A Matter of Meaning: Integrating the Deeper Human Dimensions of Climate Change Adaptation to Support Transformations to Sustainability in a Global Coffee Value Chain

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I am very grateful to the coffee producers involved in this study, their openness and curiosity to learn alongside me in this research process and share their unique insights on this complex issue. Certain actors in the global coffee value chain were of central importance in setting up this study and in connecting me with key places and participants. Due to ethics regarding anonymity, they remain unnamed but I nevertheless acknowledge them as being key contributors to this dissertation.

I also would like to thank my daughter, Anya Lydia Hochachka Simpson, for her flexibility and resilience in accompanying me through this program. No PhD process is easy, but our family faced certain substantial and unique challenges. For example, we spanned two different continents during my time at the University of Oslo campus, which meant that from age five to seven, Anya flew with me across the Atlantic (from Vancouver to Oslo or Oslo to Vancouver) fourteen times. It also meant learning a new language, culture, and set of systems, and meeting a new group of friends, all of which she approached with curiosity and open-mindedness. I honestly do not think I could have accomplished this PhD without her positive, effervescent attitude, or certainly not with as much joy and love.

I dedicate this dissertation to her.

Preface

I began telling my daughter a bedtime story over two years ago, initially as a way to help her bridge our life in Oslo with our life back in Vancouver. Over time, this story has taken on a creative life of its own. Now, we tell the story not just at bedtime, but also while on the ski-lift or when walking to school, and she and I both create 'chapters.' When it is her turn, she often muses,

> "let's say that, in the story, there is no climate change."

Each time she says that, it jolts me in two ways. First, to realize climate change is already so salient to her at age seven that she would even think to say that; and second, to realize that the audacity of imagining a world in which there isn't climate change co-arises with a moral imperative to create it as such.

This dissertation is about how to connect those two thoughts. First, it is about how people make meaning of climate change—such as, to what extent is it salient to them, how do they construe it, and how to work with different, possibly divergent, perspectives in a social context. Second, is how might we imagine and enact a world without anthropogenic climate change; that is, how might we scale adaptation to set our developmental trajectory on a different tack than the current one and towards a sustainable future.

To include both *living with* as well as *living beyond* climate change in this dissertation, I covered a lot of theoretical and empirical ground, which included examining how to enact adaptation in a more transformative manner. I sought to understand what contributes to a more effective, ethical adaptation to climate change in Guatemalan coffee-producing communities, within the larger calls for transformation to sustainability. The point of departure was that climate change is as much a psychological and social issue as it is issue of natural science (Doherty & Clayton, 2011) and that it presents less a "technical problem" than an "adaptive challenge," involving mindsets, worldviews, and values (O'Brien, K & Selboe, E, 2015). Engaging with actors across a global value chain for coffee, I sought to understand why people make-meaning of climate change as they do, as well as how collaboration might best be supported within multi-actor groups with different positions and perspectives (Hochachka, 2019, 2020b, 2021a, 2021b). I pay substantial attention to certain domains of knowledge that are less developed in the current climate change literature, namely about human 'interiority' in general and meaning-making in particular. I attempt to integrate a range of key disciplines in a transdisciplinary approach, drawing on integral models to do so. I present empirical findings of how a global coffee value chain is adapting and responding to the climate challenge. The pandemic, which occurred over the final two years of my PhD program, provided me with additional insights on how this value chain responded to unprecedented, complex issues.

This research leaves me less jolted by my daughter's frank request regarding the place of climate change in our story. I am perhaps more lucid to the challenges ahead, but also more optimistic. While we have a lot of work to do to more adequately meet the climate challenge right now, nevertheless I feel more honestly able to look her in the eye, not knowing whether we will indeed manage to enact a world without climate change, but knowing there is little else that makes moral sense than to try.

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1: Introduction

We decided to go for a walk after dinner. Every path leading from the town eventually meets a coffee farm, paths like tendrils weaving through the treed hillsides. Coffee is grown throughout this area as its mainstay of the local economy as well as a defining feature to the region's traditions and history. The evening sun lights up the green hues of the coffee leaves while the kids laugh below the branches. Our small group consists of children and adults, of varying ages, educational backgrounds, cultures, and languages, and all seem to be utterly enjoying the evening stroll. At one point, one of the women—wearing the bright red, woven colours of the area's traditional Mayan dress—reflects that this clear sky is unusual for this time of the year, and how fortunate we are that it isn't pouring with rain. I look at her, and she looks at me; the import of what she has just said dawning on us both. She mused on it later as an example of the *two faces* of climate change; and expanding with another example of how higher-altitude farms now support coffee cultivation where they never used to, concerningly indicating an overall warming trend. I think to myself, there are not just *two* but actually *myriad* views regarding climate change depending on the perspective taken about this issue; ideological, factual, or emotional, faith-based or scientific, social, ecological, or economic, and so forth. I have sought to inquire into those meanings—and how they relate with people's actions and responses to this issue—by placing such human dimensions as the focus of my study on climate change adaptation.

Despite the complex and entangled nature of climate change, the dominant definition and practice of climate change adaptation is less focused on human dimensions and instead focuses more on biophysical and techno-managerial aspects. Scholars and policy-makers have found this to be deficient in scope and approach, which in part relates with my opening story from the coffee communities. That is, while a biophysical and technological approach is able of working with a singular climate change meaning, the reality in communities and social groups is that public perceptions are diverse. As in the opening paragraph above, our communities indeed consist of kids and adults, mixed cultures, languages, and religions, varied educational backgrounds, an array of skills and expertise, leading to an understandably broad range of perceptions and understandings of climate change. *Shared meaning* about climate change is often missing, let alone a broad, convergent social mandate for climate adaptation. As such, adaptation strategies that proceed from external actors' knowledge, such as scientists or technical experts, may not adequately align with local perceptions of and responses to the issue which are often based on situated, lived experiences of how climate change is affecting livelihoods (Eriksen et al., 2015).

Ensor et al. (2019, p. 228) have described mainstream adaptation practice as "not asking the right questions," which in turn constrain adaptation to technical, on-farm adjustments, rather than recognizing the more complex entanglements of social, cultural, economic, political, and biophysical change. These scholars argue that alternative epistemological starting points for adaptation research and practice are essential for building more effective, transformative responses (Ensor et al., 2019; Nightingale, 2016). Other scholars critique the predominant focus of global change research on biogeochemical aspects and call for a more integrated approach, pointing to the lack of "a deeper focus on human-environmental interactions and the related feedbacks, which will be necessary to understand and achieve large-scale change and transformations to global sustainability" (Olsson et al., 2017, p. 1). For example, Lahsen and Turnhout argue that in order to ensure a "just transformation towards sustainability…bring(ing) the hard-won results of climate science to benefit societies…*attention must now center at least as much on the task of understanding and directing the dynamics of social and political change*" (Lahsen & Turnhout, 2021, p. 8).

A key point of departure in my approach to this study is that the current manner of adaptive responses to climate change remain incommensurate with its complexity and that the least well understood aspects of this issue—namely, its 'deeper' human dimensions—may be among the most important for effective adaptation. Resar and Swim (2011, p. 2), for example, claim that "the intra-individual and social psychological adaptation processes…powerfully mediate public risk perceptions and understandings, effective coping responses and resilience, overt behavioral adjustment and change, and psychological and social impacts." I sought a theoretical framework and study sites that would enable me to conduct an empirical study of these interwoven dynamics of climate change adaptation.

1.1 Climate change, coffee, and the role of global value chains in adaptation

This PhD was part of a larger research project entitled AdaptationCONNECTS in which adaptation and transformations to sustainability were studied in four work packages, one of which focused on coffee. My study began to take shape in 2016-2017, during which time I sought to find a research site and partner(s) that would best situate the dissertation for impact in a 'decade that matters' in terms of climate action. In meeting with key players in a large wholesale-retail corporation in the United States, I was invited to study climate change adaptation in the context of one of their global value chains (GVCs) for coffee.

Global value chains connect producing regions with consumers the world over through extensive production, distribution, and trade networks. As such, GVCs play an intriguing and central role in today's globalized economic systems (Gereffi & Fernandez-Stark, 2011). They may contain high potential for transformations towards sustainability; yet whether and how GVCs realize that potential is less well understood (Waddock, 2020). I was curious about the role of such GVCs in broader sustainability transformations, and so I sought to consider this coffee value chain as a possible site for transformation. Certain actors in this coffee value chain had been implementing an innovative approach in Guatemala that, upon first look, aligned well with the objectives of my own research. Coffee production has been substantially affected by unpredictable weather in Central America, which, added to already unsustainable market dynamics, put producers in a particularly precarious position.

Climate change threats to Arabica coffee production are significant, yet many of the impacts to date affect the producing end of the value chain. The retail side is more buffered from direct negative effects. Producers, however, face dramatic irregularities in weather patterns, such as droughts and disease, which stymie the production and result in great losses. Unpredictable weather patterns, dramatic temperature increases, and extreme weather events, such as drought or storms, disrupt the productivity and quality of Arabica beans and increase the spread of diseases like coffee leaf fungus (referred to as rust or *roya* in Spanish) (Jaramillo et al., 2009, 2011). For example, "In 2014, an unprecedented drought in Brazil caused the loss of nearly one-fifth of the country's coffee crop. Ethiopia is in the clutches of one of the worst droughts in 60 years. In Central America, an extended epidemic of coffee leaf rust has led to the loss of 1.7 million jobs" (Neuschwander, 2016). Arabica is the most prominent variety in Central America, is used as Specialty Coffee and provides approximately 70% of commercial production (International Coffee Organization, 2020). Yet, the productivity of specifically Arabica coffee is tightly linked to climatic variability which makes it vulnerable to climate change (Camargo, 2010). Arabica coffee grows best between 18ºC and 21ºC; when the temperature extends above or below this range, growth slows or even ceases (Davis et al., 2012). Temperatures overall have increased, such that coffee now grows at altitudes where it hadn't previously and the frequency of unusual, extreme weather events appears to be increasing and the apparent trend appears related to global climate change (Magrin et al., 2014; Tucker et al., 2010). In fact, research on the effect of climate change on the Arabica coffee plant has projected between a 65-100 percent decrease in Arabica production globally by the year 2080 (Davis et al., 2012).

While those future projections are dire, the present moment is also difficult. Many producers struggle to stay in step with these unpredictable weather patterns and the increases in pests and plant diseases, all of which come with increased costs of production at a time when the market price for coffee is low, in contexts which are marked by migration to regions of higher affluence, changing cultural and socio-economic practices, and increased overall environmental degradation. This is a significant concern for many inter-related sectors involved in the coffee trade. In Guatemala, it is a concern to particularly the small-scale producers for whom harvesting Arabica beans makes up a large portion of annual income and provides a pathway towards a better life. For

many of these smallholders, producing coffee is a key part of their livelihood as well as a cultural activity and a defining aspect of local identity (Tucker et al., 2010). The threats from climate change are also concerning for other actors along the global coffee value chain, such as buyers of the green beans through to roasters, retailers, and even consumers. Better understanding is needed on the entangled impacts of climate change as well as to consider the quality of collaboration needed to adapt, not just on these hillside farms but throughout the value chain itself.

Gaps in knowledge remain as to how and to what extent climate change will impact coffee growing in the Guatemalan highlands, and what ought to be done about this. First, there is localized knowledge about the impacts of climate change on coffee in this region, much of which has not been compiled and analyzed alongside research from other areas. Many of these impacts are entangled with other social, economic, and cultural changes occurring in producing regions, which can create interaction effects that are not well understood. Secondly, although possible adaptive strategies exist, they largely consist of technical solutions, such as crop substitutions and new agricultural practices, but technology does not necessarily provide cultural relevance or personal meaning, nor is it likely to stay ahead of the unpredictable impacts resulting from climate change. Local perspectives matter for finding out why climate change adaptation is important for actors in the coffee value chain, what adaptation could entail more broadly as a response to such unpredictable and entangled changes, and how greater sovereignty over climate meanings and ownership of the adaptation process could be fostered.

1.2 Homebase in human geography

Geography is a natural home of research that seeks to take a more interpretivist approach to climate change (Brace & Geoghegan, 2011; Demeritt, 2009; Hulme et al., 2009). In fact, it has been argued that global environmental change overall requires integrative research at this human-environment interface, positing that "geography is placed at the center of this emerging new transdisciplinary synthesis science" (Skole, 2004, p. 739).

In particular, Brace and Geoghegan (2011, p. 286) argue that "there is now a demand to understand *what climate change means* to so-called 'ordinary' people." This demand is driven in part by

disappointment in the 'deficit model'—namely, a model guided by an assumption that more climate science information or knowledge brought to the scientifically-illiterate general public will result in greater public engagement on the issue—which has not produced a sufficient social mandate for climate action. Proceeding from the discipline of human geography, in this study I take up the opportunity succinctly stated by Brace and Geoghegan (2011, p. 287):

> "to explore how individuals and communities understand climate and the ways it might change in the context of local landscapes and environmental challenges, researched as a lived experience with a unique set of geographies, lay knowledges, and participative practices."

A key purpose of this dissertation, therefore, is to respond to this need to account for the interacting human and biophysical/technological components and to better address the *subjective and intersubjective (which I will refer to as 'deeper' or 'interior') human dimensions*. These interior human dimensions include the subjective—individual, interior—and intersubjective—collective, interior—aspects of life, such as motivation, perception of agency, self- and social identities, worldviews, values, and meaning-making. Meaning-making—which defined in psychology as the process of how people construe, understand, or make sense of life events and experiences—is considered by some scholars to be 'first among equals' due to its role in organizing what people are aware of (Wilber, 2000). In sociology, these are considered "'deep structures' [that] operate 'behind the backs' of actors, influencing their views and preferences" (Geels, 2010, p. 497).

Despite the central role meaning-making processes play, studies on meaning-making are under-represented in the climate change adaptation literature. To address that gap, meaning-making processes became a primary focus in my dissertation. All these interior dimensions, however, correspond with personal everyday habits through to society's large-scale systems and structures, embedded across a range of unique geographies. The topic of this dissertation—how meaning, social processes, practices, and scale factor into how we understand and act upon climate change—is well addressed by human geography. Wrangling with this type of global environmental issue that touches many geographic locations in varying ways with myriad meanings is what human geography is well-positioned to do.

From this home base in human geography, to understand certain aspects of this multifaceted issue, I drew on different theoretical frameworks beyond their disciplinary perspectives, which is the defining characteristic of a *transdisciplinary* approach (Stember, 1991). Transdisciplinary in this dissertation is mostly theoretical, however, I do draw on Rigolot's references to transdisciplinarity as both an approach in search of a "unity of knowledge" as well as a "way of being" (Rigolot, 2020, p. 2). My use of transdisciplinarity draws on some of the principles of this "Mode 2 science," such as explained by McGregor (2015, pp. 6–7) and summarized as:

> "(1) knowledge is produced in the context where it will be applied;… (2) it has its own distinct characteristics beyond disciplinary knowledge; (3) …is heterogeneous in terms of skills, viewpoints and participants' experiences; (4) structures are seen as transient and evolving rather than rigidly hierarchical; (5) the resulting knowledge is socially robust and relevant for the actors involved; (6) the quality of the produced knowledge is ensured by adequate criteria and procedures" (Rigolot, 2020, p. 2).

This approach involves the mutual learning among scientists and practitioners about a complex, societally relevant problem (Rigolot, 2020; Scholz & Steiner, 2015). While an interdisciplinary study combines data from different perspectives (i.e. a stew), a transdisciplinary study seeks a unity of perspectives disclosed by but beyond disciplinary boundaries (i.e. a baked cake), such that the whole is greater than the sum of the individual 'ingredients.' Such a transdisciplinary approach would provide a way to organize my research questions, methodologies and data collection methods, and analysis for the study of an expanded, deepened understanding of adaptation.

I sought to conduct qualitative research at the synthesis of these aspects that are involved in climate change adaptation. However, such a synthesis became complicated from an ontological perspective. *What is real* is contested when it comes to climate change. On the one hand, there can be a broad range of subjective climate meanings across a society, constructed diversely by the consciousness and cultures of individuals. Yet on the other hand, climate science holds a singular objective truth about what this phenomenon is, involving rising greenhouse gas emissions and real impacts in ecosystems and societies worldwide. At the outset of this PhD program, I sought an

ontology that could include both the insights of social constructivism as well as positivism.

1.3 A word on ontology

'Truth' and 'what is real' is problematic with climate change. Alongside the scientific truth about the global warming phenomena, scholars find that "human behaviour is complex, contextual, social, and multidetermined… [such that] cognitive, emotional, and socio-cultural factors—as well as intuitive heuristics and ideological biases"—factor into people's perceptions of what is 'true' about climate change (van der Linden et al., 2017, p. 457). These operate in a somewhat cognitively-isolated manner, where uncomfortable emotional reactions can provoke people to edit what they 'know to be true' about climate change, as a way to protect themselves from it (Norgaard, 2006). Sometimes the 'truth' of science appears pitted against other cultural cognitions about climate change. This can be seen in quotes such as:

> "Individuals endowed with these critical reasoning skills… are not using them to form beliefs that are *true*. Rather they are using them to persist in beliefs that express their membership in and loyalty to opposing cultural groups, a dynamic referred to as cultural cognition." (Kahan & Carpenter, 2017, p. 310 italics added).

By pitting climate science against these alternate meanings, is to imply the latter are *untrue*. This raises an ontological tension; on the one side a universal climate science, and on the other, alternate renderings of climate change, based on belief, cultural inclusion, and social membership.

Both sides of this ontological tension have strengths but also limitations. A climate engagement strategy that assumes a singular, universal truth of climate science fails to adequately capture the other competing factors that weigh into how people formulate their perceptions and meanings about climate change. Also, holding climate science as the really 'real' can be perceived as arrogant, be off-putting, and can exacerbate political ideologies. For example, for faith-based populations it can be misaligned to the point of deterring them from being involved in or supportive of climate action. Finally, this approach subtly reduces other ways of knowing that are also important, such as indigenous perspectives and other cultural and ontological frames.

On the other side of this tension, other scholars consider the pluralism—or many truths—of climate change meanings (Hulme, 2009b). These researchers argue that climate change cannot be extracted from cultural contexts in which meaning is produced, and rather the social and cultural perceptions or 'entangled narratives' need to be accounted for (Paerregaard, 2013; Scoville-Simonds, 2018). These scholars try to account for the very localized ways that place, weather, climate and beliefs are lived by people worldwide, in which what is understood to be real is intrinsically constructed and contingent. Such *ontological pluralism* (Mercier, 2019) accounts for these culturally- and ontologically-unique framings of climate change and may ameliorate the above issues regarding climate science. However, continuing the line of thinking—i.e. that subjectivity, place-based knowing, and context-bound perceptions of climate change are sacrosanct, wherein for example weather change experienced by local people is seen to be no less 'real' than the climate change recorded by scientists (Ingold & Kurttila, 2000)—also may inadvertently contribute to the emergence of a post-truth culture. That is, a culture in which subjective truths are held relative to others, including scientific truth claims. This has opened the door to "alternative facts," "fake news," and overall the emergence of a post-truth world (Groves, 2019).

Into this space, come deliberate, organized attempts to "manufacture uncertainty" and doubt regarding climate science, diverting attention from overwhelming scientific consensus on anthropogenic climate change. Given that uncertainty exists in science anyway, this is not hard to do: "The complexity of science and the inescapable uncertainties surrounding scientific claims offer a rich landscape of opportunities to challenge science" (Oreskes, 2015, p. 3). This is not necessarily tied to any particular vulnerability in a certain faction of science, nor in a specific time period or cultural setting; rather, "a post-truth world is the inevitable outcome of greater epistemic democracy" (Fuller, 2016).

To summarize, on the one hand, we want ontological pluralism—working with the multiplicity of climate meanings and a range of subjectivities on the matter is key and cannot be discarded—not least of which would help galvanize full citizen participation in transformations to sustainability. Yet on the other hand, this can't be at the expense of climate science; the scientific consensus on climate change provides evidence that the climate change phenomenon is pushing our ecosystems

beyond the planetary boundaries that support life. I sought an ontological stance which could include both sides of this tension; the objective truths of climate science that brings forth a singular, universal notion of climate change, as well as the multiple, alternate renderings of what climate change is, wrought out by unique, context-based subjectivities.

To do so, I have drawn on *integral ontological pluralism* of Integral Theory (Esbjörn-Hargens, 2010a, p. 147). That may sound complicated, but it breaks down into five logical components, that I explain in greater detail in section 3.0 Theoretical Framework. Using integral ontological pluralism, and Integral Theory that it is part of, I was able to meaningfully include and integrate people's subjective constructs about climate change alongside the objectively-measurable rise of carbon emissions that disrupt the climate system and contribute to real impacts on ecosystems and communities, without collapsing on either side of that binary. I will go into further theoretical and empirical detail in the following sections.

In these pages and in the articles that follow, I seek to examine the perspectives of what climate change means both to individuals and social groups and explore possible inter/subjective processes towards shared meaning and greater collaboration. I take an integral approach to climate change adaptation, and propose that as a broader, deeper adaptation is carried out, the conditions become generated for transformative change. Using a transdisciplinary research design, I study a global coffee value chain—in which the perspectives, practices, positions, and power-dynamics differ across actors. Supply chains can be sites of interpersonal discord, inequity, and ideological strife; however, they can also have important mitigative influences for climate change and can become places of greater collaboration toward effective climate action. These coffee communities, and the larger value chain they are part of, provided a micro-context, or 'world within a world,' in which to study a broader, deeper conception of adaptation *as* transformation. I present various novel findings from empirical studies, with the aim to further the understanding of how integral adaptation might contribute more transformative responses to the climate challenge.

1.4 Research questions and articles

My two main research questions can be described as follows:

How does an understanding of and support for meaning-making (individually and collectively) better enable climate change adaptation to contribute to transformative responses across a global value chain? In what ways does Integral Theory provide novel insights regarding transformative responses to climate change?

Specific research questions included:

RQ1 *What does a developmental understanding of meaning-making offer climate change adaptation in a global value chain, both in terms of theory and practice?*

RQ2 *What frameworks, tools, and methods foster shared meaning amongst diverse perspectives on climate change adaptation?*

RQ3 *How can global value chain innovations in climate change adaptation be scaled to support transformations to sustainability?*

These research questions are significant insofar as greater inclusion of the psychology of climate change research—and specifically empirical studies on how to better understand and engage a variance of climate meanings across diverse populations—has been called for (Fielding et al., 2014; Gifford, 2011; Reser & Swim, 2011; Swim et al., 2009). Climate change differs from other environmental, risk, and health issues in that the causes are invisible, the impacts are largely distant or nonlocal, and the phenomenon is complex, carries uncertainties, and tends to become entangled with ideology and identity politics (Hochachka, 2020b; Hulme, 2009b; Morton, 2013; Moser, 2010). For this reason, integrative, social science research that aims to understand these complex, entangled, and interior (i.e. subjective and intersubjective) dynamics regarding climate change can help: 1) to explain the insufficient social mandate for meeting climate change commitment (Corner et al., 2018; Corner & Clarke, 2017; Whitmarsh & Corner, 2017); 2) to improve understanding on how to support shared meaning and collaboration between diverse actors (Esbjörn-Hargens, 2010a); and 3) to address and possibly resolve the psycho-social barriers to climate action (Gifford, 2011).

To answer these research questions, I specifically look at this global coffee value chain to study how individual meanings came together in groups and what the pathways towards shared meaning and greater collaboration might be. Tracing a global value chain (GVC) that links the production and trade of a single commodity enabled me to engage a range of actors—from coffee producers in isolated highlands of Guatemala through to exporters and buyers in Guatemala City to executives in retail headquarters in the United States. It also provided me a useful micro-context in which to examine the perspectives and interactions of actors across the different positions of the value chain—or, as Reichman (2007, p. 3) put it, the very "coffee bean brings an entire web of relationships into consciousness." This diverse range of actors emulated, in a micro-setting, the broader features of a global, North-South context, such as: differences in degrees of power and influence, differences in income from economic activity, differences in responsibility for carbon emissions, differences in exposure to climate impacts, differences in social identities and values, differences in educational backgrounds, awareness, and perspectives regarding climate change, and so forth. Studying pathways towards shared meaning and greater collaboration for climate change adaptation in such a diverse context would be cumbersome if working with a large global population, but was made more feasible by engaging just the micro-context of the value chain.

1.5 The layout of the dissertation

This dissertation is structured in two parts, with Part One describing the background context for the study (including case study sites, theoretical framework, and study design and methods) and with Part Two consisting of the five articles.

In section two of Part One, I describe the contextual background for the dissertation topic, namely, the coffee sector and political economy in Guatemala, coffee and climate change, and the social and ecological characteristics of the coffee communities in my study. In section three, I present the theoretical framework, including key terms, concepts and perspectives, that are foundational to my article collection. In section four, I outline the study design and the methodological approach including data collection and analysis. The chapter also includes a critical reflection on the limitations encountered in this study topic, as well as the ways I addressed ethics and validity.

Section five includes brief summaries of the five articles. Section six concludes with a reflection and synthesis of the overall findings of these articles for the broader discipline.

Part Two includes the articles. Table 2 presents the thesis at a glance, explaining how each article relates to my research questions, knowledge gaps, key claims based on results, and methods.

