become an issue of *reframing* climate information in a way that emphasizes issues that are important to individuals. Nisbet (2009) highlights that this can be done by using carefully selected metaphors, allusions, and examples. However, as shown by Whitmarsh and Corner (2016), reframing can sometimes elicit negative responses if not precisely tailored to particular individuals. Furthermore, reframing or rewording information can be interpreted as a manifestation of the public deficit model, in which scientists simply need the right words to communicate science (Pearce et al., 2015), leading to the uptake of their assertions and recommendations. However, because of the post-deficit grounding this research has taken, our recommendation is not centred on reframing scientific-recommendations but rather on developing recommendations based on diverse stakeholder input and engagement about what responses are needed. Our results show that individuals have detailed understandings of the way weather and climate impacts their lives, as illustrated by the rich narratives and descriptions provided by participants in both the interviews and focus group discussions. The public should therefore be regarded as community experts who are able to contribute to the development of weather and climate adaptation strategies for issues facing their respective communities. However, because it appears that individual perceptions and recollections of some phenomena (e.g. long-term cycles, phenomena that occurred during black-out dates) can

be limited, engagement across different forms of knowledge is important. This means that for effective climate communication and discussion among diverse stakeholders, it's important to understand the vocabulary and strategies that individuals use to communicate certain climate features.

Centering climate action on behaviours which have more tangible effects also resonates with suggestions that specific events (e.g. a drought or a hurricane) can serve as "teachable moments" to engage in discussion with stakeholders around climatic events (Lowe et al., 2006). However, as highlighted by Wallace (2012), the problem with this approach is that teachable moments are often viewed as unsubstantiated and labelled as fear mongering. This is not to say that teachable moments aren't effective, but rather that their purpose should be to illuminate society's increasing vulnerability to not only climate change but other naturally occurring disruptions, instead of implying that extreme events are a direct effect of climate change (Wallace, 2012).

Our results show that individuals are going to prepare for more immediate threats, for "what may come next". It is the weather and climate events which are temporally close to individuals that are going to prompt behaviour modifications. This is exhibited in the data through explicit statements highlighting the desire for accurate information about upcoming conditions, which can be used to make appropriate, informed, short term decisions. This is further exemplified through participant narratives highlighting adaptation behaviours they have used in the past in response to direct experiences.

If an extreme or unusual climate event requires individual or community level changes, adaptations or reconstructions, the opportunity can be used to not only address that one specific occurrence, but to simultaneously prepare for similar reoccurring and more severe events in an

environmentally responsible way. For example, instead of simply replacing shingles on a house after a severe windstorm, the opportunity can be taken to replace shingles with a stronger and more sustainable adhesive. In order for this type of communication approach to be effective, our results suggest that teachable moments be capitalized on immediately following an event, while it remains highly 'concrete' in local memory.

1.2 Climate communication should incorporate narratives, not just numbers. Another finding from this project is that participants often use narratives when communicating about prevalent weather and climate phenomena. There was often a high level of biographical detail provided by the participants in narrative form across both phases of the research study. Information about the local weather and climate were rarely discussed or portrayed in purely physical terms, but rather as the background to important, extreme, impactful, emotional, and meaningful events in the participants' lives. Furthermore, weather and climate events were often associated with family, friends, coworkers, or other community members. There was frequently a "human face" at the centre of the narratives provided throughout the one-on-one interviews and focus group discussions.

As highlighted in the first chapter of this thesis (Chapter 1 section 2.1), weather and climate are often defined and presented in numerical or graphical form, minimizing any social context (Hulme, 2008). Sometimes, attempts at adding human contexts can be seen in some weather icons used in local forecasts, for example using smiley faces to convey emotion (e.g. a happy sun, a sad rain cloud) or using umbrellas to suggest impact. However, after a brief scan of major weather forecast sources in Canada and the United States, it appears that these more "human" weather icons are currently being excluded in the major weather outlets. On the other hand however, humans remain prominently integrated in reporting about extreme weather events. For example, extreme

weather is often reported in the context of how particular weather will or has influenced humans; this is often dramatically illustrated by filming reporters outdoors, weathering incoming hurricanes, blizzards, and rainstorms.

The results from this project suggest that effective engagement with the public should prioritize the social context and meaning of weather and climate information, rather than attempting to "boil it down" to the numbers. This complements the post-normal science framework of science outlined in Chapter 1 section 2.1, where the complex socio-cultural aspects of climate are acknowledged rather than simplified through the exclusive use of numbers. Weather and climate narratives with relevant human characters offer a more natural way of discussing information, as it mirrors how people typically communicate in their day-to-day lives (Corner & Clarke, 2016). In the results of this research, precise temperatures, wind speeds, rain quantities, or snow quantities were rarely discussed or recalled by participants. Furthermore, when participants were asked to describe typical seasons in their communities (which implied physical descriptions of climate), responses were substantially shorter and less detailed (e.g. winters are windy and snowy) in comparison to when individuals discussed their past experiences of weather and climate. Instead, detailed narratives with human characters took centre-stage when participants were describing these experiences, often yielding a detailed and holistic description of the weather conditions for that particular memory.