Table 2: Thesis at a glance. Mapping the core arguments of each paper

Research Question	**Knowledge gap/framing**	**Question explored in the article**	**Claims**	**Methodology and Methods**
Article 1: "Integrating the four faces of climate change adaptation: Towards transformative change in Guatemalan coffee communities." *World Development (published)*				
Main RQ How does an understanding of and support for meaning-making (individually and collectively) better enable climate change adaptation to contribute to transformative responses across a global value chain?	This first paper sought to broaden and deepen the theoretical approach to adaptation to account for the range of subjective and objective ways that people respond to change. The proposition guiding this part of the study was that engaging a broader, deeper conception of adaptation might set the conditions for enacting transformative change.	*Are these four faces of adaptation present in how people navigate complex change processes due to climate change, and if so, how are they relevant? What insight could be gained from this for possible application in other unstudied regions?*	Engaging a broader, deeper conception of adaptation through including subjective and objective dimensions, in both individuals and collectives, would better capture the range of ways that people respond to climate change and may also set the conditions for enacting transformation.	Case study research methodology, including key informant interviews, focus groups, document analysis, and site visits
Article 2: "On matryoshkas and meaning-making: Understanding the plasticity of climate change." *Global Environmental Change (published)*				
RQ1 What does a developmental understanding of meaning-making offer climate change adaptation in a global value chain, both in terms of theory and practice?	This endeavor to include more 'interior,' subjective human dimension into adaptation, discloses a broad diversity of perspectives about climate change. While *what* climate change means to people has been examined in the literature, there is less research as to *why*	*Why are climate meanings so diverse, and what does a developmental understanding of meaning-making offer climate change adaptation?*	People construe climate change differently in part depending on the perspectives they bring to bear in their meaning-making about it. I suggest that this is important and useful in understanding the spectrum of ways that climate change is construed, such that policy-makers and practitioners can better translate to those meaning-making frames and so that	Constructive-developmental psychology assessment methodology, applying the modified-STAGES assessment

	climate meanings are so diverse. This paper sought to examine the why using a developmental perspective that is currently underrepresented in climate change research.		local people can establish their climate actions in their sovereignty of their own meanings about it.	
Article 3: "Finding shared meaning in the Anthropocene: Engaging diverse perspectives towards greater collaboration on climate change" *Sustainability Science (published)*				
RQ2 What frameworks, tools, and methods foster shared meaning amongst diverse perspectives on climate change?	This paper turned attention to the implications of these complexities of meaning-making. The paper grappled with how shared meaning might be found amidst a diversity of views on climate change towards greater collaboration.	*How can a psychosocial approach to individual and collective meaning-making help address different, possibly conflicting, perspectives to support greater collaboration regarding climate change?"*	A psychosocial approach to climate engagement—one that engages both subjectively and intersubjectively on the complexities unique to climate change—is helpful in acknowledging an ontological pluralism of 'climate *changes*' amongst individuals, while also supporting a nexus-agreement collectively. This may in turn contribute to a more effective and ethical process of transformation.	Constructive-developmental psychology assessment methodology, using the modified-STAGES model, and co-generative learning research methodology, using photovoice and focus groups.
Article 4: "The transformative potential of scaling up, out, and deep: Global value chain innovations in a changing climate" *Ecological Economics (submitted)*				
RQ3 How can GVC innovations in climate change adaptation be scaled to support transformations to sustainability?	This paper examines how a niche-level innovation can scale across three dimensions (out, up, and deep) in a global coffee value chain, against a backdrop of climate change and other global challenges.	*How can a global coffee value chain move from niche innovations within its own trade arrangements to broader transformative change against the backdrop of the climate crisis?*	This paper claims that *scaling deep* (i.e. durably into new values, action logics, and culture) was as important as scaling *out* (i.e. structurally into changed institutions and policies) and scaling *up* (i.e. structurally into changed institutions and policies). It finds that including all three forms of scaling in a comprehensive approach may explain this GVC's ability to address certain key scaling dilemmas in its response to the COVID-19 pandemic as well as serve to position the GVC	Co-generative learning research methodology, drawing on focus groups, interviews, global value chain analysis.

			well in the face of the climate crisis.	
Article 5: "Unearthing insights for climate change response in the midst of the COVID-19 pandemic" *Global Sustainability (published)*				
Main RQ: In what ways does Integral Theory provide novel insights regarding transformative responses to climate change?	This paper considers the "so what?" of this research topic, demonstrating the significance of a more integral approach in our responses to global issues today, be that COVID-19, climate change, or sustainability more broadly.	*What insights might be found in examining the differences between responses to climate change compared to that of COVID-19, particularly when it comes to transformations to sustainability?*	This article claims that certain psychological aspects made the COVID-19 response accessible and actionable in a way that climate change is not: the mental demands for understanding complex issues; psychological distance and its impacts on motivation and agency; and finite attentional resources that can render certain issues as non-salient. The article draws four lessons for climate engagement.	Document analysis

2: Background

2.1 Guatemala: Human geography and political economy

As my plane soared above Guatemala, I marveled at this country's vast differences contained within this one country: I could see the heavily populated capital city banked by high volcanos peeking through clouds, rimmed by a mosaic of green agricultural farms. Extending between both the Pacific and Atlantic oceans, is home to twenty different Maya-speaking groups, which comprise half the population of the country (Lovell, 1988). Guatemala experienced the longest civil war in the region, that lasted 36 years until Peace Accords were signed in 1996. Today, while it is considered low to middle-income country, it has among the greatest income disparities amongst other countries in that category (Chase-Dunn, 2000).

It has been said of Guatemala, that "the complex patterns embedded within the landscape, culture, and political activities of the Maya peoples can only be interpreted through four and a half centuries

of periodic oppression, displacement, and 'cycles of conquest'' (Einbinder, 2017, p. 3). Guatemala experienced three decades of civil war waged by the state to retain the political structure in support of the oligarchy; whereas the Left on the political spectrum, and with them the impoverished indigenous population, sought greater equality, land reform, and democracy (Jonas, 1991). Guatemala has suffered incredible human losses upwards of 200,000 people and human rights atrocities that were charged as genocide. Yet the country never underwent a land reform and many of the root causes of poverty that were the impetus for the conflict remain in place today.

A prominent target group during this war were Mayan indigenous communities. In the highlands of Huehuetenango, the Mam make up over 80% of the population yet the indigenous worldview and culture has been decimated and marginalized, such that those who still practice these traditions may be hesitant to admit as such. However, the Mam language is spoken by many, the traditional dress worn by the women and some men, and traditional Mam traditional medicine and health care appear to be practiced based on what products are sold in the market. In other parts of Guatemala, there is a pan-Mayan movement arising to re-establish aspects of the cosmology and culture, and research being conducted as to what insights this indigenous worldview may bring to climate change action and adaptation.

Other social entities can be considered key actors in Guatemala, some that took key positions in its civil war which carry implications into the present day. The influence of the churches, for example, warrant mention. Guatemala, like many other Latin American countries, was predominantly Catholic due to colonization. The Catholic Church has had a varied history and a huge impact on Guatemala. Starting in the 1960s, certain liberation theology voices began to influence the Catholic Church, and through the 1970s-80s in neighbouring El Salvador as well as in Guatemala the Catholic Church became more vocal on the need for justice, the alleviation of poverty, and for greater equality for the vast majority of these populations. Their alignment with 'la gente' (or the people) put them in alignment with the Leftist movements, and the military framed them as 'communist' insurgents. Much of the work of the Catholic Church however included basic poverty alleviation and community-based organizing with legacies today of medical units and hospitals, schools and education programs, and other community supports.

In 1982, an Evangelical president, Efraín Ríos Montt, came into power. His short stay in power was a bloody one and left a particular mark on the country in terms of religion. Specifically, the Catholic church, despite being the long-held mainstay for the country's religion, became targeted by the military in the perception of it siding with the insurgents. Its followers were persecuted. The Evangelical church, on the other hand, became aligned with the state, such that conversion afforded new adherents protection from the civil conflict.

This is important in my dissertation in so far as these social currents remain present in today's organizational structures and cultures in the two case study sites. Such as, the propensity to organize collectively as a cooperative and to frame the struggle against climate change in a liberation or emancipatory manner is more typical of the regions which had had greater Catholic influence and historical struggle against injustice. Today, followers of these different religions and ontologies co-exist amicably; the small coffee organization that I studied, for example, has adherents to Mam, Catholic and Evangelical faiths, each which may carry distinct perspectives on an issue like climate change. Also, because the highland regions in Guatemala had marked legacies of the armed conflict (1954-1996) and now experience ongoing distrust of public institutions, many communities there came to be supported by a proliferation of NGOs and grassroots organizations during and after civil war. These non-state actors provided direct support to small growers to produce organic coffee and gain access to fair-trade and other alternative markets, which has created an important option for sustainable livelihoods (Eakin et al., 2006). The majority of small-scale farmers are part of a cooperative or an association, which assists with loans, guaranteed buyers, and efficient transfer of market or technical information. These social and economic supports will likely become important as climate change impacts increase and exacerbate the multiple stressors present for coffee communities in the country.

2.2 The role of coffee in Guatemala

Coffee is among the most important exports for Guatemala, where upwards of 30% of the workforce is involved in coffee production (Fischer & Victor, 2014). The coffee-producing region of Guatemala has seen a pronounced political economic shift in coffee production over the last few decades. The large coffee plantations owned and operated by the traditional Guatemalan

coffee elite had largely harvested *Coffea canephora* or Robusta beans for Prime and Extra Prime coffees. These relatively low-altitude varieties, grown at 700–900 meters (2,500–3,500 feet) above sea level, are the commodity-grade at the low end of the coffee value chain. However, consumer tastes in coffee have shifted to the high-end 'specialty coffee' (Fischer & Victor, 2014). Specialty coffee is grown at higher altitudes, the best above 1,400 meters (4,593 feet), and consists of *Coffea arabica* or Arabica coffee beans. Demand for the high-quality Arabica beans has grown steeply and now makes up the majority of coffee exports (Fischer & Victor, 2014).

In concert with these changing consumer preferences, the commodity-grade lower-altitude plantations formerly synonymous with coffee production shifted to cultivate other products, and coffee production moved into the highlands where Arabica specialty coffee could be cultivated. The highland region is inhabited largely by poor, indigenous populations. To fill this emerging market niche, specialty coffee is now cultivated by mostly smallholding farmers on the vertiginous slopes of these highlands. Smallholder coffee production is a family enterprise, with spouses and children providing important labor inputs, and this enables them to self-exploit to be competitive in the global market with low labor costs elsewhere. In much of Latin America, women do not directly participate in coffee production, however in some parts of the region, including in parts of Guatemala, it can be an important vehicle for women's empowerment and income-generation (Gallagher et al., 2020), particularly in poorer households where necessity has become a driving force to challenge gender stereotypes (Nelson & Pound, 2009). For example, in one of my case-study sites, shifts in gender roles had occurred in part due to losses during the civil war and also through migration of men to the United States, such that today women are centrally engaged in production. Although this increase in highland Arabica coffee production was precipitated by global market forces, it is also now a choice based on local people's own desires and preferences, and on what it means for them as they pursue their visions of a better life (Fischer & Victor, 2014).

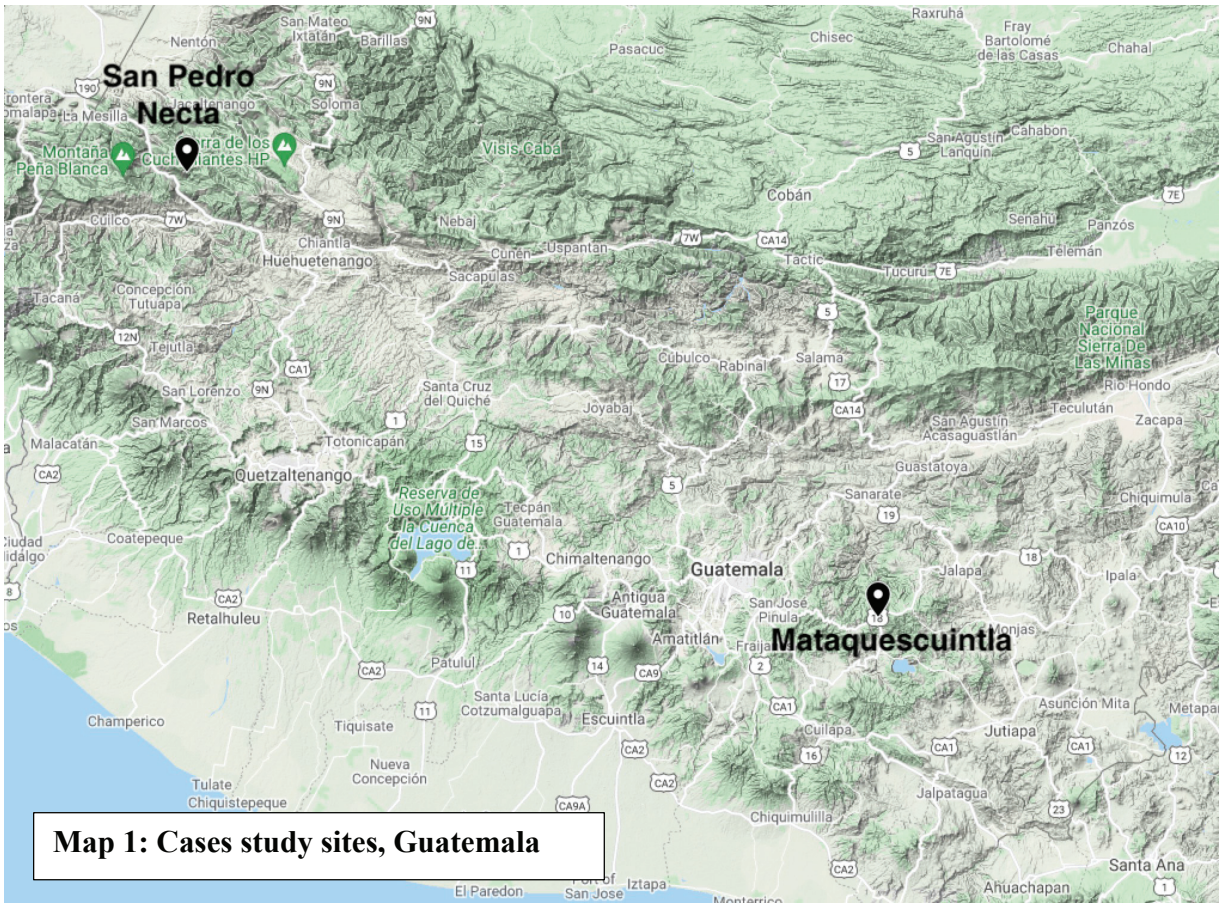
Today, it is estimated that more than 50 percent of Guatemalan coffee production comes from smallholding producers, the vast majority being Mayan and identifying as indigenous. The rural Mayan populations suffer disproportionately from poverty and lack of access to land, education, and health care (Fischer & Victor, 2012). Unlike the large low-land farms that produced commodity high-yield Robusta coffee, the producers who now grow Arabica specialty coffee are

mostly small-scale Maya and Ladino farmers in the highlands (Fischer & Victor, 2012, p. 16). As such, coffee production provides these smallholding farmers both an end in itself—to expand and increase coffee production—as well as, perhaps more importantly, as a means to other ends, a way to achieve a better life as they themselves conceive it.

2.3 Coffee communities and climate change

Arabica coffee, however, faces significant threats to sustainable livelihoods, given it is a confirmed climate-sensitive species, far more vulnerable to climate impacts than the lower-grade options, and this is already presenting significant ecological, social, and economic challenges for producers (Davis et al., 2012).

My study included two coffee communities in Guatemala, beginning in Mataquescuintla, Jalapa, that had a long-standing relationship with the buyer. I added a second region, San Pedro Necta, Huehuetenango, through more purposive sampling. See Map 1 and Table 3.



Adding this second site ensured more representativeness of communities that produce coffee in the country, including both a region of greater affluence, higher technology, and proximity to a city (Mataquescuintla) as well as a region that experiences greater overall poverty, lower technology, and is more distant from the urban center (San Pedro Necta). While the core characteristics of these two case study sites regarding coffee production are similar, the regions differ in marked ways, which became important in terms of the farmers responses to climate change and their selection of adaptation strategies.

I discuss their characteristics in detail in the first article in Part Two. Here, I introduce these regions in a high-level manner for purposes of the overall narrative of the dissertation, focusing particularly on their similarities when it comes to their challenges in dealing with low coffee prices, shifting consumer preferences, and the impacts of climate change.

Both communities are located at an altitude (approximately 1500 feet above sea level) that supports cultivation of *Arabica* coffee production on the surrounding hillsides (Table 3). This is a main income-generating activity for both locations, each with multi-generational histories of coffee cultivation. Both communities reported an array of negative impacts of a changing climate on Arabica coffee production. Aside of those commonalities, however, these two regions could be considered 'most diverse' cases with important spatial, historical, and ontological differences (see 4.2 Background to the Case Study Sites; Hochachka, 2020, pp. 5-7), making these sites interesting to compare.

In both regions, coffee farmers used emigration and income earned abroad as a strategy to manage risk in the coffee market. This is an important point, as it stretches the human geography outside of the borders of a single country, and creates a networked strategy for savings, investment, and survival during times of crisis in the coffee market. This rising importance of migration has created a transformation in the local economy in which a productive class of coffee producers is now mixed with people linked with the migrant economy (migrant smugglers, returned migrants, families with kin abroad) (Reichman, 2007). This has enabled some women to move into leadership roles, with greater economic and political empowerment, and it has enabled some landless people to secure greater upward mobility. However, there are mixed impressions regarding this migration, variable cultural and socioeconomic impacts, and concerns that it has

Table 3: Case Study Sites
(Instituto Nacional de Estadistica Guatemala, 2018)

	Mataquescuintla	***San Pedro Necta***
Population	41,818 inhabitants	38,510 inhabitants
Distance from the capital	Jalapa Department, 2.5 hours from the capital	Huehuetenango Department over 9 hours from the capital
Ecosystem type	Dry Corridor ecosystem	Western highland ecosystem
Demographic	Largely non-indigenous Ladino population (98.7% of total inhabitants)	Largely indigenous Mam population (82% of the total population)
Place in value chain	*Medium- to large-scale* coffee producers	*Small-scale* coffee producers

increased due to food insecurity as a result of climate change. The drivers for this emigration come down to poverty and access to the means to make a viable livelihood in one's own country. This also relates with the broader development trajectory of Guatemala, which has been shaped by a history of war to protect the oligarchy and private sector interests.

2.4 Adaptation and the role of global value chains

As the impacts of climate change increasingly disrupt coffee production, they in turn have cascading effects in coffee-growing communities. How producers are responding to these impacts and in what ways they are adapting, are important questions to consider.

The IPCC (2014, p. 5) defines adaptation as "adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." Proceeding from this definition, "mainstream adaptation approaches" (Ensor et al., 2019, p. 228) tend to be predominantly techno-managerial, that is, what new technologies are needed and / or how policy-makers can manage more adaptive behaviours "to reduce climate-related risks to things we value" (Dow et al., 2013, p. 305). This also remains reactive to the impacts of climate change rather than being consciously purposive in terms of addressing the root causes of what is causing such impacts and finding alternate forms of development. Such mainstream adaptation practice inadequately engages changes in social arrangements (O'Brien, 2018), and as such have been found to be incommensurate with the full complexity of the climate change issue (Ensor et al., 2019; O'Brien, 2016; Ziervogel et al., 2016). Scholars have noted the need to move from a reactive adaptation that conforms to climate change to a more deliberate, conscious transformation that contests it.

Transformation is defined by IPCC (2014, p. 5) as "a change in the fundamental attributes of natural and human systems," which challenges the status quo and maps forward a more sustainable developmental trajectory. There are important differences between adaptation and transformation, and how they relate and are connected is not clear. On the one hand, adaptation—even in its "transformational" form (IPCC, 2014b, p. 27)—remains largely focused on efforts taken to respond, accommodate, and *adjust better* to climate change conditions; whereas transformation,

on the other hand, seeks to shift the developmental trajectory towards, "strengthened, altered, or aligned paradigms, goals, or values…for sustainable development" (IPCC, 2014, p. 5). Considering *how* to connect these two endeavours of adaptation and transformation, as well as *where* to do so, are important angles to consider.

Food systems link the world, akin to its nervous system, and are thus viable sites for studying the relationship between climate change adaptation and transformations to sustainability. Global value chains move products between producing and consuming regions—from source to table, between Global South and Global North, amongst countries that are net carbon emitters with countries that bear the brunt of climate change impacts—weaving the world together by extracting products in one region and distributing them to other regions elsewhere. Climate change will affect various aspects of food systems, such as agricultural yields and earnings, food prices, reliability of delivery and food quality and safety across the board (Vermeulen et al., 2012). Yet there are disproportionate impacts on different segments of these global value chains, with low-income producers particularly being more vulnerable and having less comparative financial and institutional ability to adapt. Moreover, "incremental adaptation may be inadequate to deal with rapid shifts and tipping points for food production under climate change" (Vermeulen et al., 2018, p. 1). Adaptation, if defined and practiced more broadly, may help take into account the full complexity of this issue as well as the trajectory of development that is implicated in this issue and our responses to it. It may also assist actors to consider not just farm- or firm-level adjustments to a changing climate, but also broader, multi-scale, and also multi-dimensional strategies of transformative change. For these reasons, I saw a viable potential to study climate change adaptation within these food-trade systems, specifically coffee as a case study.

3: Theoretical framework

3.1 Integrating interiority to enact adaptation in a transformative manner

Given the complexity of climate change, I sought a theoretical framework able "to facilitate the integration and synthesis of knowledge toward a more complete understanding of the whole"

(Stember, 1991, p. 2); in other words, transdisciplinary. My reasons to seek such an approach is that the complexity of global environmental change issues—and climate change paramount within that—may require such a comprehensive response. That is, responses and actions regarding climate change are not mere economic, technological, nor scientific endeavors, and rather the "causes, consequences and responses to global environmental change [are also] fundamentally *social* in nature" (Unesco & International Social Science Council, 2013, p. 4). Given that very notion of the Anthropocene is that *humans* have taken center stage as a driving geologic force, frameworks to rigorously include and study the human dimensions of global environmental change issues makes sense. Yet, among the most critical questions for climate change research is *how* to facilitate the transformative changes necessary to avoid catastrophic climate change and its projected cascade of social-ecological impacts (Fazey et al., 2018).

Hulme (2009a, p. 42) points out that while a modern view has tried to render climate change mainly in physical terms as a technical problem to be solved, in fact it presents a more complex psychological, ethical, and even spiritual challenge:

> "rather than starting with (scientific) ignorance and ending with (scientific) certainty, telling the story of climate change is in fact much more interesting. It is the unfolding story of an idea and how this idea is changing the way that we think, feel and act."

To engage the climate change issue as such requires a way of stretching across and between disciplinary boundaries, drawing when and where necessary on science and technology as much as on morals and meaning.

I turned to Integral Theory for such a transdisciplinary framework, which has been applied to a range of global environmental change issues. While the main philosopher Ken Wilber did not work as an academic, numerous scholars have tested and developed this framework in regards to sustainability science (Shrivastava et al., 2020), sustainability (Brown, 2006), ecology (Esbjorn-Hargens & Zimmerman, 2009), sustainable development (Hochachka, 2007, 2009), and climate change (Esbjörn-Hargens, 2010; Sean Esbjorn-Hargens, 2010; Morgan et al., 2012; O'Brien & Hochachka, 2010; Riedy, 2008).

In this section, I describe this theoretical framework. First, I describe an integral ontology in more detail. Then, I explain how this framework proposes a disciplinary integration of subjective and objective domains. Finally, I apply this to an understanding of transformative change, describing certain heuristics and concepts that I used in my study of meaning-making.

3.2 More on ontology

As I introduced above, climate change presents an ontological challenge. As Hulme (2009a, p. 41) describes, unlike the scientific consensus on climate change, "there is no comparable consensus—no single perspective or vantage point—that allows us to understand what this kaleidoscopic idea of climate change means for us and our descendants." Proceeding from a singular scientific sense of climate change doesn't get far before it comes upon a high social variance on the matter—"science may be solving the mysteries of climate, but it is not helping us discover the meaning of climate change" (Hulme, 2009a, p. 41)—yet honouring every unique perspective can lead to an extreme relativism which can obfuscate efforts to spark and sustain global climate action.

Integral Theory provided a way to include social meaning but without losing sight of the science, offering a way to make ontological room for both subjective and objective truths. This ontology influences my research design and strategies, methodologies, and data collection, and so is worth outlining here, through a focus on five key points.

Firstly, Integral Theory *acknowledges objectivity (exterior, tangible aspects of life) and subjectivity (interior, intangible aspects of life), in both individuals and collectives,* such that both climate science and subjective meaning can be honoured and included. The integral framework is *transdisciplinary* in this sense, as these perspective-dimensions operate by different methodologies and validity claims (which I explain further below in this section). Ontologically speaking, this helps gets past the either/or binary of objective science versus subjective meanings, and construes climate change as "a hybrid object—a combination of scientific third-person observations and cultural second-person meanings" (Esbjörn-Hargens, 2010a, p. 144).

Secondly, Integral Theory posits the objective world and the subjective mind are not separate nor are they pitted against one another, but rather they are intimately connected. “Matter is not lower, with consciousness higher, but matter and consciousness are the exterior and interior of every occasion” (Wilber, 2007, p. 220). Further, Wilber (2007) suggests that *there is no pre-given world independent of a knowing mind that perceives it*. In other words, what is ‘real’ is “*empirically contingent* (i.e., a product or ‘co-creation’ of the knowing-consciousness)” (Hedlund, 2016, p. 189). This is important insofar as it gets beyond metaphysical truth-claims which one is expected to believe blindly. When climate science is presented as a pregiven—something you will ‘bump into’ if you learn the climate science sufficiently yourself—it can end up in a category of ‘religion’ and metaphysics; which is why ‘do you believe in the science of global warming?’ becomes a question. However, if ‘what is real’ is held to be *empirically contingent*, then the question becomes, ‘what is climate change to you?’

Thirdly, because people’s meaning-making capacities change and develop through life, ontology (or ‘what is considered real’) is also prone to change across a lifespan (Hedlund, 2016, p. 189). One can approach this in various ways; here, what Integral Theory examines is how ‘what is real’ *is stratified in complexity based on people’s developing perspective-taking capacities* (Hedlund-de Witt, 2014; Lynam, 2012, 2019). With climate change, some views are more simplistic and construed in the present moment (i.e. unusual changes in weather, rain at unpredictable times, hail hitting crops) and others being more complex and construed in broader expanses of time (i.e. global atmospheric changes due to anthropogenic activities that release carbon emissions, which foster a range of varied impacts across domains and carry a legacy across generations). This occurs across a person’s lifespan as well as in a given moment among individuals in a group.