This suggestion to approach weather and climate discussions through human-centred narratives echo Corner et al. (2018) who recommended telling a human story when communicating climate change information. The authors further suggest integrating two key elements of story structure, conflict and resolution, into climate change messages in order to provide direction and to reduce the overwhelming nature of the problem to the individuals listening to the message. This

is not to suggest a guide for how to communicate information *to* the public, which is a manifestation of the public deficit model (discussed above and in Chapter 1). Neither is it a suggestion for a method to *extract* information from the public. Rather, as highlighted by Paschen and Ison (2014), narrative approaches promote self-reflexive social spaces that can introduce alternative knowledge(s) into the design of local adaptation policies and solutions. In other words, using and acknowledging human-centred narratives as a legitimate source of knowledge creates a platform for reaching public stakeholders and providing them the opportunity to engage in the decision-making process for their communities. A powerful and innovative example of this narrative approach is *Lament for the Land* by Dr. Ashlee Cunsolo Willox and communities in Nunatsiavut, Labrador, which presents narratives about localized climate impacts in the Canadian North through film. More information about this work can be found at www.lamentfortheland.ca. Ultimately this type of communication and discussion strategy can help bridge researchers, policy-makers and the public on the issue of climate change and other climate related issues pertinent to their communities.

Reducing the emphasis of numerical data in exchange for more narrative information in climate communication may serve a purpose beyond greater promotion of stakeholder engagement: it may also help to reduce fatigue around climate change information. This fatigue has been cited as a challenge for public engagement (e.g. Nordhaus & Shellenberger, 2009; Capstick & Pidgeon, 2012). This appeared to be a prevalent issue among the individuals that were interviewed, as most participants either didn't want any more information about climate change or believed that all the necessary information was "pretty much out there". A recent study that explored various narrative strategies for engaging different audiences emphasized that individuals were frequently disengaged by "big numbers" (Whitmarsh & Corner, 2017). By revolving climate

discussion around narratives rather than on ambiguous numbers which have gone through various phases of processing, those who are uninterested, unable, or unwilling to understand the process of statistical averaging and forecast modeling are not isolated from the discussion.

Maintaining a human story throughout the process of engagement ensures that climate-related topics remain tangible to *all* stakeholders. It also creates a platform for those stakeholders to feel comfortable contributing to the discussion. This comfort and willingness to engage was exhibited in our research during the one-on-one interviews and during the open discussions and CAT activity during the focus groups, where participants provided personal narratives on many occasions. On the other hand, the colour animation activity, which unlike the other research components did not explicitly emphasize the human context of weather and climate, was the most isolating part of the research project, as exhibited by the feedback from research participants as well as limited engagement with the activity.

2. Discussion Tool for Engagement

Garnering community support for climate adaptation and mitigation strategies depends on centering those strategies on what stakeholders consider to be important. Although research shows that people are concerned with climate change (Brulle et al., 2012), it also shows that climate change lags far behind other concerns, for example the economy (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). Even among environmental concerns (e.g. toxic waste and environmental pollution), climate change is usually ranked at the bottom (Brulle et al., 2012). Instead of trying to persuade the public to change their priorities, researchers, policy makers, governments, and industry should adapt their agendas to the needs of those they try to help. However, to achieve collaborative and innovative solutions to community concerns requires the engagement of the public.

The CAT tool can be used for initiating in-depth and context-rich discussion about people's relationships and experiences with the weather and climate in their communities. In the focus group discussions, the CATs provided an opportunity for participants to think about, organize, and write down their lifetime experiences with weather and climate, and to build rapport with the researchers and with each other. Furthermore, because the instructions of the activity emphasized context over perfectly accurate recollections of climatological conditions, the activity revolved around participants' *own* personal experiences with weather and climate. This allowed the participants to feel assured in their role as an expert on community experiences of climate. The comfort and confidence felt by participants during the activity was exhibited when participants eagerly shared and compared their individual CAT entries both with and without being prompted. The ability of the CAT activity to promote productive discussion among individuals is noteworthy. The discussions that may arise from the CAT activity may ultimately promote engagement in the process of strategizing and implementing solutions for climate-related concerns, in ways that allow community members to feel empowered. This empowerment results from the CATs focus on personal experiences and impacts, which allows individuals to take ownership of their perspectives.

Sixty minutes were allotted for the CAT activity, which included instructions, time for the participants to record their entries, and discussion during and after the activity. Part of the rationale for this activity was to unveil whether an alternative data gathering method would result in increased discussions about long-term variability and about the timeframe between childhood/initial years and recent years. This did not appear to be the case. Instead, similar data were gathered with the CAT tool as was gathered with the interviews in approximately the same amount of time; including information about prominent weather and climate phenomena (e.g.

precipitation, wind), perceptions of changes within community, and insight about what people remember alongside those weather and climate memories (e.g. family, friends, extreme/unusual events). This suggests that the results from this study are a reflection of the participants' associations with weather and climate, rather than a reflection of the method used to collect the data.