One important caveat to this is Wilber’s notion that phenomena can *subsist*—such as anthropogenic climate change—and not come to *exist*, that is, ‘*ex-ist*’ defined as “to stand out, to be known, to be disclosed” (2007, pp. 251–252), until a certain meaning-making apparatus is developed to perceive it as such. However, in the meantime, alternate meanings are indeed held about this phenomenon as construed by other (both earlier and also later) meaning-making frames—such as, as a change in weather, a faith-based conception, a pan-psychic phenomenon, an opportunity for realizing human potential, and so forth—*which are also real*.

Following on this, fourthly, reality is understood as "*pluralistic* (i.e., there are multiple ontologies and many worlds that may or may not referentially overlap)" (Hedlund, 2016, p. 189). Proceeding from this idea, Esbjörn-Hargens (2010a, p. 143) presents climate change "as a multiple object with overlapping and divergent dimensions," describing the various renderings of climate change that exist today. His work in this area comes closest to the ontological stance I take in this dissertation, what he terms Integral Pluralism. In other words, the reality of climate change co-arises with the minds that perceive it, is contingent on the experience of the perceiver, is construed across a range of greater complexity, which results in multiple climate change(s).

Fifthly, Integral Theory *emphasizes how ontology is a derivative of epistemology and methodology;* that is, 'what is real' co-arises with one's thinking and doing process. Integral Theory hesitates to disconnect these three, as an ontology without the other two can easily fall into precritical metaphysics (that is, the belief in a pregiven world that is, or ought to be, accessible to everyone). Regarding climate change not as a pregiven (i.e. *this is climate change, do you believe in it?*), it is understood as a construct that is co-created via a person's way of thinking and way of doing (i.e. *what is climate change to you?*). Depending on the perspective a person brings and the tools they use to generate knowledge, this in turn renders visible the many alternate ways to construe this complex issue. This points toward an alive, enactive, world-generating ontology (or, way of being), that is always in relationship with epistemology (way of thinking) and methodology (way of doing).

To provide an illustrative example, consider a climatologist, oceanographer, coffee farmer, coffee retailer, and human geographer in Table 1. Their epistemologies and methodologies differ and thus what ontologies of climate change are held also differ.

Table 1: Enactments of climate change. What climate change is differs based on one's position in a system and the perspectives and methods used (Esbjörn-Hargens, 2010a)

The Who (A generic profession or place in value chain)	**The How** (A representative method)	**The What** (A view of climate change)
Climatologist	Comparing tree rings	There have been cycles of drought over 500 years but patterns are changing and accelerating.

Oceanographer	Tracking algae blooms with increases in water temperature	Ocean currents bringing warmer air to Mesoamerica, such that we are getting close to a 'tipping point.'
Coffee producer	Applying more rounds of fungicides to coffee plants to keep on top of leaf-rust	Climate change makes costs higher than current prices for coffee, which threatens viability of coffee production.
Coffee retailer	Runs a cross-benefit analysis	Shortages due to climate change requires shifting to suppliers in less-impacted regions.
Human geographer	Interviews with Guatemalan farmers	Climate change is entangled with other socioeconomic and cultural changes.

Such an integral ontological pluralism provided me the conceptual scaffolding to include climate science alongside the broad, diverse pluralism of climate meanings, without collapsing on either side of that tension.

3.3 The four-quadrant framework

Here, I further examine how this might actually work from a theoretical perspective. Through its four-quadrant framework, Integral theory presents a rigorous way to include insights from both positivism (without falling into reductionism) as well as from constructivism (without falling into epistemological relativism). This framework includes the interior (i.e., subjective) dimensions on the left-hand and the exterior (i.e., objective) dimensions on the right-hand, of both individuals and collectives. Figure 1 applies the quadrants of Integral theory to adaptation, as a central *theoretical framework* guiding this dissertation.

These four quadrants represent irreducible perspective-dimensions of reality made up of the interior and exterior dimensions of both individuals and collectives. The four-quadrant matrix covers much of what is typically considered important in addressing a sustainability issue, such as: the systems (economic, technological, ecological), practices (habits and behaviours), culture (worldviews and values) and experience (meaning-making and awareness).

The right-hand quadrants refer to the exterior of the individuals and collective. The Upper-Right behaviour-change quadrant includes the training, dissemination, and uptake of new practices, skills, know-how or technologies by individuals. The Lower-Right systems-change quadrant

includes the structural changes carried out by collective entities (i.e. companies, sectors, municipalities, national governments, and so forth). Techno-managerial efforts to stimulate behavioural change makes up a large portion of adaptation strategies taken by governments. Structural changes to support that take up another large portion of resources and attention in climate change response, such as changes in the built environment that support lowering emissions (i.e. bike lanes, recycling facilities, net-zero strategies) or adapting to impacts of climate change (flood protection, cooling or heating innovations for buildings, new plant varieties).

The left-hand quadrants refer to the interior of individuals and collectives. The Upper Left perspective-change quadrant includes shifts in the mental models and meanings about climate change, as well as the personal practices people may invoke to work with strong emotions about climate change (such as mindfulness, self-reflection, or prayer). The Lower Left social-change quadrant includes the social processes involved in enacting, maintaining and changing culture, such as shared values, narratives, or discourse. While less emphasized overall in climate change response, these 'interior' (individual and collective) dimensions are important aspects, such that a key argument in this dissertation is that the balance between these Right- and Left-hand quadrants ought to be weighted more evenly and greater synthesis brought between them. Swim, et al., (2009, p. 27) for example explain:

> "Psychology can provide insights into the meanings of climate change to individuals and societies… Generally, people's understandings of climate change underlie their willingness to act, and to support public policies, in response to it."

Kempton (1991) elaborates on how people's pre-existing frames of reference or mental models will also affect their understanding, perception, and reaction to information about climate change, suggesting that because climate change is not typically experienced directly, its effect is mediated through one's interpretive frame.

Other human geographers have studied the interpretive and socially-constructed aspects of climate change, "examining political spaces for deliberate transformation, defined as social and discursive space that enables reflection, contestation and purposive action" in a climate adaptation context

(Manuel-Navarrete & Pelling, 2015, p. 561). Such studies consider how to embed climate change response in social, subjective, historical and political processes, concluding that "these issues of values and ethics, risk, knowledge and culture construct societal limits to adaptation" (Adger et al., 2009, p. 335). Brace and Geoghagen (2011, pp. 285–286) point out "engagement with critical and cultural theories…bring a different sort of interpretative leverage to questions about the human dimensions of climate change by focusing (broadly speaking) on the way space, power, identity and knowledge constitute social relations."

With these as prominent human geography examples, there are many other extant studies into the Left-hand quadrants of climate change—both the subjectivities and intersubjectivity of this complex issue—much of which links with the research in the Right-hand quadrants of greater climate action and systems. Evidence of studies across all four quadrants suggests that these are minimally necessary for a comprehensive study of this issue.

Figure 1: Integral theory provides an integrative research approach to study climate change adaptation (Esbjörn-Hargens, 2009; Hochachka, 2009; K. O'Brien & Hochachka, 2010; Wilber, 1996)

	Interior (Meaning of climate change)	**Exterior** (Science of climate change)
Individual	**Personal** (consciousness, meaning, experience) *Perspective change* *Involves:* subjective (interior individual) dimension of climate change *Includes:* mindfulness, reflection, self-awareness, perspective-taking exercises, meaning-making. *Validity claims:* sincerity, truthfulness *(e.g What does climate change mean to people and why? How do people make meaning of climate change, and why?)*	**Practical** (actions, behaviours, practices, technologies) *Behaviour change* *Involves:* the objective (exterior individual) dimension of climate change *Includes:* skills-training, capacity building, technical transfer, know-how. *Validity claims:* propositional truth (*e.g. What climate-action is needed, what technologies or practices can help to reduce emissions and/or to adapt?)*

Collective	**Culture** (shared meanings, social discourse, narratives) *Social change* *Involves:* the inter-subjective (interior collective) dimension of climate change *Includes:* climate change communications and engagement strategies, public consultations, community-based dialogues. *Validity claims:* mutual understanding, justness *(e.g. What social worldviews, shared narratives, and culturally-mediated emotions thwart or support a social mandate for climate change?)*	**Systems** (systems and structures) *Systems change* *Involves:* the inter-objective (exterior collective) dimension of climate change *Includes:* environmental impact assessments, engineering net-zero built environment, adaptation planning and design. *Validity claims:* functional fit *(e.g. What systems and structures could support the development of adaptive and low-carbon futures?)*

This framework is explicitly discussed in my first article on adaptation (Hochachka, 2021a); here, I pan out and share how this overall meta-theory has informed the larger dissertation in three key ways. First, I used it as a *transdisciplinary heuristic*, to help me make sense of a broader, deeper adaptation, and, within that, to help me to bear in mind that "all the interactions among the variables in [such a] framework cannot be rigorously drawn [but rather it may] help the analyst to better think through the problem" (Porter, 1991, p. 98). Secondly, I also use this framework—in concert with the three spheres of transformation heuristic—to connect an all-quadrant adaptation with a *working definition for 'transformation.'* Thirdly, I used it *to structure the overall research strategy and my choice of methods*, including the consideration of validity claims and to inform aspects of my data analysis, which I describe in the following section.

3.4 A transdisciplinary heuristic: Broader, deeper adaptation

Despite the commitments made by nations to curb carbon emissions, key challenges remain regarding public perceptions and narratives of climate change and how to build a broader social mandate for climate action. Fielding et al., (2014, p. 413) suggest that "the development and elaboration of a social psychology of climate change would be a cornerstone of such an approach…[and that] the theories, models, and research methods of social psychology can provide a powerful arsenal to complement the approaches of other disciplines." Yet, psychological

adaptation has been relatively neglected in climate change science (Reser & Swim, 2011), and so many of its insights are not sufficiently drawn upon in adaptation or other climate engagement.

One reason for this is the uncertainty about how to rigorously combine what are very different methods and their validity claims. The above four-quadrant framework helped me to include these varying aspects of adaptation, preserving insights from distinct disciplines *on their own terms* without reducing them nor excluding others. Each quadrant in Figure 1 consists of its own paradigms of knowledge-building. This approach attempts to honour the many perspectives brought to bear on phenomena, including them in such a way that they can relate and synthesize. The premise being that no discipline is 'smart enough to be 100% wrong,' the guiding inquiry becomes, 'what is true, but partial, in each perspective?' (Wilber, 1996).

Such a *principle of non-exclusion* can help to combine paradigms (and their disciplinary practices) in a rigorous and useful way (Wilber, 2006a). Each paradigm is taken on its own terms, based on its own social practices, methods, and validity claims (Figure 1), and measured in an internally-consistent manner. This differs from cross-paradigmatic comparisons—wherein a knowledge system is compared and judged based on validity claims from outside its discipline, and as such, risks disclosing incorrect information about a given discipline (Wilber, 2017).

That is, this framework provides a way to include the study of behaviour changes and actions that will be needed in a climate change context (UR quadrant), a way to understand the structural changes to support that (LR quadrant), and also the psycho-social dynamics of meaning, values and perceptions that support or thwart such climate action (Left-hand quadrants). I used this framework as a heuristic to sort and analyze my data, generate new questions and probe uncertainties, and to assist me in understanding the broad range of adaptations and responses to change that research participants described and demonstrated. For example, regarding climate impacts in coffee production, many producers described their adaptive responses in terms of technical changes on the farms. However, responses also included subjective forms of adaptation like positive attitudes and prayer as well as strategies for group problem-solving and mutual support, which didn't fit cleanly into a typical definition of 'adaptation.' Expanding and deepening

the definition of adaptation to include the four quadrants enabled these aspects of individual and community responses and strategies to climate impacts to be included.

As I sought to connect climate change adaptation with the emerging discourse on transformations to sustainability, I found myself leaning on the four quadrant-framework to understand *how these quadrants define, study, and understand transformative change.* This theoretical framework therefore helped me in understanding transformative change processes overall, which I will elaborate on in the next sub-section.

3.5 A working-definition of transformation: Towards greater complexity

The term 'transformation' is used variously and ambiguously throughout the climate change literature (Feola, 2015). Some suggest a single agreed-upon definition may not be possible or desirable and instead place the onus on those using the concept to be explicit about how they are using it (Fazey et al., 2018), yet the lack of empirical grounding and analytical clarity can hamper its ability to be used effectively (Feola, 2015). I admittedly found the current state of the transformations to sustainability literature difficult to navigate—that is, with the rising recognition that profound and significant change is needed to meet the climate challenge, many definitions have come forward to define and describe such transformations to sustainability, each emphasizing different aspects of the problem (discussed further below)—such that at a certain point, I intentionally focused my study on adaptation.

I sought to examine what a broader, deeper climate change adaptation might entail and how it could be engaged in a transformative manner, by considering and examining the dynamics and processes of 'how' transformation becomes generated, enacted, and scaled. I did consider possible shifts toward transformation in several of my articles, however I did not explicitly aim to foster such transformation nor adequately set up the study to assess for it. Here, I briefly define and describe what transformation came to mean to me in this dissertation, noting the relevance of this working definition for transformation in my articles.

3.5.1 What is transformation?

A wide range of definitions, ontologies, and methodologies exist for transformations to sustainability. I briefly review this varied conceptual terrain in order to get to a working-definition for this dissertation.

Bennett et al., (2019) note that the scholarship on transformations to sustainability originate from three distinct literatures, to which I add two more here. A first is the *transitions* literature has studied and mapped how long-term structural transitions might occur in socio-technical systems. This is seen to occur in a step-wise manner across scales from the micro-niche scale, through to the meso-regime scale, through to the macro-landscape scale (Geels, 2010, 2011; Geels & Schot, 2007), and will have a role in low-carbon futures (Geels et al., 2016). This has partially informed more recent work in the levers and leverage points for transformative change, which builds on this notion of step-wise change (Chan et al., 2020). A second area is that of *transformational adaptation*, which challenges notion of 'incremental adjustments' in favor of more truly transformational responses that contest the dominant social and political structures, not seeking to accommodate change but rather to address root causes and realize alternative futures (Ensor et al., 2019; Kates et al., 2012; Nagoda & Nightingale, 2017; Tschakert et al., 2016). A third area harkens from *social innovation and resilience theory* that views transformation as triggered by cascading crises, system's feedback loops, or sudden non-linear change that are characteristic of linked social-ecological systems (Moore et al., 2014; Olsson et al., 2017; Westley et al., 2013). A possible fourth area of the literature is that from which Bennett et al., (2019) write, namely *just transformations to sustainability*. This fourth area seeks to understand and engage transformation through an equity and justice lens, some of which is included in the other three areas, however in this fourth area, justice carries a central role in the design and delivery of transformative change work and perhaps stands unique in that regard.

I propose a fifth body of work on transformations is also present in the literature, which overtly includes a notion of personal transformation and integrates psychological processes of change. This is not at odds with the above conceptions of transformation, in fact there is substantial overlaps, but it adds a focus on *the actors, their agency, motivations, mental models, and interior*

processes of relating with and enacting change (de Witt, 2016; Fazey, 2010; Hedlund-de Witt, 2011; O'Brien, 2018; O'Brien & Hochachka, 2010; Wamsler, 2018; Wamsler & Brink, 2018). It is this area of the literature that I predominantly drew from.

Specifically, O'Brien's (2018) three spheres of transformation applied to sustainability presents a useful heuristic, as mentioned above (Figure 2). It has been referred to as a *process-ontology*, which is aligned with and partially informed by Integral Theory. While they are not synonymous, both models—the three spheres and Integral Theory—share certain important guiding propositions. Both: 1) include and integrate subjective, interior and objective, exterior phenomena and change processes, 2) submit that change needs to occur across all domains (i.e. referred to as 'spheres' or 'quadrants' in each model) in order to support a comprehensive transformation, 3) consider that the rates and process of change differ between these domains, and that 4) the 'interior' aspects (worldviews, values and paradigms of the personal sphere) tend to shape the other domains and as such may have important leverage on overall transformations to sustainability.

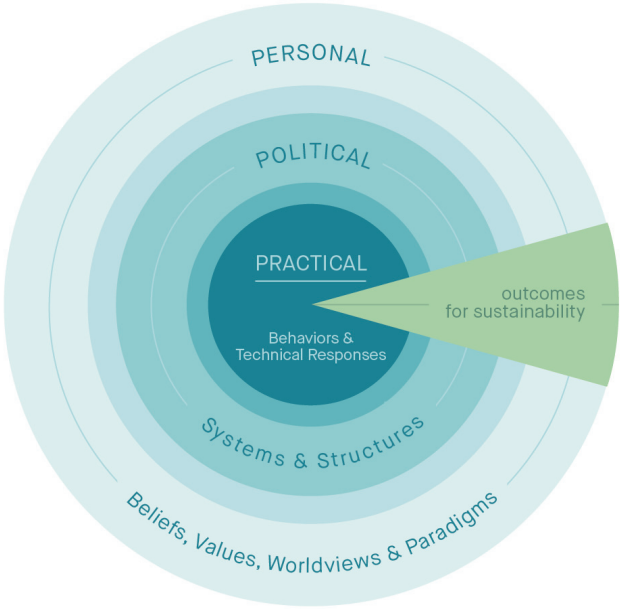


Figure 2: The three spheres of transformation
This heuristic depicts an integrated approach to fostering transformation across the Practical sphere (i.e. behaviours and technical responses), Political (i.e. systems and structures), as well as Personal (i.e. beliefs, values, worldviews and paradigms). (O'Brien, 2018).

In my applied research, I found that the quadrants of Integral Theory assisted me in research design and in data analysis, whereas the three spheres heuristic was relevant in discussing processes of change with actors in the field, to reflect on interactions between domains, and to consider "what can I (or we) do?". O'Brien (2018, p. 156-157) explains:

> "As a heuristic device, the three spheres of transformation draw attention to the relationships and interactions among the practical, political and personal dimensions of change processes…. The three spheres provide a simple and accessible way to think about social transformations."

She goes on to suggest that it could be used as an engagement tool with individuals and groups in which by using the three spheres heuristic, they can identify their own agency to effect transformation across these three spheres, rather than remaining passive 'objects of change' in more typical techno-managerial and policy-based approaches to climate action. The key overlaps between these two models described above were relevant to my study in terms of understanding the 'what' and 'the' how of transformations to sustainability.

Regarding the 'what' of transformation—proceeding from that which is common amongst *all* the above definitions—is that transformation entails a *profound, fundamental change* to set societies on a sustainable path. For example, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (*IPBES*) explains, "The sustainability goals for 2030 and beyond may only be achieved through *transformative changes, meaning fundamental, system-wide reorganization* across technological, economic and social factors" (IPBES, 2019, p. 14). However, what exactly constitutes 'fundamental change,' and how to know whether it has occurred, is less clear.

In considering this, I drew on one of the key founders of modern complexity theory, Ilya Prigogine, who's research found that open systems "evolve to higher and higher forms of complexity" (Prigogine & Stengers, 1984, p. 298). Or, as Wilber (2006a, p. 36) summarized, "time's arrow…is asymmetrically evolutionary," meaning that:

> "instead of a world where systems ran down and were subject to an ongoing deterioration, systems were found to be essentially nonlinear, dynamic and able *to transform themselves into new states of being*…[such that] the universe gets 'better' organized as it ages" (McMillan, 2003, p. 27 italics added).

What these authors suggest is that *fundamental change occurs when a higher order of complexity is established in a system.* Wilber refers to this as *a principle of unfoldment*; that is, in open systems, phenomena tends to move towards or unfold into greater complexity through evolution and development (Wilber, 2006b).

This concept has been applied in organizational change theory; van de Ven & Poole (1995, p. 515) explain, "according to life-cycle theory, change is imminent: that is, the developing entity… becomes progressively more realized, mature, and differentiated." They describe how:

> "the typical progression of change events in a life-cycle model is a unitary sequence (it follows a single sequence of stages or phases), which is cumulative (characteristics acquired in earlier stages are retained in later stages) and conjunctive (the stages are related such that they derive from a common underlying process)" (van de Ven & Poole, 1995, p. 515).

Wilber develops this idea with the notion of holons, or whole-parts, where an earlier whole becomes part of the next whole in nested degrees of hierarchical (or, more accurately said, holarchical) complexity, for example, "a whole atom is a part of a whole molecule, which is part of a whole cell, which is part of a whole organism" (Wilber, 2006a, pp. 5–6). This movement towards greater complexity occurs across various domains of life, where later complexity carries *greater depth;* that is, more complexity (i.e. a molecule has more depth than an atom; an oak tree has more depth than an acorn; an informational economic system has more depth than an agrarian system; a worldcentric perspective has more depth than an egocentric perspective). This move towards greater complexity is explained at length elsewhere.[1] Here, I examine it in the case of sustainability transformations.

This shift towards greater complexity and depth can be seen, for example, with Few et al.'s (2017, p. 5) descriptions of target outcomes for transformations to sustainability:

[1] This has been developed in depth by Wilber (1996, 2000), based on (Koestler, 1967).

> "Instrumental [which] focuses on addressing climate risk as an environmental problem; Progressive [which] targets reduction of differential social vulnerability to climate risks; Radical [which] tackles underlying causes of social vulnerability to climate risks."

On either sides of these, I would add 'Status quo,' which does not engage in change and is the least complex change agenda, and 'Paradigmatic,' based on Meadows (1999) claim that shifting paradigms may be potent leverage points for systems change, which demonstrates the furthest complexity in this schematic.

Each target outcome gets increasingly more complex by adding nuance, taking more dimensions (i.e. physical, technical, social, cultural) into consideration, demonstrating increasingly more networked-thinking, and further considering root causes and longer-term trajectories. The depth at which transformative change is sought increases with each one; each includes what was sought before but add to it with consideration of more perspectives—although that is not vice versa. That is, a Progressive target outcome for a transformation to sustainability would include Instrumental components and would build on Status Quo systems, but adds novel components, such as accounting for equity, vulnerability, and justice. That is not vice versa; that is, an Instrumental target outcome addresses climate risk from the perspective of it being an environmental problem but does not include social indicators of vulnerability, let alone further insights of the Radical and Paradigmatic target outcomes. This schematic is helpful in determining what transformation has occurred, based on the depth of complexity that is demonstrated.

For an example from my study, whereas the coffee cooperative in one case study region relied mainly on technical adjustments on farms in order to deal with climate change impacts (i.e. Instrumental), another coffee cooperative in the second case study region used such technical approaches in addition to investing in more equitable trade relationships in a fair trade organic certification that carried social and ecological objectives in addition to economic ones (i.e Progressive). Furthermore, the latter case study site was also involved in critically interrogating the paradigms of trade and contributing to a more deeply-rooted sustainability in terms of values and guiding action-logics in the value chain relationships (i.e. Radical, Paradigmatic). This

provides an example of increasing depth and, with it, increasing degrees of transformation potential in these coffee communities, set against a backdrop of the climate challenge.

Relating this with the three spheres, it becomes apparent that more depth across these examples also includes more awareness of all three spheres; the first instance primarily involving inputs in the Practical sphere, the second instance adding efforts in the Political sphere, and the latter instance also including efforts in the Personal sphere. The important point here is that this was additive, in which the efforts in the Practical sphere remained in place, while other efforts were added and integrated into the overall initiative. For example, as the GVC gained a shared sense of equity (Personal sphere), this provoked changes in relationships and systems (Political sphere), which also had practical consequences for farmers (Practical sphere).

Whether working with the process-ontology of the three spheres or the meta-theory of the quadrants, my working-definition of what transformation entails was guided by whether a shift in the depth of complexity of the system or initiative had occurred.

3.5.2 How does transformation occur?

This brings me to the question of 'how' transformations to sustainability occur. A central proposition that I present and empirically explore in my articles is that as changes occur in each of these *domains*—be it three spheres (O'Brien, 2018) or four quadrants (Wilber, 1996)—in a linked or integrated way, a greater possibility of transformation is generated.

The idea here is that change in one or two of the domains may not be enough to generate transformation. For example, a change made in the Practical sphere (such as, a company going from sourcing unsustainable to sustainable products) *on its own*, without an associated change in the Personal sphere (i.e. a new worldview and culture that supports this decision) or the Political sphere (i.e. instituting sustainable systems of trade and/or new purchasing policies), can be seen as a 'transition,' perhaps an incremental change, or a niche-development alone would be insufficient to be transformative. Similarly, a new idea in the Personal sphere guided by a new set of values or worldview *on its own*, without a linked-change in the 'rules of game' in the Political

sphere (i.e. involving the socio-political system or socio-technical regime in which that worldview becomes codified and made manifest), or the Practical sphere (i.e. involving new skills or practices) is not transformative. However, changes across all these spheres—such as a new set of practices, novel economic structure, and increased personal awareness or shifted cultural values—can increase the probability of a transformation to sustainability to occur.

Linked change across spheres or quadrants can be challenging because the *processes* and *rates* of change differ between them. It can be relatively swift, for example, to take up a new set of practices or to use a new technology but "to change [a] cultural worldview requires…a difficult subjective transformation of consciousness" (Wilber, 2006a, p. 38). These uneven changes across these domains create micro-tensions that, Wilber (2006a) suggests needs resolution for transformation as a whole to proceed. For example, he proposes that transformation in the techno-economic base which *isn't* met with changes in the associated worldview creates such a tension that could become a driver for change. This disconnect essentially creates a legitimation crisis in which "the *meaning structures* of that culture are no longer supported in a believable way" (Wilber, 2006a, p. 57). Because changes occur at different rates in each domain, *how this tension between them is managed and whether it is linked or integrated* can have a stimulating effect for overall change.

The technoeconomic base is considered among the strongest determinant of social consciousness and exerts structural influence on the individuals living within it, such that large-scale systems change will centrally be involved in how transformations to sustainability are fostered. Yet, systems-change processes require engaging with entities and structures of the Political sphere that were *intentionally designed to be stable*, such as laws, policies, and constitutions. As such, to remain in place and be sustained, any new value system or cultural norm will eventually need to be anchored in the political sphere, such as via a new set of policies, institutions, laws, and so forth. In article one, I examined the ways that this is occurring in climate change responses by the coffee producers in this study, referring to it as *critical-structural adaptation* that intentionally seeks to disrupt and reframe the systems of trade towards great equity and sustainability.

However, in Excerpt A, Wilber (2003a, pp. 33-66) also explains how transformation can also be triggered via an individual innovator who develops a new innovation, social practice, or

technology from a worldview of greater consciousness or depth. Eventually a small group of individuals—such as, actors within a global value chain—understands the idea wrought out at this greater depth and seeks to bring it forth first as a cultural micro-pattern. Sometimes, albeit more rarely, does this innovation then become a more established aspect of the socio-economic base and, when widespread adoption of new innovations occurs, it can create disruptive evolutionary forces. In articles three and four, I considered these subjective and inter-subjective dynamics towards shared meaning which in turn can impact broader—and deeper—systems change.

Riddell (2013) underscores the intense work that goes into forging such shifts, and she points to the need to draw more effectively on middle-range theories, such as, regarding the tensions between agency and structure (Giddens, 1984), and how innovations relate across micro-meso-macro scales in society (Geels, 2010). Regarding the latter, Geels' (2011) multi-level perspective describes relationships between the niche-level of a discrete innovation, with the meso-level of socio-technical regimes, with the macro-level of landscape pressures, including social norms and values. This became relevant to me in article four, exploring whether and how a GVC-innovation, as a new set of business practices (Practical sphere) manifesting at a great depth, might scale out, scale up, and scale deeply so to foster structural changes in the Political sphere or durable changes in the Personal sphere (i.e. social discourse (culture), and individual consciousness (self)).

While my working definition of transformation in its entirety was not included in the articles in this dissertation, this concept and framework contributed to my thinking and analysis throughout the study.

3.6 Meaning-making

I consider meaning-making closely in this PhD, which is a final concept that warrants elaboration in this Theory section. The term meaning-making refers to the way that people organize meaning about phenomena. Developmental psychology studies how meaning is organized and how that meaning-making process changes and develops across a lifespan. As this is a lesser understood dimension in climate change literature, I will explain certain terms and theory that I will draw on later.

Developmental psychology is the study of how psychological processes change over time and maturation (Cook-Greuter, 2004; Hochachka, 2019; Wilber, 2000). The complexity with which meaning has been organized can be assessed by analyzing written or oral expressions. Depending on what facet of consciousness is studied—be it meaning-making (Cook-Greuter, 2013), ego-development (Loevinger, 1966), value systems (Graves, 1970), morality (Kohlberg, 1981), or cognitive complexity (Kegan, 1998)—development has occurred when the previous stage has been transcended and included into a higher-order of complexity (i.e. a later stage) (Wilber, 2000). Each of these has its own methodology for assessment.

Of the developmental assessments available to me, I sought to work with the STAGES model for reasons I will explain in the Methods section below (O'Fallon et al., 2020). The STAGES model is an extension of the work of Cook-Greuter (2000) on post-autonomous levels of development, which in turn is an extension of Loevinger's (1966) model of ego development (also called 'leadership maturity'), all of which are statistically rigorous (Murray, 2017). STAGES defines 12 developmental stages across three tiers of increasing maturation and complexity, starting from the very concrete through to the more and more abstract. The complexity of how meaning is organized can be identified through analyzing texts (written or transcribed) using a guiding rubric. In Table 4 (excerpted from my second article) I include ten of these meaning-making stages and are relevant to my study (all of which is described in greater detail in Methods).

For now, the key point here is that development psychology considers transformation in meaning-making to have occurred when there is a demonstrable shift in the way that a person organizing meaning, towards greater complexity, expansiveness, inclusiveness, and nuance. Unlike a change in attitude or a change in an emotional state, a transformation of meaning-making typically is durable and becomes the 'center of gravity' around which meaning about many aspects of life is made (Wilber, 2000). While people can oscillate earlier and later than their center of gravity, and an individual will have more and less mature aspects of themselves, there will be an identifiable center of gravity (or a home base) that can be seen in their utterances and writing. Understanding this developmental perspective helps to shed light on what motivates people and why, what triggers

and hot-buttons to be watchful for, and how to best relate and resonate with how another person organizes meaning.

Table 4: Analytic framework to describe how meaning is constructed through lifespan, including preliminary application in the area of climate change adaptation.

Meaning-making / action logic (Kegan, 1998; Cook-Greuter, 2004; O'Fallon, 2013; Rooke and Torbert, 2015)	**Worldview** (Wilber, 2000) **Order of consciousness (**Kegan, 1998)	**What changes through growth and lifespan** (based on the STAGES assessment (O'Fallon, 2013)).	**Examples of how climate change adaptation would be construed and engaged.** (O'Brien and Hochachka, 2010; De Witt, 2016)
1.0 Impulsive: Concrete, individual, receptive: "if I bite my finger it hurts."	Magic worldview Imperial mind	Complexity of thought: atomistic Object of awareness: concrete Time: Immediate and momentary (earlier), view of the past (later)	Example: "I peed in the river, and the river is now getting back at me by flooding my home" (O'Fallon, 2018, personal communication).
1.5 Opportunist: Concrete, individual, active: Experience in the immediate moment what is happening to them, everything is an object but all objects are alive: their cause and effect would be perceived as magical.			
2.0 Rule-oriented: Concrete, collective, reciprocal: Opens a social dimension in which there is a more reciprocal way of viewing at the world, with an associated interest to know what others are thinking and a focus on making contracts, rules, and agreements.	Traditional / mythic worldview Socialized mind		Example: With a traditional worldview (or, second-person perspective), the climate change phenomenon would likely be construed as something in the hands of fate and more a matter of faith than science. Adaptation strategies would likely depend on what others were doing or what the rules and principles ought to dictate and would be applied in a parochial sense with localized strategies for survival.
2.5 Conformist: Concrete, collective, interpenetrative: Interpenetrates with principles which they will follow without question. This often includes the law of the land, so if practices related to climate change are the law they will often embrace them (e.g. recycling).			
3.0 Expert: Subtle, individual, receptive: Preliminary ability to take an objective view, such that responsibility, respect and other subtle ideas begin to arise from within the person (as such these ideas are cherished). Begins to see the future and see probabilities of what might happen.	Modern / universalistic worldview Self-authoring mind (early)	Complexity of thought: abstract and networked Object of awareness: subtle Time: past and future (early), multi-generational (late)	Example: A modern worldview (third person perspective), would likely understand climate change adaptation scientifically and economically and seen as a technical problem to be solved or the need for adaptation to be carried out as part of economic or technological progress.
3.5 Achiever: Subtle, individual, active: Can be strategic in planning, prioritizing of self-interests and achievements and with an emphasis on outcomes, results, and goals relating to future time; interested to measure what happens through time (hypothesis and testing, deductive thinking).			

4.0 Pluralist: Subtle, collective, reciprocity: It becomes apparent that the actions and interactions of humans with the environment cannot be separated from their context, and the socially-constructed nature of phenomena is recognized. Cause and effect depends on the situation and the circumstances. It is local, not universal.	Postmodern / pluralistic Self-authoring mind (mature)		Example: A postmodern (fourth-person perspective) would likely seek to co-create and collaboratively work towards climate change adaptation processes, as it is perceived that the future of the planet is in the hands of humanity, would view this critically and with greater emphasis on the power dynamics and systems injustices that create vulnerability and produce climate change.
4.5 Strategist: Subtle, collective, interpenetrative: Able to understand and sort contexts, climate change manifests contextually, but is adaptively complex and interconnected systemically, humans affect and recreate the ways that healthy systems interact with each other, and as such can reverse damage caused by human disruptions of natural complex systems.			
5.0 Construct-aware: Meta aware, individual, receptive: The constructed nature of reality is recognized on the whole, such that humans are seen not merely as actors in the system but rather their thoughts, ideas and beliefs about the system are constructing and shaping, as well as shaped by, its evolution and trajectory.	Integral / integrative worldview Self-transforming mind	Complexity of thought: systemic and meta-systemic Object of awareness: meta-aware Time: evolutionary both forward and backward in time, (including recognition of timelessness)	Example: An integral worldview would work towards adaptation in a trans-disciplinary manner; seeking to be aware of what people believe and how they construct meaning; ensuring that adaptive strategies can simultaneously meet the population where they are while providing some emergent ground for learning; would likely include researchers and practitioners as part of the process; and would let go of the idealistic desire for everyone to understand climate change the same way.
5.5 Transpersonal: Meta-aware, individual, active: The understanding that "my" belief and belief systems are individually constructed and often limiting—this allows people to go beyond them to individually create/construct unusual and unique solutions with an ethic behind them.			

There can be a tendency to misunderstand what these developmental frameworks actually describe. That is, developmental frameworks can be seen as hierarchical and can be seen to pigeon-hole or stereotype people. That is an erroneous understanding as I discuss in article two (Hochachka, 2019). Rather, they reflect the natural growth trajectories of meaning-making processes towards greater degrees of complexity through maturation.

A developmental perspective has been under-represented in climate change literature. While I understand that caution, I also argue that a developmental perspective when understood correctly and used ethically could be helpful in climate change engagement. I examine this in detail in article

two, three, and five. Specifically, it offers a unique explanation as to why climate meanings are so diverse in a given population, why some attributes and dynamics of this complex issue are missed by certain meaning-making capacities, and how those meanings change over lifespan. In article five, I apply a developmental perspective (along with other psychological lenses, namely, psychological distance and attentional resources), to understand the successes of the COVID-19 communications and to illustrate applications in climate change engagement.

4: Study Design and Methodology

This is a qualitative study of the meanings of and responses to climate change in two Guatemalan coffee communities, as well as the global value chain they are a part of, principally guided by action-research (Reason & Bradbury, 2008). I drew on three methodologies—case study research (George & Bennett, 2005), co-generative learning (Levin, 2014), and developmental psychological assessment (O'Fallon et al., 2020)—employing a range of qualitative methods such as interviews, focus groups, photo voice, and participant-observation.

I begin this section with a description of my research sample and participants. Then, I elaborate on my research strategy, and some aspects of the study that changed from the initial design. I go on to explain the three methodologies I brought together in this research, and then describe the methods used with each. I will conclude this section with a subsection on research limitations, ethics and diversity considerations.

4.1 Sample and Participants

My research sample included participants across a global value chain from the highlands of Guatemala to retailers in North America. The *downstream actors* in a global value chain consisting of buyers, retailers and wholesalers, whereas the *upstream actors* are considered producers, processers, and in-country merchants. Table 5 includes an overview of these participants and then the description that follows provides some context and explanation as to these different actors and their place in the value chain.

Table 5: Research participants in the global coffee value chain								
Upstream actors				*Downstream actors*				
Producers		Millers and Processers	Exporters	Buyer		Retailer		
Small-scale associated in cooperative	Medium- to Large-scale independent growers			In-country Merchants	Buyer in USA	Corporate sustainability	Corporate sales	Fairtrade organic

Coffee producers came from two regions of Arabica coffee cultivation in Guatemala (see Map 1 and Table 3). Those from Mataquescuintla, Jalapa were medium- to large-scale producers. Some producers in Mataquecuintla were members of *Colisena Cooperative of Non-Federated Coffee Producers*, a multi-purpose cooperative that has recently included coffee production and was used largely for political organizing in the face of complex socio-economic challenges for the sector. Producers from San Pedro Necta, Huehuetenango were small-scale producers, due to their size of farms as well as the family-manner in which coffee was produced. The latter group were organized in a cooperative, *Asociacion de Agricultore "El Esfuerzo" de San Pedro Necta (ASASAPNE)* which was fair trade certified. These cooperative members had a access to different kind of markets. I interviewed farmers who were cooperative members, as well as some of the cooperative staff, some of whom also operated coffee farms. Both regions were predominantly coffee-producing and had been for multiple generations.

I met both communities via my contact with the in-country merchant. He was Guatemalan, had worked with this buyer as the representative for Guatemala for many years, and knew a lot of actors, history, and present-day climate change realities that Guatemalan coffee farmers experience. Other actors in Guatemala included those involved in processing, marketing, and export. These individuals played a less central role as participants in this study, other than as participants in the focus group sessions.

Downstream actors included the wholesale-retailers who purchased this coffee and sold it across North America. Included in the focus groups were three individuals involved in the corporate sustainability protocols and processes, as well as two others involved in sales. In two other

informal meetings, I met two individuals who were with the buyer, based in the USA, and from those encounters primarily drew on participant-observation of their interactions in the group, articulated values and commitments, and so forth. I also met with a fair-trade organic retailer.

I sought to include a range of methods that would enable me to understand individual coffee farmer's experiences, responses, and perceptions of climate change, and of the group's processes towards finding shared meaning.

4.2 Research Strategy and Design

I used a strategy of Action Research in two over-arching ways (Reason & Bradbury, 2008). Firstly, in a *practical* sense by providing a process by which participants reflected on, and learned about, their own meanings about climate change and their own approaches to adaptation; and, secondly, in an *emancipatory* manner in facilitating focus groups to co-generate learning, critically evaluate, and reflect upon this challenge regarding coffee and climate change, as well as to consider the organizational dynamics and social context of the coffee value chain in addressing this challenge. While I focused my research primarily in the coffee-growing communities, as global value chains touch down in multiple locations across geographic space, I also sought to create opportunities for the multiple actors to convene as a whole value chain.

Certain changes to my original research design occurred as I became more familiar with this value chain and its actors, which is typical of a grounded approach to research. For example, while I had initially intended to conduct a global value chain (GVC) analysis at the outset, I ended up only lightly carrying out a GVC analysis in so far as I needed to understand the trade relationships in service of supporting other qualitative research interventions. For another example, I had also originally intended to conduct this group-work process as a collective impact intervention (Smart et al., 2017). However, collective impact is mainly used by practitioners to create population-level change on complex social issues but is not typically considered a *research* methodology. Instead, I designed that part of this study using co-generative learning methodology, which is considered part of action research (Levin, 2014), as I describe below. Finally, I knew I wanted to study the interior human dimensions of climate change, particularly meaning making, but at the outset I

didn't precisely know how I would do so. In the first year of the PhD program, I decided to pilot the use of a modified developmental psychology assessment (described further below) using the texts that are part of the photovoice data collection process. Photovoice involves participants in a subjective process of inquiry and interpretation, for the study of meaning-making about climate change.

My research design included three broad methodologies, depicted in Figure 6a and 6b, which provided me ways to study the different perspective-dimensions of this complex social issue. The articles related to specific and/or overlapping domains; with the solid arrows for the primary focus of the article and a dashed arrow for the secondary foci. Figure 3 gives a 'birds eye view' of how these research methodologies came together, and Table 6 lists each of these methodologies, the purpose for each, which data collection methods each involved.

In the following discussion, I describe each of these three methodologies in turn, then discuss data collection methods used, and finally turn to limitations and ethics of the study. Note that language was relevant in all aspects of this study, and so I address this issue under the sub-section, 'Limitations' below.

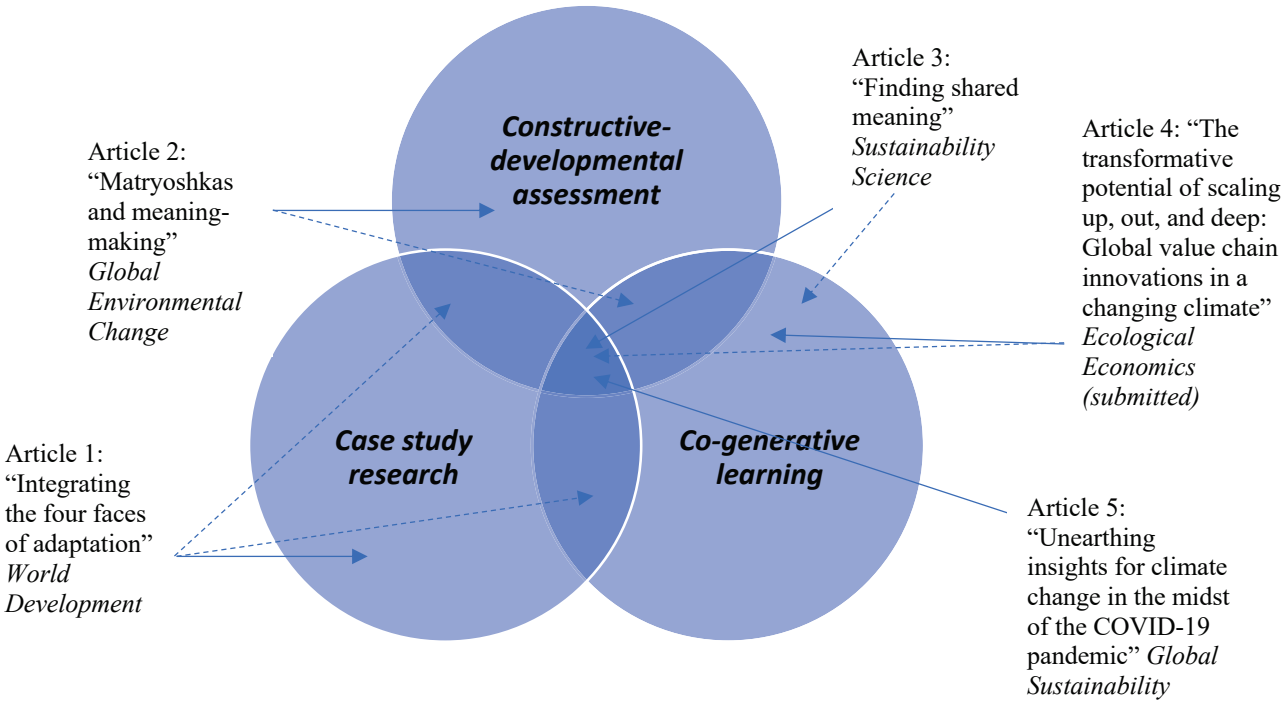


Figure 3: Three research methodologies provided unique lines of sight into a complex research phenomena that are examined through the five articles.

Table 6: An overview of methodologies and their purpose in the research design, as well as the data collection methods and their relevant limitations and ethics.

Methodologies	Purpose	Data Collection Methods	Limitations and Ethics (discussed below)
Case study methods	Purpose: To investigate complex social relationships in specific settings, structured as a pathway case study (Nome, 2007).	1. *key-informant interviews* 2. *participant-observation* 3. *focus groups* 4. *site visits*	• Generalizability, depth versus span, and validity claims • Challenges of interpretation, subjectivity, and language • Power, privilege, and positionality
Constructive-developmental psychology assessment	Purpose: To include and integrate the study of the subjective dimensions of climate change; namely, inquiring into what climate change means to participants and then looking at the patterns and constructs of meaning-making.	1. *photo voice* 2. *modified STAGES-assessment*	
Co-generative learning	Purpose: To orient the research in service of producing knowledge and greater understanding amongst a group of actors on practical problems for use in real-world settings; research towards collective impact.	1. *photo voice* 2. *focus groups*	

4.3 Methodologies

4.3.1 Case study research

I did case study research of two coffee communities in Guatemala to examine the complex, social-ecological realities that coffee producers face regarding climate change. As a qualitative research methodology in human geography, case study research is useful for investigating complex social relationships in a specific setting (Castree, 2005). Although it continues to need to defend its place in social science (Schwandt & Gates, 2017), many of the complex, 'wicked' problems today call for greater depth of situated knowledge and ways to formalize that knowledge as practical wisdom, which case studies are well-positioned to produce (George & Bennett, 2005; Schwandt & Gates, 2017). In part, I used case studies in an interpretive orientation, to describe and explain from the bottom-up how everyday practices in certain places are in turn connected with larger structures and processes (Schwandt & Gates, 2017). In another way, I also sought to use it in a more critical orientation, to understand the conditions that are necessary (i.e. structural) from those that are contingent (i.e. local, accidental, replaceable) (Blaikie, 2007; Cresswell, 2013), in an attempt to generalize causal explanations beyond the unique case at hand (Schwandt & Gates, 2017).

I structured my study as a 'pathway case study,' in which I aimed "to gain insight into the mechanisms" connecting the unique features of each case study site with their approaches to adaptation (Weller & Barnes, 2016, p. 430). I use abductive reasoning to tack back and forth, from meta-theory to empirical field work data, with the intention that data-grounded theorizing would support deeper understanding (Clarke, 2007; Danermark et al., 1997; Dey, 2004). This abductive approach helped me arrive at new insights from the grounded data to clarify aspects of the theory, and the theory itself has provided greater nuance and explication to empirical findings.

I applied heuristic Bayesian reasoning (rather than the full mathematical apparatus of Bayesian analysis) to 'mentally inhabit the world' of each hypothesis and assess which one makes the evidence more plausible (Fairfield & Charman, 2020, pp. 15–16); then, to consider the pathways to these different outcomes and what insights could be drawn from their differences (Fairfield, 2013; George & Bennett, 2005). This is explained in detail in article one.

4.3.2 Co-generative learning

The second methodology that I drew on was co-generative learning, which brought a participatory dimension into my study. This proceeds from a general belief that participatory democracy is necessary as a way of solving social problems that involve multiple contexts and actors. The focus is on the mutual learning that takes place when local 'problem-owners' (or insiders) and facilitating researchers (i.e. outsiders) come together to solve complex problems (Levin, 2014). A guiding assumption is that complex problems cannot be known from external actors only, nor from any one perspective, and thus greater insight and impact can be generated in a collective process.

While I had initially conceived of this in a Collective Impact frame, I ended up using a more research-style methodology (further explained below); however, I retained aspects of the philosophy underpinning collective impact. Collective impact is based on the premise that more effective approaches to addressing complex problems are those that involve broad stakeholder collaboration across sectors. The goal is often population-level, or systems-level, change. The theory behind collective impact is "that large-scale social change comes from better cross-sector coordination rather than from the isolated intervention of individual organizations" (Kania & Kramer, 2011, p. 38). Kania and Kramer (2011) note how some companies are beginning to explore collective impact to tackle social problems within their supply chains, providing Mars' cocoa value chain as an example. Such collective impact initiatives are designed to be long-term commitments in which collaboration amongst stakeholders arrive at multi-sided solutions to complex problems (Sagrestano et al., 2018).

While this inspired my research design, when it came to conducting this study, I realized that as a PhD student, I was unable to both put together a true Collective Impact project over the lengths of time typically undertaken for that, as well as also to try to study collaborative process within it. Instead, I drew on the overarching intention that collective impact provides but focused more concretely on the co-generative learning methodology in my research.

Co-generative learning is an action research methodology that seeks to convene learning arenas in various ways with different actors. A key aim of co-generative learning is to bring forward and legitimate diverse and sometimes divergent experiences and perspectives on a mutual issue of concern, and to facilitate dialogue and learning about it amongst actors. One of the challenges in this is to create a 'communication arena' or process that serves to surface the different perspectives amongst the

participants. This is where photo voice—as a data-collection and data-sharing method—was important for local producers in the coffee value chain to raise their insights and share their knowledge about climate change and coffee, regarding which many other actors in the value chain had not heard about before in quite that way. As such, it provided a useful starting point for subsequent discussions.

4.3.3 Constructive-developmental assessment

I used *constructive-developmental assessment* to study what climate change means to participants, analysing the patterns and constructs of meaning-making. A psychological construct refers to the system of meaning that humans hold to understand their world and experiences (Raskin, 2002). In sociology, that is explained as an approach to study the "deep structures' [that] operate 'behind the backs' of actors, influencing their views and preferences" (Geels, 2010, p. 497). These taken-for-granted deep structures are important in a climate change context: not only because ideology often dovetails with perceptions about climate change, but also because often only a fragment of the full abstract concept of climate change is understood by people, from which a mental model of 'climate change' is then built. In part for this reason, climate change has been described as an *evolving construct* that has changed over time and constructs of climate change are varied across a given population in any given moment (Breakwell, 2010; Hulme, 2009b). This is by no means a mere academic consideration, and in fact, it could point to a large part of the reason for the fractured social opinions, values, and positions regarding climate action.

However, the empirical study of "climate change as an evolving construct" is less prominent in the literature; and when it is, seldom is it integrated with other natural science findings or in policy recommendations. Constructivism, or the study of how people are "actively constructing knowledge, in their own subjective and intersubjective realities and in contextually specific ways" (Hershberg, 2014, p. 2) can be considered part of action research, particularly in its critical expressions, in which a researcher can challenge authoritative or dominant accounts of the world by researching and disclosing alternate constructions of that very world. Guba and Lincoln (2005) posit that reality is known through multiple mental constructions of it. A participatory or action research process highlights this subjective and intersubjective knowledge of the world, arguing that it results in more viable knowledge and action.

4.4 Data Collection Methods

Within these three broad methodologies, I drew on various data collection methods. Some of these (such as focus groups) were used within all three of the above methodologies, however others (such as modified STAGES assessment) were only applicable to one.

4.4.1 Focus groups, participant-observation, interviews, site visits

Methods included key informant interviews, site visits, participant-observation, and focus groups, which were conducted in Spanish.

I did 40 interviewees (30 formal, 10 informal, Table 7) with actors across the value chain (Table 5). These interviews were semi-structured and often accompanied by a site visit to the producers' farm, wet mill, or workplace. After securing the consent of interviewees and assuring confidentiality, the interview sought depth over breadth. Interviews covered a range of topics after demographic information, including 1) interviewees backgrounds and current practices in coffee production, 2) their perspectives of impacts due to climate change, and 3) their current and anticipated responses to these changes. The second set of questions frequently led to responses about broader and entangled changes in the region, in which respondents shared their views about the natural world and its changes, and their roles/responsibilities in such change. Sometimes I prompted the interviewee with follow-up questions, such as ''How do you feel about that?", and I also included some 'blue sky' questions in the third set, such as ''Imagine into the future when you are a grandparent (or an elder), what would you advise your grandchildren (or younger people) about climate change?", which has been found to be helpful in reframing an issue more broadly (Berger, 2014). I also found that as people shifted their perspective to consider climate change in relation to their children and grandchildren, they became more personal and reflective in their answers, which was helpful for eliciting personal (subjective and inter-subjective) perspectives.