Part of the time dedicated to the CAT activity included discussing ideas about how the participants believed that this tool could be improved. Participants wanted more time to complete the CAT activity and to be able to work on the CAT in different locations (e.g. at home). This was suggested with the justification that different context cues (e.g. speaking to a loved one, being at work, evaluating social media or photo albums) would trigger different memories about their past experiences. If the goal when using this tool is to unveil comprehensive historical experiences with weather and climate, this participant insight suggests that it cannot be done in a single sitting or in a single location that lacks context cues which could serve to elicit memories. Rather, individuals would require an extended amount of time to reflect on their experiences, as well as the flexibility to engage with their environment and in discussion with others, which could help trigger memories or details about their memories

Early critiques of the Life History Calendar (LHC) suggested that requiring a researcher be present during the LHC activity was one of the method's primary limitations (Morselli, Berchtold, Granell, & Berchtold, 2016). As the source inspiration for the CAT, it could be inferred that broader application of CATs could have a similar limitation. However, recent LHC-related work suggests that a researcher may not need to be physically present to effectively administer the activity. A study comparing the results of traditional LHCs conducted in-person and over-the-phone found no significant differences between the two (Freedman et al., 1988). Furthermore,

recent attempts to develop digital self-administration versions of the LHC to address sensitive topics (Morselli et al., 2016) and reduce interviewer effects and administrative costs (Morselli, Le Goff, & Gauthier, 2018) have also found few differences in data quality between contact and non-contact modes of administration. This means that building on participants' suggestions to engage with the tool at different locations for extended periods, implying that there wouldn't be a researcher present, could be feasible without sacrificing data quality. Furthermore, the literature above also suggests that a digital version of the CAT tool, which may be more convenient and approachable for certain populations, could also be effective without sacrificing data quality.

Further alterations can be made to the CAT tool based on suggested modifications to the LHC. For example, Nelson (2010) suggests using stickers as a way to help participants engage more creatively with the tool and provide an alternative method of communicating a memory, thereby reducing the redundancy of the activity. Additionally, the inclusion of culturally- and community-relevant landmark events, which are indexes that help people organize and access their autobiographical memories, may be beneficial (Glasner, van der Vaart, & Belli, 2012). Although no landmark events were used in this first version of the CAT tool, data from the first and second phases of the research project provided insight as to what relevant landmark events could be used in future versions of the CAT for each respective community (e.g. fire evacuations in Happy Valley-Goose Bay). This locally derived information about community landmark events may also be combined with landmark climate events as determined by the physical science community.

Finally, as stated by Axinn, Pearce, and Ghimire (1999), some of the world's populations do not primarily use standardized measures of time to mark personal events (e.g. Indigenous populations). The CAT structure used in this study is based on a linear concept of time (i.e. past-present). Future CAT research may consider developing the tool to be used by Indigenous

communities in a way that adopts alternative perspectives; e.g. a circular view of time in which events are organized according to their relative importance (Janca & Bullen, 2003). The need to tailor both the content and the structure of the CAT highlights the importance of co-developing research tools *with* your population.

3. Challenges Associated with the Communication of Climate Variability

The purpose of this research was to explore the extent that long-term variability was present in people's personal experiences of weather and climate. This was done to address the limited attention given to long-term climate variability within the social sciences and to explore the boundaries for discussing long-term climate variability in relation to other weather and climate phenomena. This research highlights that discussions surrounding climate variability, which is critical to a holistic understanding of the physical functioning of weather, climate, and climate change, may be largely absent in the public sphere. The results reveal challenges related to the communication of natural climate variability.

3.1 Understandings of climate are anchored on two points in time. From the data it emerged that people generally have difficulty perceiving/narrating longer-term cycles and variability in their communities. Instead, people appear to anchor their local climate histories on two distinct periods. These periods are 1) their recent past and 2) the time when individuals were first "learning" about their community, which for most of our participants was their childhood. The period in between these two more salient time points has been called black-out dates throughout this thesis. The presence of climate black-out dates is supported by the data in both the one-on-one interviews as well as the data in the CAT activity during the focus group discussion.

Because this result was not anticipated, the questions asked during the interviews and focus group discussions were not centred on identifying potential causes for the black-out date

phenomenon. High recall of recent events was anticipated, as their impact is likely fresh in a community's collective memory and remains the subject of occasional discussion. With respect to the detailed narratives relating to childhood or initial years in the community, it is possible that these years are more memorable because individuals were experiencing a variety of novel events in their lives, and continuing to form their understanding of a place. Thus these experiences strongly contribute to initial understanding of what constitutes "normal" or "everyday".

This tendency to focus on two periods (i.e. then and now) can effectively "erase" perceptions of long term variability, which would occur in cycles during the black-out periods. Essentially, the potential of misidentifying the frequency of certain phenomena increases if an individual is only "sampling" from two points in time. What may happen in these circumstances is that instead of seeing cycles, an individual may interpret the disjuncture between these two salient points as a trend and/or permanent change. The overwhelming attention dedicated by participants to the discussion of perceived changes in their communities rather than cycles, despite attempts to elicit conversion about cycles, supports this claim. Howe, Markowitz, Lee, Ko, & Leiserowitz (2013) point out that local weather conditions are a source of information that when accurately aggregated over time, can allow individuals to detect long-term local climate trends. This research suggests that individuals do not give equal attention and weight to local weather conditions across their lifespan. This may be partially responsible for the inability to detect long-term cycles in the climate.

3.2 Long-term climate variability is difficult to notice. The results of this study highlight that weather and change may be easier to notice than long-term climate variability, as illustrated by the dominance of weather and change perception narratives in the one-on-one interviews. The quantity of words used to describe the weather, short-term variability, and change animations in

contrast to the decadal and centennial variability animations during the color animation activity provide some evidence to support this claim.

Long-term variability may be more difficult to notice for several reasons. One of these reasons may be familiarity. The participants in our study frequently noted how weather is a daily topic of conversation with family, friends, and even strangers. Climate change, although not typically a daily conversation piece, was something that participants expressed having heard about, have a certain level of understanding about, and are concerned about. On the other hand, individuals are not familiar with long-term variability, as exhibited by lack of knowledge from participants about long-term local climate cycles. Individuals may simply focus on concepts that are familiar to them when interpreting their personal experiences of weather and climate. As pointed out by Howe (2018), this is consistent with the phenomena termed motivated reasoning, which is the tendency to interpret information in a way that corresponds with preexisting understandings about how the world works.