Table 7: Sample demographics

Interview Data:	***Formal interview:***	***Informal interview:***
Small producer	11 (6 women, 5 men)	
Medium/large producer	11 (1 women, 10 men)	
Intermediary		1 man
Farm worker (migrant)		1 woman
Farm worker (permanent)		1 man
Cooperative employee	4 (3 women, 1 men)	2 (1 women, 1 men)
Buyer	2 men	
NGO	1 man	
Technical specialist		2 (1 women, 1 men)
Exporter		2 men
Retailer	1 woman	1 man
Total:	*30 formal interviews (11 women, 17 men)*	*10 informal interviews (3 women, 7 men)*

Focus Group Data:	***Numbers:***	***Location:***
Information focus group, 2017	12 (2 women,10 men)	Mataquecuintla
Information focus group, 2018	12 (12 men)	Mataquecuintla
Information focus group, 2018	10 (8 women, 2 men)	San Pedro Necta
Information focus group, 2019	10 (8 women, 2 men)	San Pedro Necta
Information focus group, 2019	4 (2 women, 2 men)	North America (virtual)
Synthesis focus group 1, 2018	11 (9 women, 2 men)	San Pedro Necta
Synthesis focus group 2, 2019	10 (9 women, 1 men)	San Pedro Necta
Synthesis focus group 3, 2019	10 (9 women, 1 men)	San Pedro Necta
Sharing focus group 1, 2019	20 (11 women, 9 men)	Guatemala City
Sharing focus group 2, 2020	26 (11 women, 15 men)	Participants from all regions (virtual)
Total:	*8 focus groups*	

I conducted ten focus groups in total. Two information focus groups in Mataquescuintla (2017, 2018) were held with members of the Colisena cooperative; these were largely different respondents than those I had interviewed. In San Pedro Necta with the Asaspne cooperative, I held two information focus groups (2018, 2019), and then three synthesis focus groups which related to the photo voice process (see below) (2018, 2019); these were with largely the same respondents that I had also interviewed. The questions that guided the focus groups pertained to what 'climate change' meant to coffee producers, what changes and impacts participants had observed in the region, what common themes participants identified with or could add to from other responses in the group, and how participants were adapting and responding to stressors and challenges. The focus groups included gentle prompts for people to reflect on deeper meanings and beliefs they held about certain things, such as nature, changes over time, and society (including gender). I held

one virtual Information focus group with the North American side of the value chain in 2019, which was then followed by a virtual Sharing focus group in 2020 with a multi-actor group.

4.4.2 Photovoice

Photovoice was the central method I used to gather data in this part of the study. It involves several steps, which can become 'arenas' for learning, reflection and collaboration.

The first step is to introduce the overall idea of the project, to which the photo voice questions are directed. This involved an opening meeting with the coffee cooperative in San Pedro Necta. At that meeting—which I refer to here as an information focus group—we discussed coffee in a context of climate change, without going into the climate science as such, but rather staying with the local experiences of unusual, unpredictable weather, climate-related impacts on the plants, and other interlocking social, cultural, economic and technological changes that participants saw as related with the issue of climate change. At this point, I introduced the photo voice exercise and ten participants consented to participate in it. I provided cameras to those who did not have a smart phone with a camera and we embarked on an introductory session of photo voice. In this introductory session, participants went outside, either alone or in small groups, and spent approximately one hour doing the photo voice exercise of answering an inquiry question (namely, "What is important to me?") through photography. Upon return, each individual shared their photos, providing a title and an interpretation of what the photo sought to 'say' or what it meant to the photographer.

The second step included two cycles of photo voice. Participants spent three days considering the question "*what does climate change mean to me?*" They then selected their top three photos and shared those with me, providing a title and description for each. Then, I asked them a second question, "*how am I adapting?*" and they spent another three days taking photos, selected their top three, and did another photo-text interview with me. Those interviews lasted between 45min-1hour. This resulted in 60 photo-texts.

The third step involved a synthesis focus group amongst the photo voice participants in which they each presented their photos to each other and began to consider common themes across the compiled 60 photo-texts. We began this with a synthesis focus group in July 2018, and then continued with a second synthesis focus group in July 2019 with enlarged printed photos that I put up on the walls. At that point, we did a more formal sharing and pattern-finding on the photos, wherein the participants came up with seven common themes. A third synthesis focus group in July 2019 focused on the process of photo voice itself.

The final step of the photo voice were two sharing focus groups, one in Guatemala City with other actors in the value chain in Guatemala, such as the in-country buyer, exporter, marketing, and other technical experts from Anacafe, Guatemala's national coffee association. The second one was carried out virtually on Zoom with simultaneous translation. That session included actors from each point in the coffee value chain (Table 5), including other downstream actors in Guatemala as well as other upstream actors in the USA, namely several actors from the wholesale-retailer. One final component of this sharing phase was the production of a lay-document presenting the results of photo voice, for use by the cooperative on their website and with other buyers and actors in their region.

4.4.3 Modified-STAGES assessment

To gather data on these multiple renditions of climate change, I used photovoice in a psycho-social manner which is further explained in article three. Photovoice invites participants into an inquiry about a certain topic, as described above, and engages them in a photo elicitation process. Participants titled and described their photos in a one-hour interview with me (heretofore referred to as photo-texts). By recording, transcribing, and analyzing these photo-texts using a modified-STAGES assessment (which I describe further below), I was able to discern certain aspects of their meaning-making processes which shaped their constructions of climate change. This was followed by a group sense-making process (i.e. a series of focus groups described above) in which each participant first presented their photo-texts to the group, then participants engaged together in a collective pattern-finding process, discovering the common themes across all the photo-texts. A

further sense-making process occurred as the participants presented these photo-texts to other actors in the value chain as a critical awareness-raising (or concientization) process.

Here, I describe in detail how I analyzed the photo-texts for the meaning-making that they demonstrated using the STAGES developmental assessment methodology (O'Fallon et al., 2020). STAGES includes three tiers as the Concrete, Subtle, and Meta-aware, each of which consists of four stages.[2] The progression is defined through the increasing perspective-taking capacities that become available to individuals. The STAGES assessment is usually carried out as a Sentence Completion Test (SCT) involving 36 sentence stems, in which the language properties are studied for the complexity of meaning-making. This involves three main criteria:

1) What is the object of awareness (i.e. concrete, subtle or meta-aware) in this text?
2) Is the text written in a receptive, active, reciprocal, interpenetrative orientation (e.g. "I may be…"; "I plan to...", "together we might…")?
3) Is the text oriented to the individual or collective (e.g. construing meaning through the lens of "I" versus "we")?

I chose STAGES for three reasons. (I review and discuss STAGES in comparison with other developmental psychology alternatives in greater detail in Hochachka (2020a).) First, the STAGES model conducts assessment of texts based on certain language parameters in how meaning is organized, not on the content of what has been said or written. This differs from other developmental assessments which are based on prior exemplars of responses at each stage. In comparison, STAGES analyzes the language properties of how meaning is being organized as demonstrated in the text. This appeared to me to be provide a more durable and potentially more useful approach to understanding meaning-making across contexts in which education levels, backgrounds, and subcultures differ.

Secondly, since one of the objectives of my research is to make a case for interiors in climate change, I needed to find a developmental assessment methodology that could be modified for use

[2] Thus, (as introduced above) the stages are identified as 1.0, 1.5, 2.0, 2.5...6.5, where the "1." to "6." reflect the six person perspectives, and the ".0" and ".5" reflect the early and late phases of each. 1.0 through 2.5 are in the Concrete tier, 3.0 through 4.5 in the Subtle tier, and 5.0 through 6.5 in the Metaware tier.

in empirical research on climate change without compromising its rigor. With its focus on underlying language properties, modifications of the STAGES assessment can be created that are still psychometrically valid (O'Fallon & Murray, 2020). This allows for the developmental analysis of arbitrary text, such as the photo-texts, which are more naturally occurring, compared to the more artificial, arduous, and clinically-based "sentence completion test" that is typically used.

Thirdly, I had a prior professional relationship with certain experts who work with the STAGES assessment (namely, Terri O'Fallon and Tom Murray), which I drew on to check and to strengthen the validity of my own use of this model. This collegial partnership assisted me in mitigating bias and correcting for errors, strengthening the quality of my analysis. Having a prior relationship with certain experts using STAGES supported this research partnership.

I used a *modified* version of the full STAGES assessment that was better suited to community-based climate work. Photo voice data was assessed for perspective-taking capacity by coding the photo-texts according to the three following themes, considering an array of variables within each. These are based on and relate closely with O'Fallon's scoring logic above, but I modified them in a manner that I considered would be pragmatically useful and intuitive to climate researchers in the field. They included:

1) Object of awareness (concrete, subtle or meta-aware),
2) Complexity of thought (atomistic, mechanistic, context-dependent, or systems thinking); and
3) Scope of time (no-time; present and past; past, present and future; evolutionary).

For example, with a photo-text, I analyzed the way meaning and understanding was expressed, looking first at what the 'object of awareness' was, such as concrete (i.e. weather), subtle (i.e. cause-and-effect trends in weather patterns over time (early), or considering how this relates with changes in culture and context (later), or meta-aware (i.e. reflective of one's own awareness of climatic changes over time, considering past and future generations). In this photo-text, I also analyzed the complexity of thought and the scope of time represented in the text: such as, 'it's

usually raining *now*, at this time of year' 'weather patterns are irregular due to interlocking factors and have contributed to overall change in the climate over the *past few years*,' and 'changes in the climate are co-arising with cultural, technological, economic changes that depend on the region a person lives in and will affect *future generations* in detrimental ways.' Although those are only examples, they serve to illustrate the kinds of complexification of thought as well as the embrace of time that can be identified in the photo-texts.

I did a pilot case study of this "modified STAGES assessment" of how meaning-making might affect views of climate change (Table 8). Using previous photovoice data from El Salvador, in which participants explored their own perspectives on climate change and adaptation by taking photos in response to questions about what climate change and adaptation (i.e. *What is climate change to me? How am I adapting?*), I analyzed their photo-texts to understand how different perspective-taking capacities arrived at different meanings about climate change. I applied this same modified STAGES assessment in Huehuetenango, Guatemala, with coffee farmers photovoice data, as one part of several ways I examined meanings and meaning-making for individuals and groups.

Table 8: Modified STAGES assessment framework (excerpt from Hochachka, G. 2021). Describes why meaning is organized as it is assessed by the *object of awareness, complexity of thought,* and *scope of time*—based on how much of the complex hyper-object of 'climate change' can be seen, at what complexity, via what meaning-making apparatus—drawing on developmental psychology theory as well as empirical findings in a climate change context. Climate meanings are based on Hochachka (2019), whereas stages 4.5 and 5.0 are drawn from applications of developmental psychology in organizational development (Brown, 2011; Cook-Greuter, 2004; Torbert and Barker, 2014).

Stages of meaning-making		***Meanings of climate change***
Concrete	*Rule-oriented 2.0* *Conformist 2.5*	Meaning of climate change is described as changes in weather in **literal, concrete**, **immediate terms**, such as epic floods, dry spells, intense rains, unusual storms; Makes some connections between objects, but these objects of awareness all remain concrete; Represent an **atomistic** and immediate view of climate change, with the scope of time focusing mainly on the **present**, stretching somewhat towards the past. Rule-oriented 2.0 is more passive and attending to follow what the rules dictate; whereas conformist 2.5 is more active and attending and aligning what other people expect and what social norms dictate.
Subtle	*Expert 3.0*	Meaning of climate change starts to include **some subtle concepts** (such as "diversity") and considers a larger envelope of time stretching from the past and to **some degree into the future**; is more **passive** than active (i.e. receiving a training and being taught what to do to adapt), yet was still largely anchored in concrete phenomena (i.e. acreage, trees, compost).
	Achiever 3.5	Meaning of climate change demonstrates thinking that is **more abstract** and use further subtle concepts (such as, "contamination"), considers relationships and **links between things** and tends to forecast further into the future; Employs **cause-and-effect** logic therefore accounts for the networked ways that increases in temperature, human activities like pollution, and health impacts are included; Employs **instrumental** thinking, organizing meaning in a more **mechanistic** and **logical** way.
	Pluralist 4.0	Meaning of climate change is even **more subtle or abstract**, including ideas such as history, inter-generationality, and impermanence; Includes a **broader contextual understanding** and **multiple causes or contributing factors**; Demonstrates **linked-up** meaning-making, and **early systems thinking**, and a higher propensity for **self-reflection**.
	Strategist 4.5	Meaning is derived from an able to **understand and sort contexts**, understood as **complex and interconnected systemically**; Includes an understanding that people **affect and recreate** the ways that healthy systems interact with each other, and as such humans can reverse damage caused by human disruptions of natural complex systems; The **role of humans** therefore in a social-ecological system is perceived in both the **causes and the resolution** of this issue.
Meta-aware	*Construct-aware 5.0*	Meaning is understood with **an awareness of the constructed nature of reality** on the whole, such that people are seen not merely as actors in the system but rather their **thoughts, ideas and beliefs about the system are constructing and shaping, as well as shaped by**, its evolution and trajectory.

4.5 Limitations

4.5.1 Limits of Integral Theory

I begin this discussion on limitations with a meta-comment about Integral Theory itself, which has received certain critiques that are worth mentioning. Three such prominent critiques include: one, it is hyper-intellectual ('too heady') and is not empirical enough; two, it is too fixated on growth-to-goodness models; and three, that it doesn't engage middle-range theories—that is, theories that a based on empirical research as opposed to grand theorizing using broad abstract entities—nor with cross-scale dynamics, which are particularly important in sustainability. I will take these in turn.

First, as a meta-theory, Integral Theory never claimed to be empirical at the outset; indeed, it is a deductive, intellectual theory (or meta-theory to be precise, in that it is a theory of theories). To hold it accountable to a lack of empiricism seems incongruent when that was not its articulated intent. With that said, many empirical studies have now been carried out that demonstrate its ability to assist in resolving confusion when it comes to complex issues.

Second, the growth-to-goodness assumption, which is described in greater detail in article two, is a relevant critique that warrants careful consideration. Misunderstandings abound with developmental theories. A key aspect of these is that later development describes 'more' (more complexity, more nuance, more space and time included, and so forth), but it is not necessary describing something 'better.' With later development, rather, there are more places where things can go wrong (Wilber, 2000). Rather than focusing on the upper ranges of such growth trajectories, I argue it is far more relevant and useful to work with developmental models in ways that focus on how people are organizing meaning in this present moment, in service of improved understanding, connection, and communication. With that said, it is important and ethical to understand what these developmental approaches seek to explain prior to engaging with them in hand; that is, they ought not to be used for pigeon-holing or stereotyping people nor for putting some people 'ahead' of others, rather they are trying to take stock of what people are aware of and

how people are navigating meaning in their lives at any given moment, while also considering how that process changes over time. These are important distinctions which render notions of growth-to-goodness in a critical light.

Third, it is the case that Integral Theory takes at meta-perspective, as if viewing the situation from an altitude of 50,000 ft, and doesn't bother with middle-range theories. That is a valid critique as many important middle-range lenses can be glossed over with such a generalist, meta-theory. However, academics that use this theory tend to build such bridges, as I have done here. Specifically, in article four, I draw on two middle-range theories in concert with aspects of Integral Theory that have been found to "develop significant lines of sight into the process for enacting more emancipatory and complex worldviews and social structures, suggesting the contours of an integral social theory" (Riddell, 2013, p. 132). It appears that the proliferation of research that applies Integral Theory elsewhere tends to connect with these middle-range theories where applicable (Esbjörn-Hargens, 2010b).

4.5.2 Generalizability, depth, and validity claims

Human geography has a long and strong tradition of case studies. The intuitive methods used in case study research give the sense that it's "been around as long as recorded history," yet in fact it has gone in and out of favor over the last five decades, facing various critical challenges throughout this time (George & Bennett, 2005, p. 5). Some of these challenges include the difficulties of: 1) generalizing findings from single cases, 2) articulating the relevance of its deep-yet-narrow results, and, 3) maintaining rigor when using qualitative methods to understand the subjectivity of social meaning.

Case studies risk collapsing precisely along these three tensions and yet within them we also find their strengths. On the one hand, case study research uniquely generates context-sensitive knowledge that discloses the meanings and interpretations, the motives and intentions, that guide people's everyday lives and to develop invaluable practical wisdom about the social world (Blaikie, 2007; Schwandt & Gates, 2017). On the other hand, scholars have critiqued this kind of research as being "merely descriptive" and "not scientific" (Ragin & Amoroso, 2010, p. 110);

Flyvbjerg (2006a, p. 220) reports that some have gone as far as to dismiss the ability of case studies to "provide reliable information about the broader class" and suggests that this characterizes the conventional opinion about case study research on the whole. Along with these other scholars, Yin (2013) warns that this hierarchy of method, in which case studies are relegated to the bottom rung as useful only in exploratory phases of more serious investigation, is inaccurate.

The way case study research is set up may position it well to reckon with not only these challenges as well as the key tensions that they reflect from human geography. These tensions include: the unique and the universal, between depth and span, and between subjectivity and objectivity (Bailey et al., 1999; Cresswell, 2013; Flyvbjerg, 2006b). First, case studies are critiqued for leaning too much towards the unique by their focus on in-depth study and by their small number of sites, and this, especially when seen through the lens of the statistical methods, presents difficulties for how to move from the unique, specific case to a universal, general theory (Flyvbjerg, 2006a; Schwandt & Gates, 2017). Secondly, the benefits of in-depth study are many, and yet invariably case studies wrangle with the fact that that is made possible by constraining the study to a manageable number of cases—their very depth is born essentially at the expense of span—which raises critical questions of relevance (George & Bennett, 2005). Thirdly, while retaining a small *n* in a case study can provide for thick, rich, often subjective descriptions, with evident strengths in terms of "capturing insider meanings and complex contextuality" (Schwandt & Gates, 2017, p. 123)—that is, not just giving voice, but giving *accurate* voice to research participants—some critique that it is done at the expense of rigor, and may itself be marred by the respondents' bias when reporting what they think the researcher wants to hear or the researchers own bias when interpreting the data (Flyvbjerg, 2006, p. 219).

In this subsection, I describe each of these limitations (which can also be seen as strengths) and then describe ways that I set up my research design to address them.

First, in my study, I was considered carefully what could be generalized; more specifically, by determining what surface characteristics from more durable dynamics operating in the case study sites. In article one—which is where I used case study research methods—the variables I examined in terms of *spatial*, *historical*, and *ontological* differences between the two case study sites were

surface, contingent variables specific to their contexts—it would be erroneous to generalize those to apply elsewhere. However, as I studied the *responses* local people had to their circumstances—both past events, but also to climate change impacts in the present moment—I began to note that they did so via certain capacities—namely, being attentive and adept in the subjective, intersubjective, objective and interobjective perspective-dimensions. These gave rise to a more (or less) four-quadrant adaptation (involving the personal, practical, co-generative, and critical-structural adaptation), all of which is further explained in the article. For example, being attentive to one's own subjectivity, such as, feelings, awareness, and insight, contributed to fostering the adaptive capacity for personal adaptation to unexpected change; being attentive to inter-subjectivity, such as, the group, community or cultural wellbeing, contributed to fostering the capacity for co-generative adaptation; and so forth. By focusing on these 'deeper' and more durable perspectival capacities, rather than the historical, contingent variables of these unique sites, meant that this data from these case studies could be generalized to apply elsewhere. Had I mixed these up, surely this case study research would fall into a troubling limitation.

Second, an important question I considered in my case study design was, 'how can a case study be set up to make depth count?' My response to this was to conduct ethnographic-style immersion in my case study sites; that is, I stayed in the community, spent mornings and evening immersed in community life, attended two different church services, spent time on people's farms, accompanied participants in day-to-day activities including certain important events (Christmas Eve), alongside my own research activities. I wouldn't call it truly ethnographic, as these field stays were not months-long endeavors—due to my own family circumstances, I was only able to stay for a month at the most—yet I repeated these 2.5 week-4 week field trips three times between 2017-2019, shifting it online in 2020 due to the pandemic, which is why I refer to this as an ethnographic-style immersion. I also carried out in-depth interviews with informants, as well as my use of subjective and intersubjective methods, such as photo voice, reflective interviews, and in the co-generative learning (more below). Photo voice in particular was designed to mine deeper shafts of human perception about climate change. The extended interview format, wherein they were able to interpret and explain their photos, provided a process to share in detail their subjective meanings about climate change. Some aspects of my interviewing questions, particularly the 'blue-sky' questions, were chosen to elicit in-depth responses, by supporting interviewees in reflection.

Third, how could I be certain that the methods I chose were able to give me 'true' insight into the situation of climate change in these regions, including the subjective aspects I was specifically interested in? In qualitative research that seeks to synthesize subjectivity with science, Bailey et al. (1999, pp. 172–173) suggest that the problem lies not in a lack of validity for this data, but in *a narrow view of validity itself*. These authors quote Marshall (1986, p. 197) who supports the idea that validity is an integral element which: "becomes largely a quality of the knower, in relation to his/her data and enhanced by different vantage points and forms of knowing—*it is, then, personal, relational, and contextual*" (Bailey et al., 1999, p. 172 italics added). Wilber (2001) develops this idea further with a notion of there being four classes of validity claims that correspond with precisely these dimensions of human life, namely: the personal which corresponds with *sincerity or truthfulness*; the relational which corresponds with validity claims of *mutual understanding or justness*; and the contextual which he splits into two dimensions to correspond with *propositional truth* (when examining individual units) and *functional fit* (when examining collective units, such as systems) (see Figure 1).

In my research design, I included multiple verification strategies (Maxwell, 2013) that ranged across at least three of these validity claims: *truth and functional-fit* (of the objective facts across the sites), *mutual understanding or justness* (of the intersubjective sense-making that this data reflected), and *truthfulness or sincerity* (of myself as a researcher).

In terms of the *validity claim of truth and functional-fit*—namely, to know if what data I had collected was 'true'—I used triangulation of both methods and sources; that is, consulting respondents multiple times with different methods in various settings. This let me assess for comments that were outliers to the core of knowledge on a certain topic. This also helped me to ensure I had reached data-saturation on the topics of interest and check whether or not what I heard on one farm was relevant elsewhere. Was my data true and did it functionally-fit with the context and system, or was it at odds with key features of the system in question? For example, the majority of respondents spoke at length of the added inputs to coffee farms that were necessary to address the impacts of climate change, added to that, I saw with my own eyes as a participant-observer the browned leaves from roya and the negative impacts on the coffee trees; had one respondent said

otherwise I would have questioned why and would have sought more information regarding that data, as it would not have functionally fit into the broader ecosystem which evidently conveyed hardship regarding dealing with roya. This in fact occurred, however, the respondent himself said that there was a reason his farm was less impacted by roya, such that he had managed to avoid it, affirming both the truth of the matter conveyed by other respondents, but also conveying a functional fit with the whole picture present in this ecosystem.

In terms of the *validity claim of mutual-understanding*, (or "mutual knowledge" as described by Giddens *in* Blaikie (2007, pp. 96–97)), I engaged in an ethnographic-style immersion in the case study sites, which helped to build rapport and mutual trust, and also used participatory research methods (i.e. focus groups and collective pattern-finding). In this way, the participants themselves had space to clarify, describe, and refute the data as the study proceeded. I also showed photo-voice participants transcriptions of their interview, and requested that they check it over for accuracy. After having left the field, I sent specific quotes that appear in the articles for participants to verify as accurate, and in one case when I got back clarifications and additions, I then synthesized the slight elaborations they had sent back to me with their original quotes (Birt et al., 2016). I also emailed both cooperatives a translated summary of two of the papers (article three and four), including the full Results section. These verification efforts supported mutual understanding, that I had not come and extricated knowledge without checking with the very people who lived there, and rather I sought ways to check and relate the data of this study with the people whom it concerned.

In terms of the *validity claim of truthfulness or sincerity*, this raises the issue of bias and critically questions the ability for a researcher to be objective in data collection or analysis. The difficulty was bias is that one cannot see what one cannot see, and therefore the inclusion of other people to 'check' one's own view is essential. Here, specifically in regards to the modified STAGES assessment data, I had another trained psychologist analyze 20% of the same data set, which I then compared to my own findings and adjusted my assessment process as needed. This being the same process used in, for example, grading in courses at University of Oslo, it seems a basic way to address the subjectivity inherent in scoring or assessing written works. In the field in Guatemala, I had research assistants work with me in both communities for key moments in each field trip. In

San Pedro Necta, this included a Guatemalan who knew the culture and context and understood the colloquial ways of expressing certain things, making him a good person with whom to check and triangulate my own perspective of certain situations. In Mataquescuintla, this included a Salvadoran who took extensive notes which she shared with me, such that we were able to triangulate our observations. Throughout I also employed critical self-reflection on my own observations so that, to the extent possible, I could mitigate bias in my own thinking processes.

4.5.2 Challenges of interpretation, subjectivity, and language

As one of my key arguments in this paper is that the psychological dimensions of climate change matter, I sought to find and / or demonstrate practical ways for lay-practitioners to integrate psychological tools into climate change engagement. However, an important limitation in this regard is that I am not a trained psychologist and thus needed to be cautious and critically self-reflexive in terms of what claims I was making and how I arrived at that outcome. In this study, one way I managed this limitation was to shift the focus that is normally on the *person* who has responded to a prompt, to focus instead on a *particular piece of text*. Which is to say, the findings point to the meaning-making that the photo-texts demonstrate, rather than to the meaning-making of the people who produced those works.

By organizing my data in this way, the point I am seeking to make is that climate change is understood in varying ways and that the complexity of that ought to be considered in greater depth by climate change practitioners. As such, the meaning-making data presents a snapshot of a specific moment in time. Which is to say, I do not make long-standing claims about these findings nor do I make claims about the people holding those perspectives in a psychological sense. Rather, this data serves to illustrate the variability in perspectives on climate change, giving a glimpse into the range of ways to approach and understand a complex issue, and a chance to consider broader, more democratic avenues towards sharing meanings in such complex settings.

Another limitation was the role that language played in this part of the data collection. I and my research assistants spoke Spanish. One assistant was Guatemalan, and therefore knew the cultural context such that he was able to explain certain contextual features to me; the other was Salvadoran

but had worked in community development in Guatemala. Neither were of Mayan-descent and both were university-educated. I asked the study respondents and/or my assistants for further clarification on aspects I did not understand. For the transcripts, I hired professional translators to assist me with the translation, however, I also went back over their translations, paying attention to certain Guatemalan colloquialisms or to correct any very context-based terms that were unique to these case study sites. Although some of the respondents in San Pedro Necta spoke Mam as their first language, they spoke Spanish in a professional setting. I spent extensive time in the interviews with participants who spoke Mam as a first language, checking my understanding of what they had expressed in several ways. Also, because they went on to present their photo-texts at least two more times to the group, I was also able to verify my understanding in those later settings. I also gave the full transcriptions of their photo-text interviews back to the respondents for them to check.

4.5.3 Power, privilege, and positionality

The coffee producers in my study are of communities that I describe as 'triply-exposed' to both *poverty* and *climate change*, as well as the *diversity, equity, and inclusion challenges* of living as indigenous and people of colour in colonial, privileged systems of trade. Recapitulating the economic inequity, whereby producers earn the least in a global value chain, the climate change impacts are born out far more heavily on the producing end of the value chain. The more typical stressors involved in coffee production are exacerbated and amplified by climate change impacts of unpredictable weather, outbreaks new pests, and natural disasters. All the while, these producers were not the populations responsible for the majority of these carbon emissions that caused (and are causing) this climate disruption. These inequities—in economic, social, and now climate terms—run along colonialist lines. As such, climate justice inspired my choice of an action research strategy and influenced much of the design of the photo voice and co-generative learning methodology: namely, this climate challenge ought to be more evenly shared and adaptation be made more just.

Towards such greater climate justice, the co-generative learning approach goes a long way towards intentionally engaging a solution space that is, true to its name, co-generated between insiders (i.e.

internal problem owners) and outsiders (external change agents). However, as Levin (2014, p. 6) points out, this can raise a power asymmetry between outsiders and insiders:

> "The outsider designs training sessions that make development and transfer of knowledge possible and uses his or her influence to direct the developmental process. The professional researcher necessarily exercises power in this process. Dealing honestly and openly with the power these requirements grant to the researcher is a central challenge in action research change processes"

This power dynamic constitutes an important limitation of this methodology that I had to consider with care.

Various aspects contribute to this power dynamic, the most evident of which is my whiteness. Geography is known for having a dominance of whiteness, in part due to a neoliberal academic context. This is relevant to reflect on in my study in two ways: 1) the ways in which difference is not fully allowed, and rather "produces an epistemological space in which humans are all the same (the so-called 'level playing field')" (Berg, 2012, p. 511) and 2) the "micro-geographies of…'white rescue fantasies'…[in which while we may] understand ourselves to be critical geographers,…at the same time…we continue to be privileged as members of a group (white people)" and benefit from these very structures of privilege (Berg, 2012, p. 512). Berg (2012) notes how a proxy for being anti-racist that is often given is that 'one is friends with of people of colour;' yet notes the very ways in which such friendships are understood through a neoliberal lens views them as *individual relations* rather than seeing these as part of broader *social relations* of inequity and privilege. While contacting our commonalities and creating friendships is important, it doesn't get around the structural hegemony they are embedded in. Geography as a field, nor I within that as a white researcher, can tear asunder from these larger social, historical relations in which we are embedded, but we can operate on them critically and reflexively.

My own story with this begins with my father. My father was of Russian descent and was born and raised on a farm in Alberta, Canada; he didn't receive formal education until they moved into the city at age 10. When he entered the urban school, he was treated as an ignorant farm-boy but nevertheless went on to become a well-regarded Canadian biologist. He never forgot the initial IQ tests he and his

siblings were required to take as they first entered the urban school; how he had scored ‘imbecile’ at that time, and yet upon graduation just a few years later, in a second IQ test he scored ‘genius.’ He rejected such tests, saying that the tests only measured for an urban way of thinking and left out important perspectives that he’d learned in a rural setting—perspectives that he later mused were the foundation for his award-winning scientific research. Although he was privileged himself, my father’s story impacted me and led me to value equity across socioeconomic status and racial background, and particularly underlined the importance of including marginalized perspectives and less-dominant ontologies and epistemologies.

I have sought to exercise critical-reflexive awareness of my own privilege and place it in service of greater equity, specifically by using participatory and action research methods and a critical approach. As an ancestor of Russian and British settlers, I wish to acknowledge that for over half of this dissertation, I lived and worked on the hereditary, unceded territory of the Musqueam First Nations while in Vancouver, for the other half on the Sami First Nations lands while in Oslo, and while in the field in Guatemala, I stayed and conducted research on Mam traditional lands. I am established in systems and structure of privilege, which I benefit from by no action of my own; there are ways in which I get up each morning and need not fight certain fights to end up winning anyway, by the end of the day. To the extent possible, I have sought to make known and to make visible my own critical positioning within these structures of power (Rose, 1997).

For example, in my fieldwork, I introduced myself from within my own identity and history; I acknowledged the power imbalance regarding the contacts I had access to in this value chain merely because of my own whiteness and privilege. I was transparent on what my critical intentions were in my selection of methods—namely, to provide ways that producers could voice their perspectives, the importance of including marginalized perspectives for positive collective impact, and my opinion that more perspectives on a complex issue like climate change produces a more durable response in addressing it. For me this involved not only a social awareness, but also a self-awareness. For example, I practiced active open-mindedness to new ways of being, belief systems, and customs or practices that were not familiar to me, and to new insights (sometimes critical) about myself in order to remain curious, humble, and able to be surprised. I moved with these in an ethnographic manner, seeking to connect with our common humanity and the shared human needs for security, belonging and acceptance. Part of this active open-mindedness therefore was an open listening.

This critical-reflexive awareness also influenced my research design in at least four important ways. Firstly, my intention to use photovoice with Guatemalan coffee producers who are vulnerable to climate change, was in large part to address a *power imbalance.* Through the photo-texts, producers could make their realities visible in advocating for greater climate justice in a trade-system that does not have formal ways to account for such realities. In the focus groups with multiple actors in the value chain, various positions were represented, and the power was not equal among them (i.e., it was not a 'level playing field'). I sought to challenge that by bringing these actors together into shared processes of dialogue and social learning. Even the mere fact that both far ends of the GVC met in a shared space—producers through retailers—was itself described as 'unprecedented' for this value chain. In article two, I describe certain concepts like *sovereignty* over one's own meaning-making, the need for more *democratized* meanings about climate change adaptation, and the need to decenter techno-managerial adaptation so that local people can *translate* what climate adaptation means to them in more resonant ways.

Secondly, my choice of case study sites enabled me to examine and uplift certain adaptive responses that were uniquely present for coffee farmers in the regions that have greater indigenous culture and a longer-standing struggle against colonially-driven political-economic inequity (particularly in Huehuetenango). This contributed to reweighting the *ontological imbalance*, in which Western ontologies typically dominate over indigenous ones. These producers were responding and adapting to climate change in a holistic manner that made them better positioned to meet the challenges of climate change. The Ladino case study site, with greater access to technology and financial means, was found to be less prepared than the coffee producers in the Mayan region of Huehuetenango. In Huehuetenango, the coffee producers had organized cooperatively, sought their place in a fair-trade system, and that had personal adaptation practices alongside those of more practical, technical adaptation, which taken together set them up with greater resilience to confront and respond to climate change. One argument I make is that this was in part due to the background presence of indigenous worldviews in Huehuetenago, that drew on alternate ways of adapting to change. This was the main topic in article one.

Thirdly, the multi-actor focus groups fostered greater understanding of what farmers face dealing with climate impacts alongside the ongoing challenges of low price and unfair trade. This contributed to reweighting the *epistemological imbalance* in which privileged actors in regions of greater affluence tend to not know the realities of farmers in producing communities, nor acknowledge their traditional

ecological knowledge systems derived from living on the land. For the downstream actors (i.e. buyers, exporters, retailers), while some of this may have been known 'academically,' it was another matter to see and hear these perspectives directly from the producers. I sought to address power imbalances in these multi-actor groups through ensuring equitable space was provided for all actors to voice their perspectives, and specifically designing the agenda to include time for the producers to present about their experiences and responses to climate change on their coffee farms. As such, the actors in the value chain built greater shared meaning about climate change, impacts on coffee, and what to do about it, which was the main topic of article three.

Fourthly, holding the final multi-actor focus group in the middle of the health pandemic enabled the value chain to see how their investments into greater empathy and improved relationships mattered when it came to another more immediate global crisis namely COVID-19; which gave ideas and inspiration for continuing such a GVC innovation to confront the climate crisis on the longer term. This contributed to reweighting the *methodological imbalance* between the objective, measurable methods—typically ones a modern, capitalist economy accounts for and upholds—and the inter/subjective methods which tend to factor less easily into such modernist calculations of value. Making visible the key contributions of the interior, intangible dimensions of this GVC innovation provided a way to challenge the dominant set of practices in global trade, and constructively offer a practical alternative for value chain relations. This was the main topic of article four.

4.6 Ethics

This study was approved by the Norwegian Centre for Research Data (nsd.no). I provided respondents an explanation of my study and my role within that, and requested their verbal, written, or active informed consent to participate, which they could withdraw at any time. For the photo voice exercise, this included written consent provided by forms which participants signed. For key-informant interviews, this included verbal consent. For focus groups, this included mainly active consent, whereby their participation indicated their active consent to be part of the study. I kept respondents' names anonymous, and the list was only be stored on my own personal laptop, and I (the project leader/student) was the only person with access to it. I also kept the names of the company, exporters, and retailers anonymous, however, by request the cooperatives wanted to be named so that they could use the products of this action research in their own work. This meant

that for certain respondents, there could be indirectly identifiable background information; for those individuals I sent the quotes I was including to the respondents to read and approve. However, this was a general practice I undertook in this project, such that even respondents without such indirect identifiable data also had a chance to review and verify their quotes. I compiled summaries of the articles that were closely connected with Guatemalan participants, namely for articles one and four, sharing the quotes I intended to use with respondents. These summaries included translations of the results sections from each paper in their entirety. Also, full transcripts of the photo voice interviews in Spanish from in article three were provided and reviewed by respondents. Mostly these were shared for validity and accuracy, however there was also an ethical rationale for me in doing this—namely, I wanted to ensure that this knowledge was not merely extricated from its context for use elsewhere, and rather was a co-generated, shared product for participants and respondents. Data was stored on my personal laptop under a security password in a locked room; the data will be stored with personal identification until 31.01.2024, after which point it will be made anonymous.

5: Article Summaries

5.1 Article 1: Integrating the Four Faces of Adaptation: Towards transformative change in Guatemalan coffee communities

One of the objectives of my research was to broaden and deepen my theoretical approach to adaptation to account for the range of subjective and objective ways that people respond to change. The proposition guiding this part of the study was that engaging a broader, deeper conception of adaptation might set the conditions for enacting transformative change. Here, I tested the hypothesis of an integral adaptation approach, that O'Brien and myself published on in 2010, using Case Study Research methods in Guatemalan coffee communities. The integral adaptation framework includes four quadrants derived by the interior and exterior of individuals and collectives (or, experience, behaviours, culture and systems). The specific research question guiding this part of the study was "*how can an integral approach contribute to a more transformative adaptation?*" In my first paper, I carefully examined how coffee producers in two

case study sites navigate complex change processes due to climate change. This resulted in my first paper published in *World Development*, entitled, "Integrating the four faces of climate change adaptation: Towards transformative change in Guatemalan coffee communities."

In this article, I examine the critique that techno-managerial adaptation is not enough alongside the calls for greater integration of the psychology of climate change, in search of testing the theory of an integral approach. I take seriously the need for including the interior human dimensions with rigor, alongside the more typical ways that adaptation to climate change is engaged. These interior human dimensions include what I have termed "personal adaptation" and "co-generative adaptation" to refer to the subjective and inter-subjective ways that people respond and adapt to unexpected change, and the exterior aspects include "practical adaptation," that involve technical or behavioural changes, and "critical-structural adaptation," that involves deliberative attempts to address the developmental trajectory in a broader, more structural sense.

I describe these four 'faces' or quadrants of adaptation and explain certain propositions that this theory carries. Paramount in these propositions is the notion that conditions for transformation can be generated, as these four faces of adaptation are allowed room in a larger and deeper practice of adaptation.

The ensuing empirical study then applies Case Study Research methodology to examine two case study sites that offer a useful comparison in that they carry some similar attributes while other variables are markedly different. Analysing data from key-informant interviews, focus groups, site-visits, and participant-observation according to the four-quadrant framework, I then applied certain tests using Bayesian logic to "inhabit" the world of each hypothesis.

The findings describe: 1) how critical-structural adaptations were helpful in disrupting structural arrangements in ways that practical adaptations alone were not; and 2) that the interior adaptations (personal and co-generative) were less emphasized overall but can be effectively integrated, either implicitly or explicitly, with dominant forms of adaptation practice. The results demonstrate that the four quadrants of adaptation are present and relevant for how people respond and react to change, and also suggest that something alchemical is made possible through the synergy of these

adaptations as they co-arise (or, better said, 'tetra-arise') at the interface of subjectivity and objectivity, in individuals and collectives.

5.2 Article 2: On Matryoshkas and Meaning-Making: Understanding the plasticity of climate change

The endeavor to include more 'interior,' subjective human dimension into adaptation, discloses a broad diversity of perspectives about climate change. While what climate change means to people has been examined in the literature, there is less research as to *why* climate meanings are so diverse. An under-represented area of the psychology literature—namely, constructive-developmental psychology—specifically studies how meaning is organized in more complex ways through greater maturity. This has been found useful in fields such as education, leadership, and organizational development, yet it remains a largely missing lens in the field of climate change. A second specific research question, therefore, sought to understand: "*What does a developmental understanding of meaning-making offer climate change adaptation?"* This in turn led to my second paper, which was published in *Global Environmental Change*, namely, "On matryoshkas and meaning-making: Understanding the plasticity of climate change."

In article two, I consider the plasticity of meanings about climate change and contemplate how climate change—being complex, distributed across space and time, and highly abstract—presents high mental demands on people to grasp in its totality. It has been referred as a wicked problem, a hyperobject, a multiple object, and an evolving construct. In part because of this, climate meanings vary considerably. I review various psychological approaches that consider this from a variety of angles, such as via segmentation studies of values, mental models research, and via studies on psychological distance. I then specifically explore a less well-known literature in climate change research, namely developmental psychology. Developmental psychology explains how meaning is organized in greater degrees of complexity through maturation and across a lifespan. Using previous photovoice data from a similar highland rural context in El Salvador, I pilot the use of a modified-STAGES assessment to look at what range of meaning-making was present in the sample of this rural population. This provided a cross-sectional glimpse into the spectrum of ways that meaning about climate change is organized.

The findings suggest that a developmental perspective brings an important explanation as to why some meanings about climate change differ. Some meanings are concrete and immediate and framed in terms of seemingly unrelated elements (i.e. weather change). Other meanings about climate change are more abstract, involving cause-and-effect, mechanistic, and logical understanding, and involve the present, past and near-term future. Still other meanings about climate change are highly abstract, contextual, and can involve networked or systems-thinking, and involve present, the distant past meaning evolutionary time, and the distant future meaning unborn generations, and even the timeless now. In each rendition, more of the hyperobject of climate change is perceived.

This supports a greater plurality of views about climate change and provides a useful blueprint for how climate communications could better account for and align with these different forms of meaning-making. People gaining a sense of sovereignty over their own climate meanings could generate a broader social mandate and support climate action.

5.3 Article 3: Finding shared meaning in the Anthropocene: Engaging diverse perspectives for greater collaboration on climate change

My third paper turned attention to the implications of these complexities of meaning-making, and grappled with how shared meaning might be found amidst a diversity of views on climate change. The diversity of perspectives explored in article two results in values-clashes and interpersonal conflicts on the matter of climate change. Adger (2003, p. 388) has argued that, although societies have (technical) capacities to adapt, "these capacities are bound up in their ability to act collectively." Seeking to examine this collective action, in this third paper, I considered how a greater social convergence might be found about an issue that is typically highly divergent. Applying the modified-STAGES assessment that was piloted in article two, as well as using photo voice methodology and other participatory research methods, my third paper asked, "*How is shared meaning amongst diverse perspectives on climate change fostered?*" This led to my third article, "Finding shared meaning in the Anthropocene: Engaging diverse perspectives on climate change" which is in peer review in *Sustainability Science* journal.

In this paper, I explore an approach through which we might find shared meaning at the interface of individual and collective views about climate change. In a social context today, in which despite clear scientific findings on climate change, perceptions and attitudes remain fractured. Such an insufficient social mandate slows climate action at a time when the climate science suggests it ought to quicken. I first present a conceptual framework that describes five psychological reasons why climate change challenges individual and collective meaning-making, and also provides a way to understand how meaning is organized within that. I then use this framework to inform the use of photo voice as a transformative (action-research) method, examining its ability to overcome some of the meaning-making challenges specific to climate change. I discuss how participants from a coffee cooperative in Guatemala reflected first on their own climate meanings and then engaged in a shared meaning-making process with other actors in the coffee value chain. Findings suggest a psychosocial approach to climate engagement—one that engages both subjectively and intersubjectively on the complexities unique to climate change—is helpful in acknowledging an ontological pluralism of 'climate *changes*' amongst individuals, while also supporting a nexus-agreement collectively. This may in turn contribute to a more effective and ethical process of transformation.

5.4 Article 4: The transformative potential of scaling up, out, and deep: Global value chain innovations in a changing climate

My fourth article sought to study how scaling collaboration could occur, when meaning-making processes are taken into account. Global value chains (GVCs) may hold important potential for transformations to sustainability in a context of climate change. Yet, their potential for sustainability may depend on whether, and how, certain discrete innovations that might work at a micro-context can scale into broader macro-scale change. Consequently, I examined how actors in a global coffee value chain hailing from different positions and perspectives—namely producers, buyers, exporters, and retailers—engaged in innovative trade relations against a backdrop of climate change. Guided by the specific research question, "*How can innovations in climate change adaptation be scaled as transformations to sustainability?*" this paper examined how can a global coffee value chain moved from niche innovations within its own trade

arrangements to broader transformative change against the backdrop of the climate crisis. Using qualitative research methods (i.e. focus groups and interviews) as well as global value chain analysis, I studied possibilities for scaling positive collective impact in this case study of the Guatemalan coffee GVC. This completed my final paper, entitled, "The power of scaling up, out, and deep: Transformations to sustainability in a changing climate" which has been submitted to *Ecological Economics*.

In this article, I present an action research study of a global coffee value chain, extending geographically from Guatemala through to North America. Drawing on data from key informant interviews, I first describe this GVC's innovation, consisting of tracing source (i.e. to know where products originate and what socio-economic and ecological issues are faced by producers, and buying above the cost of production), address overall community development (i.e. to provide technical, social and economic benefits to support overall development of producing regions), and to integration interior, intangible aspects such as cultivating empathy and improved relationships.

Then, I examine the GVC's ability to respond in a sustainable manner to unexpected global-change phenomena. The COVID-19 pandemic that occurred midway through this study presented immediate threats to the supply chain on various fronts in real-time, requiring the GVC actors to draw on their innovation and to test its scalability in response to an unprecedented situation. As such, COVID-19 crisis operated as a proxy for the climate crisis to study the potential for GVCs in scaling innovations into broader transformations to sustainability.

In my analysis, I examine the GVCs ability to address key upscaling dilemmas, applying Moore et al.'s tripartite framework for *scaling out* (i.e. extensively into greater numbers), *scaling up* (i.e. structurally into changed institutions and policies), and *scaling deep* (i.e. durably into new values, action logics, and culture). Research findings suggest that *scaling deep* was as important as scaling out and up, and that such a comprehensive approach may explain this GVC's ability to address certain key scaling dilemmas in its response to the COVID-19 pandemic as well as serve to position the GVC well in the face of the climate crisis.

5.5 Article 5: Unearthing insights for climate change response in the midst of the COVID-19 pandemic

The fifth paper answers the "so what?" of this research topic, demonstrating the significance of a more integral approach in our responses to global issues today, be that COVID19, climate change, or sustainability more broadly. In this paper, I considered the responses to the COVID-19 pandemic that occurred in the final two years of my PhD program, and compared those responses to that of the climate crisis, so to harvest insights for more effective climate change engagement. This was guided by the specific question, "*What insights and implications does an integral approach contribute regarding transformative responses in an overheated world?* The resulting article was entitled "Unearthing insights for climate change response in the midst of the COVID-19 pandemic" and was published in *Global Sustainability*.

This final article integrates the body of work compiled in this dissertation by looking at what implications an integral approach might have in understanding responses to global crises. While the climate crisis is slow-moving, the COVID-19 pandemic arose abruptly and was considered by many as an experiment forced upon the world community. As such, responses to the pandemic offered important lessons about socio-ecological systems as well as processes of transformative change. What enabled responses to COVID-19 to be as effective as they were, right at a time when climate action is notably lagging behind what intergovernmental panels have called for?

In this article, I examine what occurred in the COVID-19 pandemic response that could be learned for the climate crisis. I focus on three psychological aspects that made the COVID-19 response accessible and actionable in a way that climate change is not: the mental demands for understanding complex issues; psychological distance and its impacts on motivation and agency; and finite attentional resources that can render certain issues as non-salient. Applying several key concepts of an integral approach to climate change adaptation, which were introduced and tested in the earlier articles, I demonstrate the explanatory power of this integral approach. Certain lessons for climate engagement are drawn from this discussion, including: 1) the usefulness of concrete, simple, and personally-relatable messaging; 2) more diverse and democratized climate understandings and stories; 3) greater recognition about how psychological distance affects

meaning-making and sense of agency; and 4) appreciation of attentional crowding and the need for sense-making strategies about complex issues.

6: Synthesis and Conclusion

My overarching research question is: how might processes to better understand and support meaning-making (individually and collectively) better enable climate change adaptation to contribute to transformative responses in an overheated world?

6.1 Implications of the findings

Through empirical research, this PhD examined the questions: *How does an understanding of and support for meaning-making (individually and collectively) better enable climate change adaptation to contribute to transformative responses across a global value chain? In what ways does Integral Theory provide novel insights regarding transformative responses to climate change?* The study encompasses three main findings which carry key implications for both theory and practice in the current climate change discourse.

Firstly, this study makes a strong case for how interiority matters in climate change adaptation, and provides empirical data for how such integration of both interiors and exteriors may even situate adaptation to be carried out in a more transformative manner. Getting beyond technocratic solutions to climate change by improved integration of other perspectives in more transdisciplinary approaches may be 'the challenge' of this decade. The bottleneck is less the technology to create a sustainable future, rather it is the social support for setting society on such equitable and sustainable trajectories. Findings from this study showed that such integration in indeed possible. In local coffee-growing communities, this study shared empirical results of adaptation strategies that integrated the 'four faces of adaptation,' namely the interior and exterior of the individual and the collective, and in turn set the cooperative up well for meeting climate change impacts with a range of approaches to adaptation and may support the cooperative in engaging in transformative change (article one). A deeper appreciation of how interior human dimensions affect the variance

of perspectives on the matter, and how to work within that diversity towards shared meaning, was found in article two. Findings in that article suggest that pathways to greater collaboration entail appreciating multiple ontologies of climate change and finding a network-understanding in groups. Third, when it comes to considering how innovations might scale more broadly than niche, micro-situations and into transformative change, article four found that strategies to scaling had to consider interior dimensions (scaling deep) as well as exterior dimensions (scaling up and out). All these findings underscore the importance of integrating interiors in climate change adaptation and transformations to sustainability.

Secondly, a key finding in this PhD is the extent to which meaning-making matters in climate change adaptation and in overall climate communication and engagement strategies. This is an identified gap in current literature, as seen in reflections on the global environmental change research field, in which O'Brien (2021, pp. 1–2) states:

> "global change research has failed to adequately integrate the subjective realm of meaning making into both understanding and action. Not just meaning making in general, but the differences in and dynamics of meaning making, including how they relate to beliefs, values, agency, empowerment, creativity, emotions, and not the least, political action."

This dissertation specifically considers meaning-making in three of the five articles—the first piloting a modified, field-based approach to assessing the ways that meaning is made about climate change, the second which applies that approach in working towards a shared meaning in diverse groups, and the third which investigates the implications of this understanding in the effectiveness, or not, of climate change communications compared to that of COVID-19. These findings underscore how greater understanding of meaning-making can support more effective engagement. For example, while "researchers find that the most successful communication is to use extreme weather as an entry point" (Hatch, 2021, p. 8), the reasons why are not typically provided; at some point, a different entry point will be more effective, based on the developing meaning-making capacities of populations. My study provides insight in the meaning-making mechanisms that operate 'behind the backs' of actors in society. Rather than focus on *what* themes work for framing climate change today, instead this supports building the capacity for climate

change engagement strategies that get at *why* certain messages and framing work better than others. Here, what is provided for climate change engagement is a durable understanding of how to listen for how meaning is being put together 'under the content' about climate change itself, so that regardless of the fleeting, mutable, and superficial changing trends in framing, what will be understood is the meaning-making apparatus that is coordinating those perspectives into 'what climate change means' to an individual or segment of the population. These findings will complement existing psychology of climate change research and contribute to generating and building a broader social mandate for climate adaptation and action.

Thirdly, the need for transdisciplinary approaches is becoming increasingly clear. This study shares an empirical example of what 'transdisciplinary' can look like in a field-based study. This could contribute to the growing literature on this topic, and may provide other researchers with novel ideas on how to structure their studies, how to include a range of validity claims, and honour and include different methodologies based on their distinct disciplinary insights, without reducing or dismissing any lenses of import. Approaches like this that come closer to being commensurate with the full complexity of climate change are helpful, especially when part of broader research agendas for transformations to sustainability.

6.2 Recommendations for future research

In terms of areas for further research, there is much yet to be understood about how a developmental perspective can be of use in the climate change adaptation, engagement, and action. For example, studies into meaning making could be better integrated into not only climate change research, but also in policy processes. This has direct relevance in climate conversations and other community engagement processes. Differences with meaning-making are important to understand and account for in order to enhance the quality of such conversations and to forge shared understandings of the problem and possible solutions. Climate change communications and engagement toolkits that are developed for use in a given context or community would be strengthened by considering the range of climate meanings present across the population. While segmentation studies are increasingly common, more nuanced and deeper investigations into the

underlying worldviews, value systems, and meaning-making that shape perceptions of climate change would provide more detailed understanding of the perspectives within such segments.