Another explanation could also be that long-term variability is less relevant to people's lives than weather and climate change. This is supported by the findings that participants care about adapting to immediate threats (i.e. weather) and that they would appreciate improved short-term daily forecasting. Furthermore, regarding climate change, 30 of the 33 participants indicated some concern about climate change and 17 of them expressed that they perceive climate change to be currently influencing their communities. This contrasts with the less relevant long-term climate variability, with participants explicitly stating that information about long-term variability would not be useful in their daily lives.

A final potential explanation for the difficulty participants had noticing very long-term climate variability is that in a practical sense, it is the same as change. Long cycles, particularly

cycles exceeding the average human lifespan, are effectively permanent from an individual standpoint. Whether or not individuals understand the period of the cycle doesn't make its impact any less relevant or distinguishable from change. This may be a less accurate analysis for people whose well-being and life's work depends on long-term planning however, as they may already be in the habit of thinking long-term, in which case the periods of the cycles become more visible and relevant.

3.3 Communication about climate variability is rarely concrete. It would be wrong to say that climate variability has been completely ignored in media. After all, the individuals who participated in this study noted having heard of phenomena such as the El Niño-Southern Oscillation, which is one of the dominant modes of interannual variability worldwide. However, none of the participants were able to provide accurate details about the phenomena. This limited understanding stems from reasons that link to the communication lessons described in section 1.1 of this chapter. First, known cycles of variability are typically understood in terms of weather and climate phenomena that were considered abstract by participants in the present study (i.e. air temperatures or modest changes in precipitation). Second, climate variability, like much current weather and climate discourse, relies on numerical communication rather than more narrative approaches that incorporate social context.

In cases where climate variability has extended into a biographical human narrative, however, it has been in relation to extreme events. For example, the mildest winter on record (snow-free) in Vancouver, Canada occurred during the Vancouver Winter Olympics in 2010, largely as a result of an El Niño event (Environment and Climate Change Canada, 2017). While an occurrence like this may partially explain the familiarity of the term El Niño to the participants of this study, the limited knowledge about El Niño exhibited by those same participants may be in

part due to the lack of impact El Niño has on the climate in Newfoundland and Labrador (Finnis & Bell, 2015). That is, the national (and narrative) attention given to El Niño may explain the familiarity with the phenomena, whereas the lack of regional relevance of El Niño may explain the limited understanding about what the phenomena actually is.

4. Areas for Future Research

This project opens the opportunity to a variety of future research projects. First, future research should consider investigating different regions that are influenced more or less by long-term climate variability. Specifically, it would be interesting to examine a region which is strongly influenced by the El Niño-Southern Oscillation, as it is one of the more commonly noted inducers of climate variability.

Another area that would benefit from further research would be examining the impact of integrating and normalizing discussions of natural climate variability on people's ability to recognize this variability and its influence on their climate experiences. As highlighted in Chapter 4 section 3.2, participants may stick to concepts that are familiar to them when interpreting their personal experiences of weather and climate, which is consistent with the phenomena of motivated reasoning (i.e. the tendency to interpret information in a way that corresponds with preexisting understandings about how the world works). It is possible that with increased familiarity and understanding about climate variability, that individuals may reflect differently on their experiences. Furthermore, the opportunity can be taken to examine how this integration and normalization of climate variability impacts attitudes about climate change.

Another area for further research regards the improvement of the CAT tool. Suggestions from both this projects' participants as well as suggestions directed towards improving the Life History Calendar (LHC) method serve as valuable starting points for improving this tool. These

suggestions can serve to create a more standardized tool to be used on a larger scale, or a more comprehensive tool to gather a holistic picture of people's experiences with weather and climate. Furthermore, an exploration of the various potential uses of the tool is warranted. For example, the CAT may have value as an education or engagement tool, rather than simply a research instrument. The tool could also be tested under a variety of time constraints, which may yield insight into the quality of information retrieved under strict time limits versus unlimited time (e.g. for reflection, discussion with others, or referencing news articles or social media). Lastly, the tool could be expanded to explore people's ideas about future weather and climate. This may help researchers further understand knowledge and attitudes about local climate and climate change, and potentially reduce the psychological distance individuals feel regarding long-term climate variability and climate change.

5. Limitations of this Study

This study had multiple limitations with regard to its design. One of these limitations is with respect to the small sample size in both the one-on-one interviews (n=33) and the focus group discussions (n=12). Although valuable insight about local experiences with weather and climate was gained, results are not generalizable to the entire population. Furthermore, because some of the individuals self-selected to participate in the study, there is likely a bias that resulted from that approach. As the researchers themselves noted, those who were choosing to take part in the study, which was advertised as a weather and climate study, often expressed high levels of environmental concern or interest. Another limitation is that all the data gathered throughout the study was self-report data, which is susceptible to various biases. The bias of primary concern was the potential of social desirability bias. Because the study was about people's experiences with weather and climate in Newfoundland and Labrador, it is possible that the participants believed that the

researchers were interested in experiences of *climate change.* Thus, to appear knowledgeable and environmentally concerned about climate change, participants may have reported their experiences in a way that was consistent with a climate change narrative. Another important limitation regards the differences in data collection in Phase I of the research study. Because individuals were interviewed either in-person or over the phone, there may have been significant differences in the content of the data that does not necessarily reflect differences in lived experiences. Furthermore, because most of the in-person interviews (which were on average 20 minutes longer than the telephone interviews) were conducted in St. John's, our results may be skewed towards representing the experiences of those individuals who live in St. John's.