Developmental psychology also brings important nuances to the understanding of transformation, specifically regarding the mechanisms and manifestations of change that occurs in the personal sphere of transformation. The climate change field would do well to look to such a discipline that has advanced research in this area. Without these lenses, our collective capacity to make sense of transformation is hindered. These further studies on the personal sphere of transformation also need to consider its synthesis with the other three spheres, as per what cCHANGE is undertaking in Oslo, Norway. In this regard, I see the value of long-term, situated 'transformation labs' ("T-Labs"), akin to what Charli-Joseph et al., (2018) carried out in Mexico, that investigate the processes of transformations to sustainability. These types of empirical studies that are set up to foster the conditions through which transformation across all three spheres becomes more probable as well as designing the assessment tools to examine where and how transformation occurred would be helpful. Given the timelines we are working with in terms of carbon emissions reductions, such studies into the means, manner, and efficacy of transformation are best carried out as action research, in which researchers can experiment, prototype, harvest learning, and iterate successes in partnership with communities and organizations in regions where impact is sought.

Finally, more empirical studies into broader, deeper adaptation projects are needed, to understand the range of situated and embodied ways that local people understand and seek to respond to climate change as it arises in their home regions. The four-faces of adaptation provides an interesting starting point, but there are other ways to address this multifaceted understanding of adaptation, and more empirical work in this area would be helpful.

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8: Appendix Interview Guide

In this Interview Guide, the overview of semi-structured questions for the key-informant interviews, photo voice, and the co-generative learning process is provided.

Key-Informant Interviews

The questions in the key-informant questionnaire were semi-structured. Below is a sample of questions I would select from, however I added questions to encourage the interviewee to expand on certain points or clarify what they meant.

1) What is your name?
2) Tell me a bit about your involvement with coffee?
    a. How long have you been producing? Multigenerational?
    b. How is coffee production going?
    c. Has (and if so, how has) being part of a cooperative (or not) supported you?
3) Have you noticed any changes in the climate in recent years?
    a. How is coffee impacted by climate change?
    b. In what ways is your community affected by climate change?
4) What are the ways you are adapting or responding to these changes?
    a. What are some possible ways that the value chain could adapt to climate change?
    b. Can you explain how you respond to change as a cooperative?
5) How do you feel about the situation with coffee right now?
6) Let's imagine your grandchildren… If you were able to give a message about coffee to your grandchildren once they are grown up, what message would you want to give to them?

Photo voice

Research participants will use photography to explore and examine their own perspectives on climate change impacts in their community and ecosystems. The process will open with an informational meeting in which the purpose of the research is described, and the Information Form were signed by interested participants.

The photovoice process included an inquiry questions: 'What is climate change to me?' and 'How am I adapting?' Then, participants took photos over a period of time (2-3 days), followed by an interview in which participants downloaded their photos, selected their top three, and interpreted the meaning behind the photo in regards to the inquiry question.

The process continued with a focus group session in which the group identified a representative sample of the photos to reflect their collective message about each question as a community. Associated with each set of representative photos the group would identify a narrative to explain or describe its meaning and significance.

Step one: Gather, introduce the objectives and the agenda for the session

Step two: Participatory process examining each question and selecting which three photos best reflect the collective message. This included discussing and brainstorming what the shared messages and common themes were and prioritizing which photos best reflect the message.

Step three: Collate the photos and messages, and as a group reflect on key themes in what was learned. The semi-structured questions will be guided by the following format:

- *What* was the main thing you learned in this process of photovoice?
- *So what* does it tell you about climate change in your community and the coffee value chain, and about collaboration?
- *Now what* do you see needs to happen for you as a community and for the coffee value chain considering what we have learned?

Co-generative Learning Focus Groups

A co-generative learning process was held through a series of focus groups with representatives from across the value chain including the producers involved in the value chain in Guatemala. This co-generative learning process builds on the typical notion of a Change Lab (Westley, Goebey, & Robinson, 2012) and construes this more as a collaborative space for shared innovation, inquiry, and action towards positive collective impact on a shared goal, namely climate change adaptation in the coffee sector. This process was held as a series of focus groups to explore the question of what kind of collaboration could support the degree of transdisciplinary inquiry, multi-sector engagement, innovation and transformation for climate change adaptation to be successful, and to examine the role that coffee retailers might play in adaptation efforts. This included semi-structured and open-ended questions during the focus group to examine various aspects related to climate change, coffee, and collaboration. Below, the categories of themes are provided below, with some sample questions included.

The Coffee Value Chain
How does the value chain currently work?
Who's involved in the value chain, and what value do they add?
What about the value chain is strong?
What is the nature of that strength?
Where is the value chain vulnerable?
What are the characteristics of that vulnerability?
Where is there potential (for greater productivity, quality, or community resilience) that has not been actualized?

Climate Change
In what ways is climate change noticeable in the value chain right now?
What climate change impacts are expected for Arabica Coffee beans that we know about from other regions?
What climate change impacts could occur (or are occurring) specifically in the Guatemalan highlands?
What scenarios can we anticipate in terms of climate change impacts on coffee in this region, based on scientific projections and on anecdotal findings (including the photovoice data)?
How might changes in global coffee markets, in relation to climate change, affect prices and supply from Guatemala?

Adaptation Realities and Potentials
What are the ways that the value chain is already adapting to climate change by necessity?
What are the adaptive strategies already in place?
Where in the value chain are there weak points for climate change, and which do not have an adaptive strategy associated with them?
What are some potential adaptations along the chain?
What would different perspectives 'see' in this problem-set?
What new potentials arise when we consider those different viewpoints?
What types of systems and structures might need to transform?

Reflecting on Collaboration and Scaling
What happened in terms of the collaboration in this process?
What worked well, and what stalled or failed?
What could be scaled and how?
What was the greatest area of surprise, flow, and insight?
Are there areas of conflicts or areas of disagreement?
So what does this tell us about doing multi-sector, transdisciplinary collaboration?
So what might our group tell other groups embarking on a multi-sector collaboration?
Now what does this mean for adaptation in the coffee value chain?
Now what can or should happen next?

9: Articles I-V

I

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Integrating the four faces of climate change adaptation: Towards transformative change in Guatemalan coffee communities

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ABSTRACT

Despite the complexity of climate change, the dominant definition and practice of adaptation remains reactive, incremental, and focused primarily on biophysical and techno-managerial changes. Researchers suggest this is necessary but insufficient, noting the importance of integrating subjectivity in a more comprehensive approach to adaptation and in moving toward deliberate transformation in a climate change context. Here, I consider how to expand the scope and depth of 'adaptation' as it is currently defined and practiced, presenting an Integral conceptual framework that integrates the 'interior' forms of adaptation and thus can account for the diverse ways that local people are responding to entangled changes at the local level. Drawing on case study research in Guatemala, I explore how a more balanced integration of subjective and objective adaptive capacities, in individuals and collectives, leads to four types of adaptation—personal, practical, critical-structural, and co-generative. Findings describe: 1) how critical-structural adaptations were helpful in disrupting structural arrangements in ways that practical adaptations alone were not; and 2) that the interior adaptations (personal and co-generative) were less emphasized overall but can be effectively integrated, either implicitly or explicitly, with dominant forms of adaptation practice. This study demonstrates how a more comprehensive approach to adaptation may better position communities to engage in transformative change.

1. Introduction

> *Of all the oppositions that artificially divide social science, the most fundamental, and the most ruinous, is the one that is set up between subjectivism and objectivism. The very fact that the division constantly reappears in virtually the same form would suffice to indicate that the modes of knowledge which it distinguishes are equally indispensable to a science of the social world that cannot be reduced either to a social phenomenology or to a social physics. (Bourdieu, 1992, p. 25).*

Climate change adaptation, defined and practiced in a primarily technical manner, has been called "necessary, but not sufficient" (Pelling, 2011, p. 6), as it is mismatched with the actual complexity of the climate change issue (O'Brien, 2018). Ensor et al. (2019, p. 228) have described mainstream adaptation practice as not asking the right questions, which in turn shapes the definition and practice of adaptation towards technical adjustments, rather than recognizing the more complex entanglements of social, cultural, economic, political, and biophysical change. This can perpetuate business-as-usual development logics and structures that reinforce technocratic patterns of control, and fail to meet the dynamic intricacies of the climate change issue (Scoville-Simonds et al., 2020). O'Brien (2012, p. 673) emphasizes the need to gain a "deeper understanding of the human dimensions in order to inform transformative responses to complex problems such as climate change." As researchers seek this deeper understanding and conceive of what might be more commensurate with such complexity—subjective human dimensions—or what I refer to here as 'interiority,' is receiving increased attention in debates about global environmental change processes (Manuel-Navarrete et al., 2019). Interiority refers to the intangible, unseen domain of life in both the individual and collective spheres, including beliefs, understanding, morality, motivations, values, and worldviews (O'Brien & Hochachka, 2010). Gosnell et al. (2019, p. 1) describe how climate-smart adaptation, for example, involves more than technological innovation; rather, "it involves subjective, nonmaterial factors associated with culture, values, ethics, identity, and emotion." Pointing out the importance of interiority as well as its gap in mainstream adaptation, these scholars argue that alternative epistemological starting points for adaptation research and practice are essential for building more effective responses (Ensor et al., 2019; Nightingale, 2016; O'Brien & Hochachka, 2010), and some researchers go as far as to redefine sustainability as being contingent on the "congruence

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between subjective and objective dynamics." (Manuel-Navarrete, 2015, p. 1).

Yet, the subjective, interior dimension of climate change is the least well-represented in current adaptation efforts and it is not equally weighted with the other strategies (O'Brien & Hochachka, 2010; Wamsler & Brink, 2018; Woiwode, 2016). Climate change funding continues to privilege the natural and technical sciences over the social sciences by an enormous degree; as such, many of the key unsolved climate-change puzzles are in the realm of the social sciences and involve interiority, not the least of which include how the rapid and deep alteration of attitudes, norms, incentives, and politics called for across the climate change field might in fact occur (Overland & Sovacool, 2020). O'Brien (2018, p. 155) notes that "the objective and subjective dimensions. . .have been widely described in the literature on climate change responses, yet seldom integrated." Despite studies on the psychological dimensions of adaptation (Grothmann & Patt, 2005), on how to account for "emancipatory subjectivities" (Manuel-Navarrete & Pelling, 2015, p. 558), on the relationship between "human beings' inner dimensions and adaptation" (Wamsler & Brink, 2018, p. 55), on the role of "interiority" in climate change adaptation (O'Brien & Hochachka, 2010, p. 92), or on involving the subjective, non-material factors (Gosnell et al., 2019), further research is needed for how to meaningfully and rigorously *integrate* this understanding of interiority in climate change responses. Better integration of the subjective and objective dimensions of adaptation, in individuals and collectives, may provide a way for adaptation to be more deeply rooted than technical changes, and adequately address the structural and psychological aspects. When understood as more than an objective application in a region, adaptation becomes a process that is understood and experienced subjectively and worked out inter-subjectively amongst people.

Here, I explore the integration of these interior dimensions for a broader and deeper approach to adaptation, further iterating O'Brien and Hochachka's (2010) preliminary ideas for an Integral adaptation framework and taking the Bourdieu (1992) quote above seriously. Since the research gap is not in the *absence* of this scholarship on interiority per se, but rather in its integration into the overall field, I proceed with optimism that such integration may open up new potential for how to engage adaptation from an alternative epistemological starting point and in a transformative manner. This optimism derives from studies that suggest that some of the most powerful leverage points for systems change are actually interior, such as paradigms and worldviews (Abson et al., 2017; Meadows, 1997; O'Brien, 2016), and that the probabilities for transformation become generated as these exterior and interior dimensions are integrated in a more balanced manner (Esbjorn-Hargens & Zimmerman, 2009; O'Brien & Hochachka, 2010; Riddell, 2013). Throughout this paper, I explain the details and dynamics of what I mean by this in adaptation. For now, my point here is that important work ahead, particularly for adaptation practitioners, policy-makers, and researchers, may be to draw together and synthesize the subjective and objective perspectives that already exist in adaptation in novel ways, which may reveal unseen potentials or help to sharpen understanding of existing puzzles in climate change adaptation practice.

2. Background

2.1. Where the story begins

Climate change impacts are pronounced for coffee. Studies project that Arabica coffee (*Coffea arabica* L.)—70% of global production—is considered a climate-sensitive species, facing severe risks and projections with global warming (Davis et al., 2012), which is anticipated to exacerbate other stressors that producing regions face. Guatemala, for example, has the highest proportion of ecologically degraded land in Central America (currently 58.9% of the nation) (Magrin et al., 2014, p. 1514), is the most food insecure country in the region (affecting one third of population), experiences high rates of migration, and has the greatest impacts of climate variability and change in the region, all of which coincide in the coffee sector. The warming temperatures, associated increases in pests and plant diseases, and climatic variability present a complex challenge to an already socio-economically stressed rural population.

Producers are doing everything they can on their farms, largely with what is considered techno-managerial adaptation. Despite this, the problem seems to morph and shift swiftly, with unexpected challenges arising each year, leaving many to question whether technical adjustments are sufficient to address such a multifaceted issue. Constraining adaptation to primarily objective efforts (i.e. applying fungicides, retaining soil moisture, new seed varieties) reduces the full complexity at hand. Integrating subjective dimensions (i.e. beliefs, values, meaning-making, etc.) with those ongoing objective efforts may be crucial to be able to see the entire range of adaptative responses and, when taken together, may be able to reckon with the interlocking root causes of the issue.

2.2. Including the objectivity and subjectivity of adaptation

Technical approaches to complex issues are seldom enough, and research in climate change adaptation is increasingly critical of their limited scope and inability to address the structural aspects underlying the climate challenge. There are calls to rectify that situation, not only by taking a more critical approach (Pelling, 2011; Scoville-Simonds et al., 2020; Sherman et al., 2016), but also by coupling material and cognitive dynamics and integrating these subjective or interior dimensions more effectively (Gosnell et al., 2019; Manuel-Navarrete, 2015; O'Brien, 2018).

Albeit somewhat eclipsed by the dominant techno-managerial adaptation definition, literature on the interior dimensions of adaptation exists. There has been substantive work on the interior dimensions of environmental experience in the social sciences (Breakwell, 2010; Gifford, 2011; Markowitz et al., 2013; Weber, 2010), some of which preceded climate change scholarship. Among the forerunners was White (1945) who studied human adjustment to environmental change 75 years ago, including human perception, aspirations, and understanding, as part of what became known as a "wisdom tradition" in geography (Wescoat, 2006, p. 707). However, the issue of climate change presents a unique set of challenges today—with its scale, dynamism, and the fact that it is an "evolving construct" (Breakwell, 2010, p. 857)—requiring an adaptation that can coevolve with it, not as an external threat to be adjusted to or managed but as an internal aspect of our decisions, choices, and even values (Pelling, 2011). There remains a need "to develop and test frameworks that facilitate a systematic examination of the subjective attributes of climate change adaptation" (Fresque-Baxter & Armitage, 2012, p. 251) and to consider the connections between perception/awareness and behaviour change in adaptation (Gosnell et al., 2019), in both individual and collective domains.

To better understand the role that individuals' subjectivities play in adaptation, Grothmann and Patt (2005) developed a Model of Private Proactive Adaptation to Climate Change (MPPACC), which was later built upon by Frank, et al (2011). In these studies, the distinction was made between "objective adaptive capacity," what an individual could *do* as indicated by the availability and access to resources, and the "subjective adaptive capacity," which is their *perceived* ability to carry it out, or the extent to which they

felt they have control over global and regional environmental problems (Grothmann & Patt, 2005). These perceptions of agency when facing intractable issues and the ways in which individuals subjectively enact resilience are forms of personal adaptation.

In the collective domain, research has been done on the inter-subjective dimension of adaptation as well. Manuel-Navarrete et al. (2019, p. 2) view "collective intentionality as a key subjective force in the Anthropocene." Adger and Kelly (1999, p. 257) describe how "adaptation is socially mediated. . .as a composite of individual adaptation, such that adaptation comes about through activities which depend on the participation of group members in discourse, imitation, or shared collective or individual action." While many of the unpredictable variabilities in weather compound pre-existing inequalities and social stressors, nevertheless "there is reason to believe that positive consequences are also possible, as people take collective responsibility for a shared problem" (Swim et al., 2009, p. 8). Tschakert et al. (2016) describe how this requires collective learning spaces and ways to build emancipatory agency together, including "tools, processes, and practices that support the generation and exchange of knowledge and facilitate decision making" (p. 182). Scaling this more broadly, Manuel-Navarrete et al. (2019) describe how collective intentionality is a necessary force to disrupt unsustainable path dependencies.

What these researchers argue is that *objective* adaptive capacity—such as resources, affluence and socio-economic factors that predominate in mainstream adaptation studies is—important; however, the *subjective* and *inter-subjective* adaptive capacities in a region may actually be equal or even more important areas to focus on (Gifford, 2011; Grothmann & Patt, 2005). In response to this argument, an increasingly number of studies have, for example, sought to understand the role of beliefs, values, and worldviews in transforming individual and shared mindsets (O'Brien & Sygna, 2013), the emotional implications of climate change and for reconceiving "low-carbon subjectivities" (Head, 2016), the process of "subjectivization" in perpetuating path dependency (Manuel-Navarrete et al., 2019), the cognitive and psychological processes that underlie public opinions (Wolf & Moser, 2011), and the plasticity of meanings and range of worldviews on climate change that factor into adaptation decision-making (De Witt et al., 2016; Hochachka, 2019; Hulme, 2009).

More work is needed to bring that area of scholarship forward, ensuring it is more equally weighted, and integrating "inner/subjective dimensions" in adaptation (Brink & Wamsler, 2019, p. 1351) in both individual and collective forms. Yet, there has been a noted "absence of a common interdisciplinary framework for organizing and linking subjective and objective research" (Thomas et al., 2018, p. 8) including that found in climate adaptation. This is the gap I address in this paper.

3. Towards an Integral framework for adaptation

In seeking a more integrative framework, I found that some calls for more 'holistic' responses to climate change carried an impractical sense of needing to include *everything*. Thomas et al. (2018) suggest this is particularly the case when the boundaries on what ought to be included are not clear and the measures to determine what is most significant are absent; they argue that rather than attempting to include multiple *disciplines*, it is prefer-

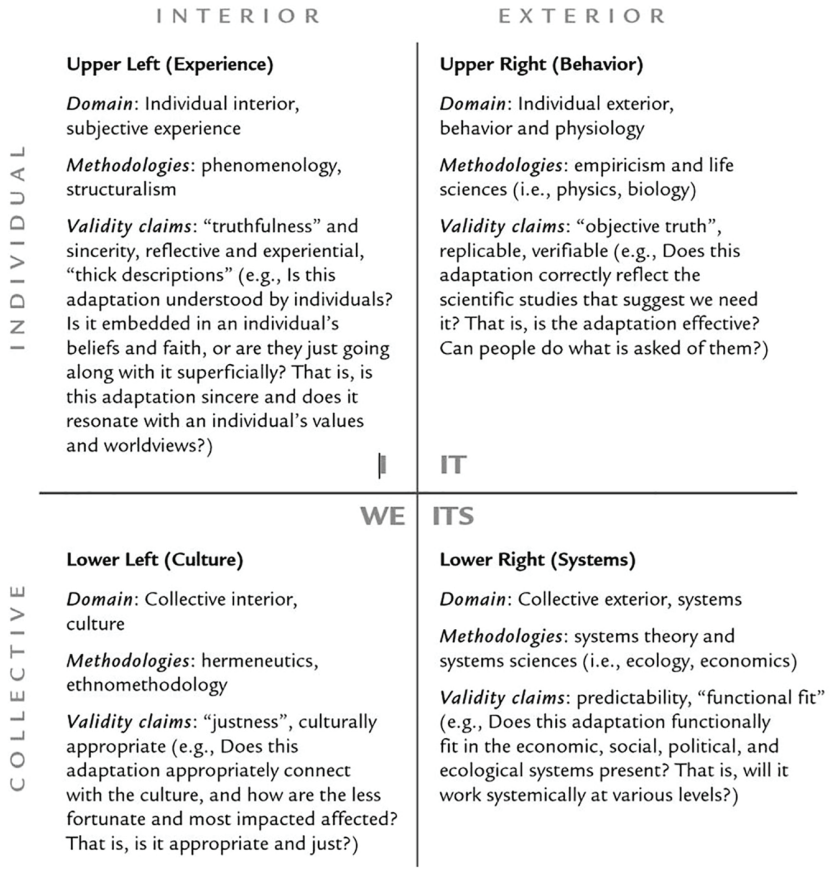

Fig. 1. The Integral framework's four domains of reality, with validity claims related to adaptation (adapted with permission from O'Brien and Hochachka (2010, p. 93)). This approach has also been applied to sustainability (Brown, 2006; Riddell, 2013), ecology (Esbjorn-Hargens & Zimmerman, 2009), and climate change (Esbjörn-Hargens, 2010); Morgan et al., 2012; (Riedy, 2008)).

able to include multiple *perspectives*. I found that the quadrants of the Integral framework were useful in this respect. By combining first-person perspective and third-person perspective (individual and plural), these quadrants disclose four domains of reality: experience, behaviour, culture and systems (Fig. 1). This has been theorized by Wilber (1996), applied in ecology and sustainability (Brown, 2006; Esbjorn-Hargens & Zimmerman, 2009), and applied in a preliminary manner to climate change adaptation by O'Brien and Hochachka (2010) and Morgan et al. (2012).

In Fig. 2, I posit that climate change adaptation has four irreducible expressions or faces, made up by the interior or exterior dimensions of individuals and collectives. The interior dimensions are considered subjective and inter-subjective aspects of individuals and collectives, respectively. The hypothesis is *that deliberate inclusion of more quadrants and perspectives (be it implicitly or explicitly) would lead to a more comprehensive adaptation—possibly even rendering an alchemical emergent* (which is further explained in point 3 below). If true, it would support climate change policy-makers and practitioners in expanding the concept of adaptation to include all four of these aspects that are important to people in responding to change and may also shift the focus away from treating climate change as a technical problem to that of an adaptive challenge.

The Integral adaptation framework includes certain propositions; the following four are relevant to this study:

1. First, the quadrants are implicit and inherent to people's experience. When deliberate attention or intention is brought to bear on the processes or practices in these dimensions of experience, these four quadrant-domains could be described as being 'more balanced.' For example, every individual coffee producer has a subjective, interior dimension (Upper-Left quadrant), but not everyone deliberately includes interior, *personal adaptation* processes as they go about coffee production. Or, every group of coffee producers has inter-objective ways in which they functionally-fit within other systems in a region (Lower-Right quadrant), but not every group intentionally includes a deliberate *critical-structural adaptation* for how they participate in those systems.
2. It has been proposed elsewhere that this greater balance may produce wellbeing or 'inherent health in the all-quadrant occasion' (be it, in a cooperative, family, community, or individual), and vice versa (i.e. a deficiency in one area can stall progress in others) (Esbjorn-Hargens and Zimmerman, 2009). Therefore, while gaps are not necessarily problematic, they ought to be examined carefully, as they may indicate an imbalance of focus or that an important aspect of comprehensive adaptation has been missed, and synergies warrant close study to see how elements came together, why, and with what effect. If this framework is applied explicitly, it would be possible to design adaptation policies and programming with a deliberately broader, deeper scope, carried out individually (i.e. by a farmer or by a policy-maker) or in a group (i.e. by a cooperative executive committee or by an NGO board of directors).
3. Integration happens through including the first- and third-person perspectives of individuals and collectives, thereby creating the conditions for adaptation in personal, practical, co-generative, and critical-structural forms. Engaging these four expressions of adaptation in a deliberately more balanced way—whether that is done implicitly by engaging processes in these inherent aspects of experience or explicitly by applying such a framework as this—opens up different framings of the problems and different types of solutions, and could affect some type of 'alchemy,' in which a whole emerges that is greater than the sum of the parts. This could include transformation, defined here as a "significant change in form, structure and/or meaning-

	Interior	Exterior
Individual	**Personal adaptation** Personal competencies such as attitude, values, self-regulation, resilience, or metacognitive skills, that support individuals in how they orient psychologically to meet the adaptive challenge. ***Subjective perspective*** - *Occurs as* individuals build or maintain personal wellbeing, resilience or anti-fragility in order to stay well in the face of ongoing, unexpected, entangled impacts of climate change. - *Includes* the personal processes used to be whole and well, resilient (bouncing back into shape) or antifragile (bouncing forwards into greater wellbeing); to become aware of the situation one is in; to draw on insight and intelligence from within.	**Practical adaptation** Technical or behavioural competencies to bounce back, diversify, shift practices flexibly, be practically resilient to impacts, or dynamically prepare for what might come. ***Objective perspective*** - *Occurs as* individuals apply new skills, practices or technologies in order to stay well in the face of ongoing, unexpected, entangled impacts of climate change. - *Includes* the behavioural changes and technical efforts taken towards adaptation; includes managerial or technocratic solutions; can be 'innovative' when working on longer time-lines.
Collective	**Co-generative adaptation:** Inter-subjective or inter-personal competencies for adaptation, such as social capital, networking capacity, or collective processes working together on complex problems, in order to stay well specifically towards climate change. ***Inter-subjective perspective*** - *Occurs as* groups maintain their collective wellbeing, resilience or anti-fragility, collectively problematizing an issue, building social awareness, and for developing a shared vision towards adaptation. - *Includes* the inter-subjective capacity to react, problematize and vision collectively, to maintain social resilience or develop antifragility.	**Critical-structural adaptation:** Systems competencies to challenge, contest, reflect on, advocate for, or create the systems and structures needed to support adaptation in a way that also considers the overall developmental trajectory and the deeper interlocking causes of climate change. ***Inter-objective perspective*** - *Occurs as* groups address the structural and systemic dimensions underpinning the impacts they are experiencing, to address the aspects needed to stay well in the face of change. - *Includes* the inter-objective competencies used to contest existing systems and re-create new ones that are more adequate to the task of ensuring sustainable livelihoods in a changing climate.