One of the most important limitations to acknowledge involves the one-on-one interview questionnaire. The intention of this study was to explore potential avenues to better discuss long-term variability with a general audience. The data showed that few people engage in discussions about long-term climate variability, and potential reasons for this are discussed in section 3.2 of this chapter. However, another potential explanation for this result is that the questions asked were not effective at prompting discussion about long-term variability. For example, we used seasonal markers (which is categorized as short-term variability) to begin a discussion about the weather and climate. Because of the focus on seasons in the beginning of the interview, it is possible that individuals centred on seasons and other forms of short-term variability, thus limiting their attention to forms of longer-term variability in their lives. This limitation is important to acknowledge not only to better understand the results, but to also inform future research that aims to contribute to the development of discussions around long-term climate variability.

One final limitation of the study regards the definition of the term *variability* and its relationship to the word *cycle* that the researchers adopted throughout the research process (i.e.

tool development, data collection, and analysis). As highlighted in Chapter 1 section 1.2, climate variability is defined as the semi-regular fluctuation of climate about its mean state. In the atmospheric sciences, this semi-regular fluctuation is often discussed in the terms of cycles (e.g. decadal cycles, seasonal cycles); this is particularly true of longer term variability, such as the decadal-scale fluctuations associated with the Atlantic Multidecadal Oscillation. However, this relationship between the term variability and cycle is not necessarily used in the same way in everyday language. For example, in everyday language, the word variability can often have connotations of inconsistency or unpredictability. Cycle on the other hand carries connotations of regularity. The researchers attempted to decipher the intended meaning when respondents used words such as variability or cycle by prompting further discussion (e.g. do you expect it to get warmer again now that it is cooler?). However, it is possible that term meanings became lost in translation during the interview process and corresponding data analysis.

Chapter 5: Conclusion

Understanding climate variability, that is, the semi-regular fluctuation of climate about its mean state, is crucial for a holistic understanding of weather, climate, and climate change. In the physical sciences, considerable attention is given to developing knowledge of the physical functioning of climate variability as well as the various impacts of climate variability on the environment. Furthermore, growing attention is dedicated to distinguishing the complex and uncertain influence of natural climate variability from anthropogenic climate change (e.g. Cassou et al., 2017 and Garcia, Monier, & Selin, 2017).

In the social sciences however, climate variability, especially long-term climate variability, is often overlooked. Likewise, public communication of climate change and media representations of climate change tend to give imprecise attention to the issue of climate variability, by either magnifying or limiting discussion on the topic (Boykoff, 2011). The mistreatment of climate variability in fields outside of the physical sciences has resulted in a lack of understanding about how people experience, interpret, and talk about climate variability, and in turn, produced uncertainty among "public communicators" who are unclear how or to what extent to address the topic.

The inability to have informed discussions with public, private, and government stakeholders about what the effects of climate variability mean in the context of climate change presents a couple of problems. First, because the effects of climate variability may mask the effects of climate change during natural cooling cycles (Trenberth, 2012), it results in an opening for skeptical arguments against the anthropogenic influence on the climate (Morin, 2013). Secondly, climate variability may have localized impacts on individuals' livelihoods (e.g. West & Vásquez-León, 2008), thus an inability to talk about climate variability could result in communities that are

unprepared to face the effects of climate variability (especially if the effects either heighten or conflict with the predicted effects of climate change).

This thesis argues that the limited attention given to climate variability is a manifestation of the public deficit model (Nerlich et al., 2010; Wynne, 2006), where the public is understood as lacking the competencies to make sense of climate variability. Likewise, it is a manifestation of normal science (Kuhn, 1962), where messages about climate change are tailored to be simple rather than complex through the exclusion (deliberate or not) of natural climate variability.

This research addressed the lack of adequate attention given to climate variability in the social sciences (e.g. Ayal & Filho, 2017; Le Dang et al., 2014) by focusing on the local knowledge related to climate variability in Newfoundland and Labrador, an area that experiences significant natural climate variability, including prominent decadal cycles. Furthermore, to address the concerns surrounding the public deficit and normal science treatment of climate variability, this research was grounded in post-deficit and post-normal science approaches (based on recommendations from Klenk et al., 2017; Pearce et al., 2015; Kraus & von Storch, 2012; Boykoff, 2011; Gross 2010; Nerlich et al., 2010; Davidson-Hunt & O-Flaherty, 2007; Felt & Wynne, 2008; Wynne, 2006; Funtowicz & Ravetz, 2003). Grounding this research as such has allowed us to i) acknowledge the participants as a source of knowledge rather than a 'sink' requiring expert information and ii) directly address and explore the complex interaction of climate variability, climate change, and weather with culture, society, politics, and individual psychology.

Data were gathered from a total of 45 participants in different communities using two different research methods: semi-structured one-on-one interviews and focus group discussions. Phase I of the study collected the one-on-one interviews conducted either in-person or over the phone with 33 participants. The questions participants were asked explored their past engagement

with the outdoors, their interpretation of typical seasons in their respective communities, their past experiences with weather and climate, and their opinions and knowledge regarding weather, climate, and climate change. The purpose of this phase of the study was to gather baseline data about people's experiences with weather and climate in their communities, as well as data about if, to what extent, and how people are talking about climate variability. Phase II of the research study involved three focus group discussions with 12 participants. The purpose of this phase of the study was to i) allow the opportunity for the research participants to contribute to the data analysis process ii) gain more detailed understandings about weather and climate experiences and iii) test proposed communication/discussion tools.

Overall, this research makes multiple contributions to the social dimensions of weather and climate literature. First and most generally, the results from both phases of the project provided additional support for current recommendations to communicate climate change in narrative form (e.g. Corner et al, 2018). Our results illustrate that in contrast to mainstream discussions about weather and climate, which are often centred on numerical information (e.g. temperature and precipitation values) (Hulme, 2008), discussions individuals have about the weather and climate contain a great deal of biographical detail in narrative form, and are often explicitly connected to a "human face" (e.g. family, friends, coworkers, or other community members). Furthermore, these same discussions are often in relation to weather and climate phenomena that has a tangible impact on community members. This finding also is consistent with existing recommendations that climate science communicators focus on personally relevant climate phenomena (Corner et al., 2018; Lowe et al., 2006).

This research makes a novel contribution in the development of a climate discussion tool. The Climate Autobiography Timeline (CAT), which was developed for this project, was as an

effective and engaging tool for recording past experiences with weather and climate, and for eliciting discussion about those experiences. This tool yielded information about weather and climate experiences that were comparable to the information gathered from the individual interviews. Furthermore, participants were enthusiastic about working with the CAT, which is an important characteristic of any tool intended for community engagement.

Where this research makes its most valuable contribution to the literature, however, is regarding the insight gained about social dimensions of natural climate variability. Specifically, the results reveal challenges related to the communication of natural climate variability. One of these challenges regards how individuals interpret their lifelong experiences of weather and climate. From the data it emerged that individuals tend to anchor their climate histories on two distinct periods in their life (typically childhood and recent past), rather than on their entire life course. This results in "black-out dates", the time between the two salient periods, in which there is a tendency to recall limited detail about weather and climate phenomena. This is a problem because it reduces the potential that individuals would interpret their experiences as climate variability rather than change. Another challenge facing the communication of climate variability is that long-term climate variability may be difficult to notice in contrast to weather and change. Potential reasons for this include familiarity with the concept of climate variability, the relevance of its impacts, and the lack of practical difference between climate variability and climate change. One final challenge is that existing efforts to communicate climate variability may be doing so in ways that are not narratively significant to individuals.

This research opens a window into the previously unexplored social aspects of natural climate variability. What is clear from the data across both phases of the research study is that discussions about climate variability appear to be mostly absent in the public sphere. It is important

that scientists, governments, and communities address the challenges outlined above, because by continuing to limit discussions of climate variability where they should be integrated (e.g. discussions about climate change, policy decisions), we may be perpetuating an inability to understand and contextualize climate variability in our lives. This research suggests that helping individuals note the relevant impacts of variability in their own lives (e.g. winds and snowpack versus mean temperature and precipitation) could be a potential route to address the challenges outlined above.

If science, government, environmental groups, concerned individuals, and other stakeholders hope for more meaningful engagement with climate, climate variability, and climate change, effort should be placed on integrating and normalizing discussions about climate variability in social spheres. This is particularly important for the news media to consider. As highlighted by the participants of this research, most people learn about climate change from either digital or print news media. This in turn can help create more complex forms of climate literacy within communities and therefore increased opportunities for the public to consider climate variability in the context of their own lives.

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Appendix 1
Phase I (One-on-one Interviews) Interview Schedule

1. **Tell me about yourself and living in this community.**
   [prompts: age, education, length of residency in this region, occupation, previous occupations, life-long resident—why?, mover to the area—why?)]

2. **Describe your relationship with the outdoors.**
   [prompts: time spent outdoors for recreation and work, changes in outdoor activity—why?, types of activities, seasonal activities. Change of plans due to conditions outside; importance of being outside – why?; role of weather in day-to-day life; occasions when particular attention turned to weather/conditions outside

3. **Describe typical seasons in this region.**
   [prompts: How would you describe the weather today/Is it typical for this time of year?; spring, summer, fall, winter. Reliability of the seasons; describe range of weather conditions you experience from one day to another/one year to another

4. **How well do previous years match this typical [fall, winter, summer spring]?**
   [prompt: Year to year? What is the impact of these changes on you? Childhood compared to now? Do you/How often do you see abnormal patterns? Do you think other family members or community members agree these are typical, or do they have differing ideas?]

5. **Could you describe any memorably unusual years or weather events you've experienced while living in this region?**
   [prompt: What made them memorable? How did these memorable events influence you personally? How long did these conditions last? Do you recall discussing reasons for these unusual conditions, or hearing about possible reasons in the news (prompt with El Niño, Polar Vortex, jet stream if they're unsure?)What do you think about these explanations?]

6. **What kind of discussions do you have with other community members about the weather?**
   [prompt: who do you discuss it with (parents, grandparents, coworkers, friends); how often do you discuss weather; how does unusual or changing weather impact them? How do the discussions you have with these individuals influence you?]

   [Transition] Part of this conversation also concerns climate change topics. We aren't testing your knowledge of climate science, but are interested in your personal opinions and experience. There is no right or wrong answer, and you can give as little or as much information as you would like. Also, feel free to skip any questions that you're uncomfortable with.

1. **How knowledgeable do you feel about climate change?**
   [prompt: what do you know, source of information, role of source, first time hearing about climate change, experiences of CC, desired climate change knowledge, improvements in communicating climate change information. If at all, what makes you think that the climate is changing?; concerns about CC]

8. **Do you think that members of this community believe that climate change has impacted this region? / If at all, in what ways do you feel that climate change has impacted this region?**
   [In what ways, do you believe the changes/memorable events discussed above have anything to do with climate change?—why or why not?]

9. **Do you have an opinion about climate change politics?**
   [prompt: If yes, please elaborate? your involvement in climate change politics? Who is responsible for addressing climate change? Role of scientists, environmental groups, media, general public? Your involvement in addressing climate change?]

Appendix 2

Recruitment Flyers

Phase I Recruitment Flyer for the community of Happy Valley-Goose Bay

Newfoundland and Labrador
Weather and **Climate** Study

✓ **Are you at least 30 years old?**

✓ **Have you lived in Happy Valley-Goose Bay for at least 15 years?**

Two students in the Dept. of Geography at Memorial University are conducting a research study on local experiences of weather and cliamate as part of their Master's Theses. Eligible participants will engage in a telephone interview about their personal experiences with weather and climate. The interview will take approximatly 30-60 minute.

The proposal for this research hasbeen reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about te researc, such as the way you have been treated or you rights as a participant, youmay contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861

To participate, please email or call Olivia Vila to schedule a telephone interview:

ofv861@mun.ca

1-709-864-8474

Phase II Recruitment Flyer for the community of St. John's

Appendix 3
Phase II (Focus Group Discussions) Research Instruments

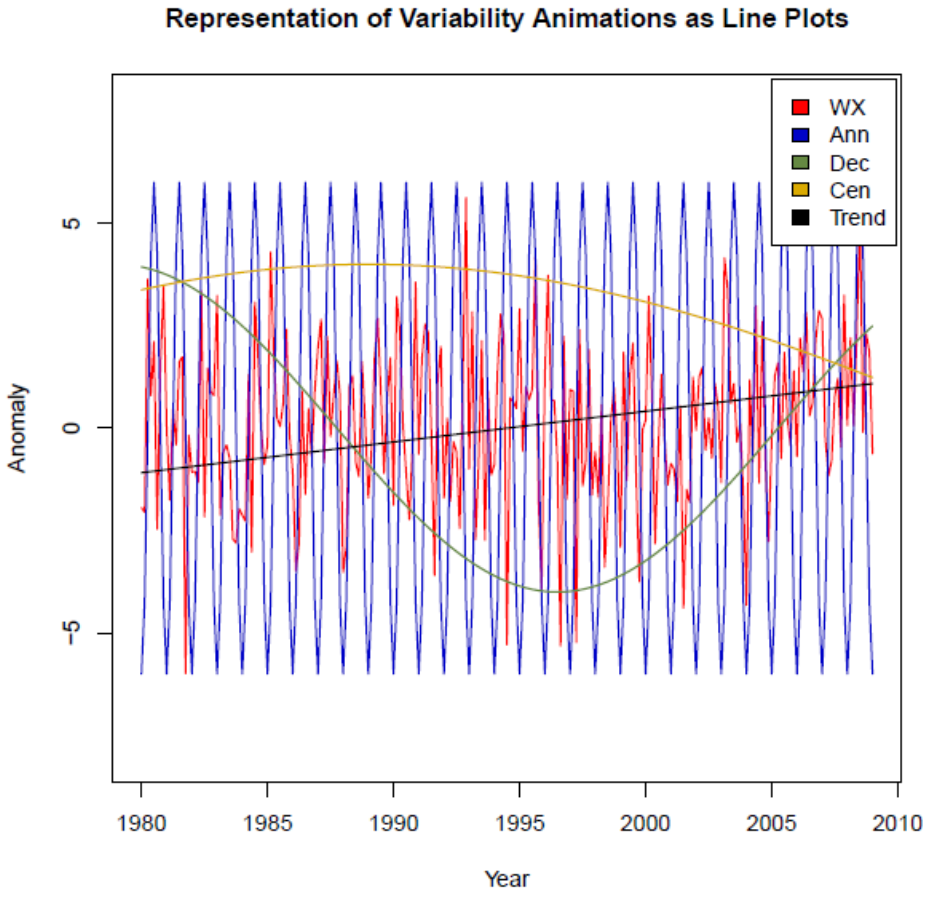
Question Guide

1) How could information about long-term climate variability be useful?

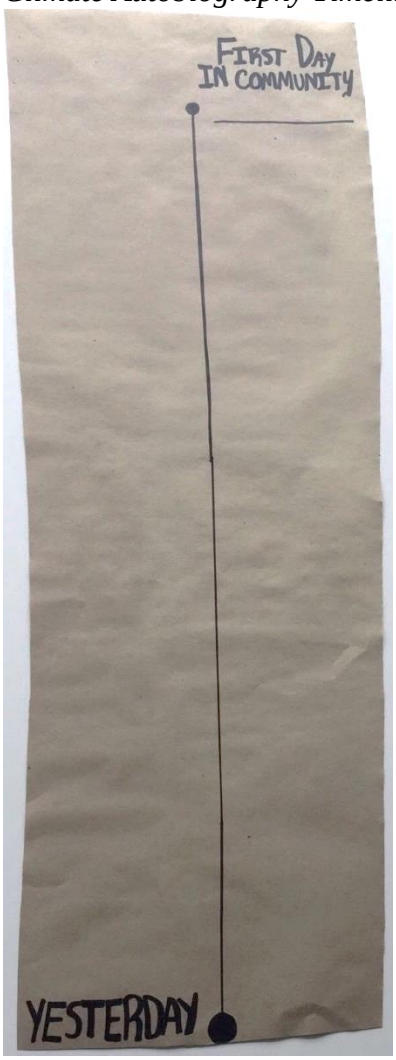
2) Do any of your experiences with weather and climate in your community indicate the presence of long-term variability in your community?

3) How could the weather and climate communication be improved?

Line Plots that represent the variability/trend colour animations



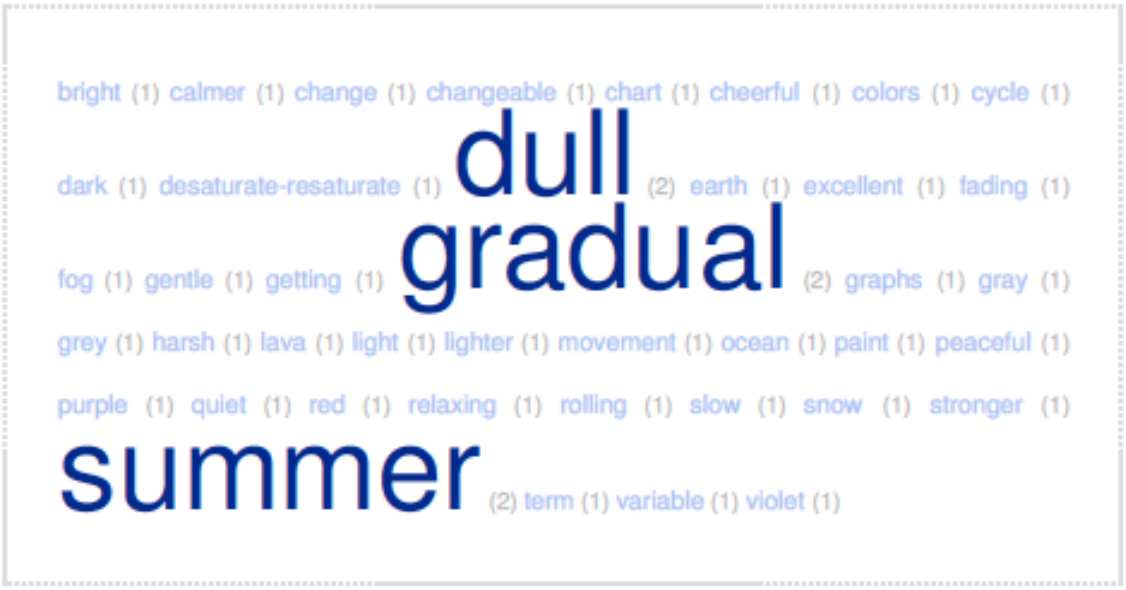
Climate Autobiography Timeline (blank)



Appendix 4

Colour Animation Activity Word Clouds with Word Counts by Type of Animation

Change Animation

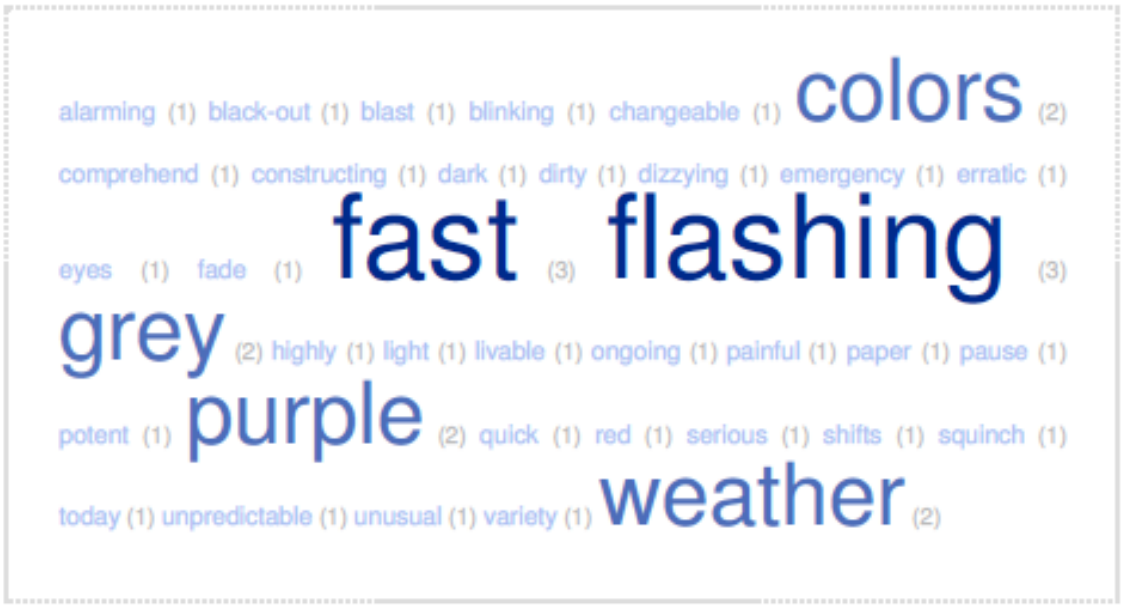


Centennial Variability

Decadal Variability

Seasonal Variability

Daily Variability (Weather)



Combination