Fig. 2. The four faces of adaptation (Brown, 2006; Esbjorn-Hargens & Zimmerman, 2009; Morgan et al., 2012; O'Brien & Hochachka, 2010; Wilber, 1996).

making" (Leichenko & O'Brien, 2019, p. 180), and may contribute to the understanding of how fundamental, step-changes of the sort proposed by 'transformational adaptation,' as compared to 'incremental adaptation' (Kates et al., 2012; Few et al., 2017), may come about. O'Brien and Hochachka (2010) even suggest that adaptation may require active engagement with, and changes in, worldviews, belief systems, and values, which they suggest occurs through this deliberate integration of interiority.

4. However, questions remain in the literature regarding the pathway from comprehensive adaptation to transformation. Some scholars suggest is not necessarily linear, but rather is *enactive*, which means brought forth or disclosed by a series of behaviors of a perceiving subject or subjects (Di Paolo et al., 2010; (Esbjörn-Hargens, 2010); Wilber, 2006). The proposition here is that *a well-rounded adaptation may increase the probability of transformation being enacted*. This paper engages this in an exploratory manner, but is not explanatory and does not undertake a rigorous test for whether transformation had occurred, which, albeit an important future question, would not only require more space and a different design, but is also a contested subject (Salomaa & Juhola, 2020). Rather, I attempt to connect the ideal of transformation with the practice of adaptation, through an emphasis on the meaningful integration of its four faces, which O'Brien and Hochachka (2010, p. 100) proposed:

> can foster radical transformations in the way that we think about responding to change, from something that society manages through behavioral and systems changes to something that humans consciously create in alignment with their beliefs, values, and worldviews.

To the extent possible, I reflect on the evidence of transformation using the above definition and this quote as indicators.

4. Case study of adapting to climate change in coffee growing regions of Guatemala

4.1. Research design

Are these four faces of adaptation present in how people navigate complex change processes due to climate change, and if so, how are they relevant? What insight could be gained from this for possible application in other unstudied regions?

To study these research questions, I carried out qualitative case study research in the coffee-growing region of Guatemala. Three trips were conducted from 2017 to 2019, for which ethics approval had been granted by the Norwegian Center for Research Data. I used an abductive research approach (Dubois & Gadde, 2002), which entails iteratively moving between inductive, open-ended research to "soak and poke" in the details of the case and casting my net widely for alternative explanations to more deductive attempts to verify hypotheses (Bennett & Checkel, 2015, p. 18).

I structured this research as a pathway case study (Nome, 2007) which "aimed to gain insight into the mechanisms that connect some explanatory variable (X1) to some outcome (Y) in specific cases," (Weller & Barnes, 2016, p. 430) from which insights could then be used in other case sites that feature a similar X1/Y relationship. The outcome I was interested in was the approach to adaptation being taken. I selected these cases based on an expected relationship between X1 and Y (coffee-growing regions facing some degree of challenge due to climate change), yet chose two case study sites that contained sufficient variation so to gain a perspective on the findings (Box 1). The two cases shared certain core similarities (both being coffee growing regions in the same nation and selling to the same buyer within the same value chain (X2 variables); yet, these cases could be considered 'most diverse' (Seawright & Gerring, 2008) as they also contained a lot of variation due to their spatial, historical and ontological differences (X1 variables, described further below).

Box 1. Independent Variables		SPN	MATA
X1 explanatory	q Spatial – highlands, distant from urban center, small producers, higher vulnerability	√	
	r Historical – civil war, cooperativist, critical-awareness / liberation theology	√	
	s Ontological – indigenous Mam, spirituality integrated (traditional or integrative worldview), gender influence (predominantly women)	√	
	t Spatial – dry corridor, close to urban center, larger prodcuers, more privilege and wealth		√
	u Historical – less war and more stability and privilege, individualist, higher technology		√
	v Ontological – Ladino, modern worldview, gender influence (predominantly men)		√
X2 controls	A Coffee production at over 1700 ft above sea level	√	√
	B Long histories of coffee production	√	√
	C Same primary buyer in global value chain	√	√
	D Same global value chain	√	√
SPN: q r s ABCD = Y (or, X1[qrs] X2[ABCD] = Y)			
MATA: t u v ABCD = Y (or, X1[tuv] X2[ABCD = Y)			

The design entailed careful use of evidence in a two-step study: first, to examine the main and rival hypotheses, by applying heuristic Bayesian reasoning (rather than the full mathematical apparatus of Bayesian analysis) to 'mentally inhabit the world' of each hypothesis and assess which one makes the evidence more plausible (Fairfield & Charman, 2020, pp. 15–16) (see Appendix 1); then, to consider the pathways to these different outcomes and what insights could be drawn from their differences (Fairfield, 2013; George & Bennett, 2005).

4.2. Background to case study sites

Both cases are located approximately 1700 feet above sea level (Fig. 3) and have long histories of *Arabica* coffee production as a main income-generating activity. Spatial, historical, and ontological differences exist in the two regions (Box 2), which become important in understanding their approaches to adaptation.

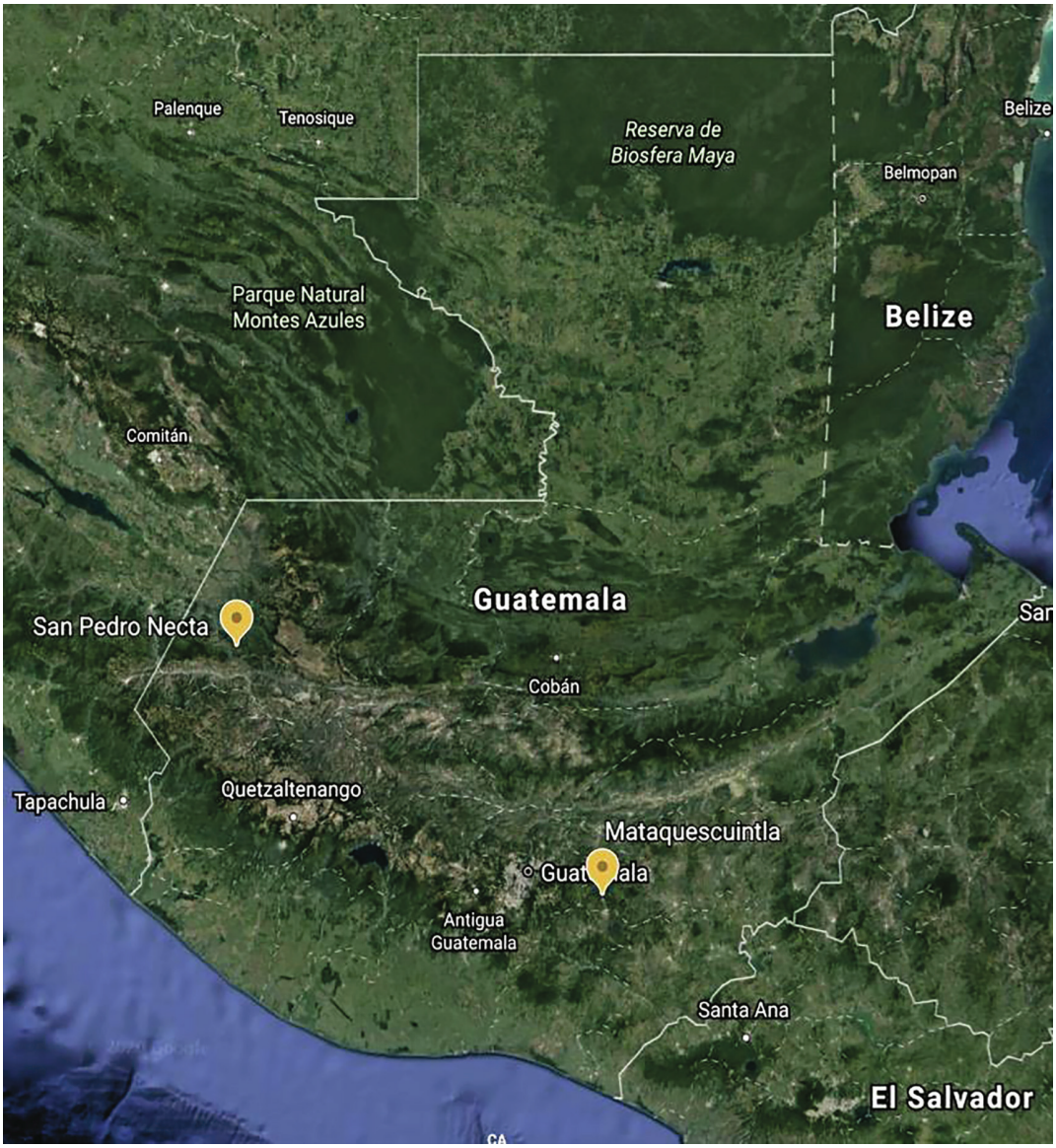

Fig. 3. Map of research sites in Guatemala.

Box 2: Case Study Sites (Instituto Nacional de Estadistica Guatemala, 2018)	
Mataquescuintla (population 41,818)	*San Pedro Necta* (population 38,510)
Jalapa Department, 2.5 hours from the capital	Huehuetenango Department over 9 hours from the capital
Dry Corridor ecosystem	Western Highland ecosystem
Largely non-indigenous Ladino population (98.7% of total inhabitants)	Largely indigenous Mam population (82% of the total population)
Medium- to large-scale coffee producers.	*Small-scale* coffee producers

Spatially, economic potential is higher in areas closer to the capital city, in regions with favorable soil and road conditions, such as found in Jalapa; whereas the highland region of Huehuetenango is in a lower-per capita income bracket (World Bank, 2004, p. 33) and is more vulnerable socio-economically, consisting of smaller landholders, less infrastructure, difficult topography, and limited access to credit and financial capital (Cox et al., 2009; World Bank, 2004). These regions "tend to have lower levels of education, larger families, and strong communal traditions and cultural values that are not well understood in the context of the market economy" (World Bank, 2004, p. 3). Mataquescuintla, in the Dry Corridor, has more negative impacts attributable to climate change compared to SPN, in the more humid highlands, although SPN could be considered to be more vulnerable to those impacts having higher per capita poverty.

Historically, Huehuetenango was heavily affected by the Guatemalan Civil War (1960–1996), with much of the armed conflict being directed towards the indigenous Mayan populations. It had strong Leftist resistance and a prominent Catholic liberation theology influence during the war, and since that time, a preference for cooperative organizing (Jonas, 1991). In contrast, Jalapa in the southeast experienced less armed conflict and, being located so close to the city, a higher overall per-capita income, better roads, and more consistent markets, as well as larger farms and more

options to diversify production (Cox et al., 2009). Although Mataquescuintla's demographic characteristics made that region more privileged than SPN, on the other hand, the latter had had to reckon with, and build social networks for, persistent social, economic, and political hardships for many decades.

These regions have different worldviews, cultures, and religious affiliations, which create differences epistemologically (i.e. ways of thinking) and ontologically (i.e. in terms of the nature and relations of being) (Escobar, 2020), and which elsewhere has been found to influence adaptive capacity (Paerregaard, 2013; Pyhälä et al., 2016; Scoville-Simonds, 2018). SPN demonstrated a more *collectivist* culture, perhaps due to the exposure to Leftist-thought, which was resonant with and supported by both the Catholic social programs during and after the civil war as well as from the indigenous Mam influence. Both the Catholic Church and the Mam indigeneity—which are substantially woven together in the region as evidenced, for example, in the Mam practice of burning candles in the Catholic churches and praying the rosary on certain important Mam occasions—were heavily undermined and dismantled for political reasons during the civil war, by both the military as well as factions in the Evangelical church (Cobos García, 2006). However, aspects of the Mam cosmology are seen in the town and surrounding rural area (e.g. medicinal plants and ritual materials sold in the market suggesting the Mayan healing practices continued, women wearing traditional dress and continuing to practice Mam traditional weaving) and in some households (e.g. use of a Mayan wood-fired sauna), such that I could reasonably suspect that aspects of the worldview remained. For example, I noted a palpable openness to subjective experience in SPN, the latter demonstrated in the practice of prayer integrated into the course of daily life and organizational operations, suggesting possible influences from an *indigenous* cosmology, in which self (subjectivity) and nature/-world are not ontologically separate (Escobar, 2020).

Mataquescuintla demonstrated a more *individualist* culture, demonstrated by the individually-run farms and higher usage of innovative technology (e.g. sophisticated nurseries and irrigation systems). The population being almost entirely Ladino gave it a Western feel. While there was some Catholic religious affiliation, this was less evidently an integrated part of social life (e.g. prayers not included prior to meetings) and the mode of expression of people I spoke with was logical and rational. Although the lower levels of education were similar in both regions, people in Mataquescuintla had higher secondary and post-secondary education than those in SPN: 20% more secondary and 25% more post-secondary education (Instituto Nacional de Estadistica Guatemala, 2018). The values for freedom, progress, and achievement was suggestive of a *modern* worldview, defined by Leichenko and O'Brien (2019, p. 59) as that which "stress[es] individuality and the importance of rational inquiry. . .[and] trust in technological progress."

4.3. Methods, validity and analysis

My sample included 28 interviewees in both regions (15 in Mataquescuintla, 13 in SPN). This began through snowball sampling, but later was more purposive. For example, in Mataquescuintla I sought to interview a woman and sought a meeting with the Colisena cooperative as male producers and individual farmers predominated the sample up to that point. I did the same in SPN, but typically in reverse (i.e. male interviewees, unassociated farmers). In this way, I sought to ensure my sample was adequately representative of the coffee producers in both regions, despite the possibility of some intra-region variation.

The coffee producers I met with in Mataquescuintla (13 men, 2 women) were middle- to large-scale producers on farms that ranged from medium (50–100 manzana, 1 manzana = 8353 square meters or 2.064 acres) to large (upwards of 300 manzana) with the exception of two temporary workers and one permanent employee. In SPN, research participants (7 women, 6 men) were small producers, meaning they produced coffee in a family-run manner on less than 50 manzanas of land; some worked in administrative positions in the coffee cooperative. Their names and positions are anonymized.

Methods included key informant interviews, site visits, participant-observation, and focus groups, which were conducted in Spanish. The primary researcher (myself) and research assistants spoke Spanish. Although some of the respondents in SPN spoke Mam as their first language, they spoke Spanish in a professional setting. An associated aspect of this study, although not reported on here, was the use of photography linked with questions (i.e. photo voice) in the indigenous SPN, which provided Mam-speakers with a non-linguistic way to share their ideas. Although I do not include the data from photo voice in this cross-case comparison—because I had not used that data-collection method in Ladino Mataquescuintla—it did assist me in SPN on checking for internal validity on subjective topics in the interviews and focus groups.

The interviews were semi-structured and often accompanied by a site visit to the producers' farm, wet mill, or workplace; some were walking interviews. The themes of the interview protocol were: 1) the respondent's background and current practices in coffee production, 2) the climatic changes they had observed over time, and 3) their past, present, and imagined future responses to those changes. The second set of questions frequently led to responses about broader changes in the region, in which respondents shared their views the natural world and its changes, and their roles/responsibilities in such change. Sometimes I prompted the interviewee with follow-up questions, such as "*How do you feel about that?*", and I also included some 'blue sky' questions in the third set, such as "*Imagine into the future when you are a grandparent (or an elder), what would you advise your grandchildren (or younger people) about climate change?*", which has been found to be helpful in reframing an issue more broadly (Berger, 2014) and which I found helpful for eliciting personal (subjective and inter-subjective) perspectives.

I conducted focus groups in each community. Two focus groups (n = 12) in Mataquescuintla were held with members of the Colisena cooperative (*Cooperative of Non-Federated Coffee Producers*); these were largely different respondents than I had interviewed. In SPN, I held three focus groups (n = 10) with the Asaspne cooperative (*Asociación de Agricultores El Esfuerzo de SPN*) with the same respondents that I had also interviewed. The questions that guided the focus groups pertained to what 'climate change' meant to coffee producers, what changes and impacts participants had observed in the region, what common themes participants identified with or could add to from other responses in the group, and how participants were adapting and responding to stressors and challenges. The focus groups included gentle prompts for people to reflect on deeper meanings and beliefs they held about certain things, such as nature, changes over time, and society (including gender).

The research design included multiple verification strategies (Maxwell, 2013). These included triangulation of both methods and sources (many respondents were consulted multiple times with different methods in various settings) so that I could ensure I had reached data-saturation on the topics of interest and check whether or not what I heard on one farm was relevant elsewhere. Given the nature of some of the subjective aspects that I was interested in, I also distributed my research trips across 1.5 years, involving an ethnographic-style immersion in the case study sites, thus building rapport and mutual trust. The abductive approach and the use of process-tracing helped me in exploring alternative hypotheses and counterfactuals. By limiting travel in 2020, the glo-

bal COVID-19 pandemic affected my ability to conduct member-checking of the interview transcripts. However, I sent specific quotes that appear below for participants to check, and then, as per Birt et al. (2016), synthesized the slight elaborations they had sent back to me with their original quotes. I also emailed both cooperatives a translated summary of this paper, including the Results section. The strengths of my methods include depth and richness, and a possible limitation is that of generalizability.

Qualitative data analysis included note-taking, transcribing, and coding the interviews and focus groups, both manually and using NVivo (Miles et al., 2014). I coded transcriptions for what the data sought to explain (interior/exterior, collective/individual forms of adaptation) (O'Brien & Hochachka, 2010), which pronouns were used by the interviewee to describe this phenomena (i.e. "I", "we" or "it/its") (Wilber, 1996), and what forms of knowing (perspectival, participatory, procedural or propositional) were demonstrated (Vervaeke, 2019), based on Figure 2 and further explained in Appendix 2.

5. Results

The results found that coffee producers in the two regions adapted to change in diverse ways, weighting their adaptations differently across the quadrants (Figure 4). Mataquescuintla stressed the primary importance of practical adaptation (73%), with some references made to the critical-structural adaptation (16%), and with fewer references made to the interior adaptations (8% and 3% respectively). SPN described a more even spread of adaptations, with the practical and critical-structural at 29% and 35% of total responses coded, and with the personal and co-generative adaptations at 20% and 16% respectively (or, combined, 36%).

Overall, it can be seen that the interior adaptations (personal and co-generative) were less emphasized over the exterior (practical and critical-structural). However, in SPN, their distribution was more balanced, even though the exterior adaptations remained twice that of the interior (with 36% Left-Hand quadrants and 64% Right-Hand quadrants.) Below, I examine the differences between these two cases depicted in Figure 4, examining the forms of adaptation in each quadrant.

5.1. Practical adaptation

Practical adaptation was employed by coffee producers in both regions like the front-lines of defense against climate change impacts. The top four of these practical adaptations consisted of 1) adding inputs into the coffee, such as fungicides, fertilizers, and mulch; 2) managing the coffee farm well, through pruning back the coffee, retaining soil humidity, and maintaining the shade trees; 3) planting different varieties of coffee which were more resistant to leaf rust, and 4) diversifying income generation, which (if affordable) included new export crops, external training, and also included migration to secure livelihoods elsewhere.

Additional inputs to manage the impacts of climate change made up the majority of codes in this quadrant. Adding more fungicide, more frequently, was reported as effective to keep the *roya* from spreading, but the additional applications are expensive. In Mataquescuintla, it was explained that as soon as a producer finds a case of *roya*, they apply fungicide in a 25 m circle around that tree, and "this now makes up 65–70% of their costs for production," the most-costly part of the operation (Respondent Mata 20). Similarly, in SPN, one respondent explained, "One must apply fungicide so that the *roya* won't spread every 45 days" (Respondent SPN 32), which can mean applying fungicides 4–5 times per year rather than the typical 1–2 times.

The second area of practical adaptation was the overall management of the coffee farms which included proper pruning, maintaining shade trees, correct timing for harvesting berries, and collecting the waste-water from processing the beans. One producer in Mataquescuintla explained how they've "had to return to the traditional coffee cultivation: sustainable, more shade forest, and less intensive agriculture" (Respondent Mata 11). In SPN, some respondents described how they learned new techniques for managing the coffee farms through technical support from the Catholic

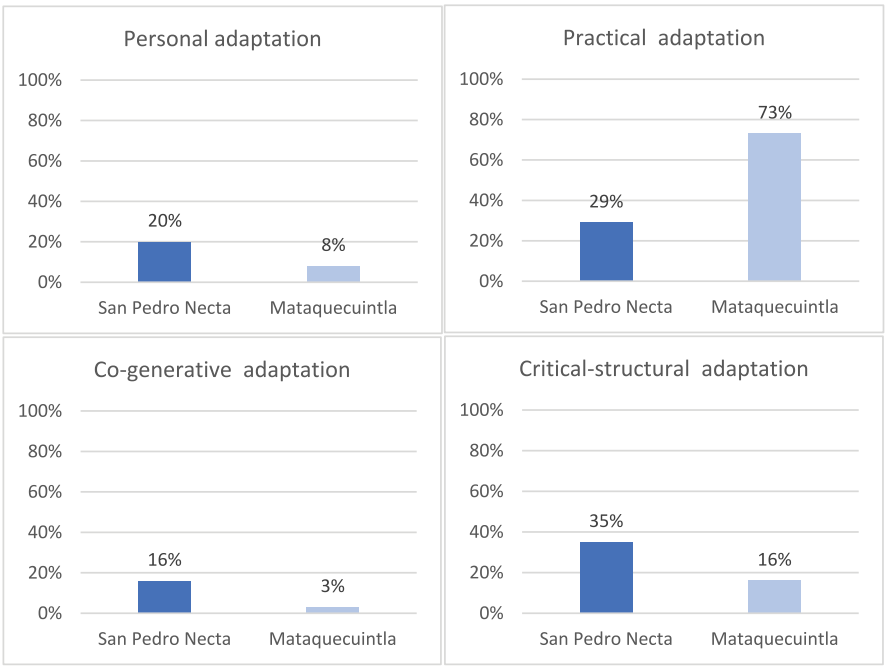

Fig. 4. Percent distribution of adaptations by quadrant (percentage of responses from interviews and focus group data were calculated based on the number of codes in each quadrant out of the total responses in each community. This mitigated for any quantitative difference in data collected in each community).

Church and from Anacafe (National Coffee Association), organized via the cooperative Asasapne: "Experts from the Catholic Church, helped us with technical support for the coffee plantations; I learned to sow along the contour lines so that the soil doesn't slip away [erode] and so that the water is retained" (Respondent SPN 27).

The third area of practical adaptation was the use of rust-resistant varieties to combat some of the climate-related impacts on the coffee. "A strategy that we've tried is to use new varieties of coffee plants in the coffee farms, some that are resistant to *roya*. We have analyzed this [across the farm] and 'renovated' the coffee trees that were susceptible to *roya*" (Respondent Mata 16). However, varieties that are resistant to *roya*, such as *Catimor* and *Sarchimor*, while they may be a stop-gap measure, were later found to not produce a quality cup and had to then be eliminated from the plantation. Explained one respondent in Mataquecuintla, "The truth is, we don't know what is coming next: we don't know what resistance we'll need [and] what varieties to sow" (Respondent Mata 24).

In Mataquecuintla, income diversification was a central adaptative strategy. For example, one respondent explained, "Another thing that can be done is to plant timber between the coffee plants, so that one is producing two things on the land" (Respondent Mata 13). The majority of producers I interviewed in Mataquescuintla had invested in a second or third industry on the coffee farm, such as poultry for sale to McDonald's, tomatoes for sale to Burger King, water to be sold in plastic bags locally, and timber. Other respondents there spoke about other diversification possibilities, such as Payment for Environmental Services, *Pin-For* program in which farmers were compensated financially by the state for maintaining their forests, or planting other income-generating trees, such as macadamia nut.

SPN did not use diversification as an adaptive strategy in the same way. Respondents explained that this was largely because they were small producers and part of the defining difference between small- and medium-sized production was precisely whether people had access to land and financial resources to diversify industrially into other products. One woman did small home-based income-generating businesses, such as, selling frozen chocolate bananas out of her kitchen and selling Avon products; however, it wasn't at the industrial scale of Mataquescuintla. The one producer in SPN who had diversified into tomatoes did so with money earned living in the USA for five years; during which time, he also raised funds to buy his property, the coffee trees for the farm, and to build his house. I heard about this type of USA-based savings strategy from at least two other coffee farmers as well as anecdotally from other people in SPN.

In both regions, migration was indeed a possible 'income diversification' strategy, sometimes to Mexico, more often to the USA; "Our parents cultivated coffee. I can cultivate coffee; I want the means to sell better—I don't want to have to go to the USA—but my son won't cultivate coffee if this business doesn't become sustainable" (Respondent Mata 23). In SPN, 7 out of 13 respondents had family members living in the North (which was not something I had asked formally in the interviews, but was mentioned as part of other answers). Explained one respondent in SPN, "Some men have already migrated to the U.S. and they send funds from there so that their wives can maintain the coffee plantations" (Respondent SPN 6). One producer in SPN had been given a development grant to employ 50 coffee workers to help reduce the drivers of US-migration.

5.2. Critical-structural adaptation

The majority of respondents in Mataquescuintla expressed frustration by their economic fragility in a global market and lack of voice in political-economic decision-making, both exacerbated by ongoing climate variability. A small minority of farmers, however, were fortunate to have secured a buyer who approached the coffee trade differently; as one respondent explained: "There are 'innovative people' who have differentiated themselves in the market, like 'James' (pseudonym), who have come to the field to do direct trade" (Respondent Mata 13). This innovative buyer bought at a price that was intentionally above the cost of production, invested in social programs in coffee communities, and sought to better understand the present and anticipated climate-realities in coffee-producing regions—and the arrangement demonstrated a small-scale case of critical-structural adaptation. However, these innovative practices did not necessarily add up to a restructured system of trade. Respondents noted the need for more such buyers like him:

> Do you know 10 more like James with that vision? with that deep conscience? James [who had first come here 27 years ago] had anticipated almost 30 years ago what we would like to see happening [here in this coffee growing region], I wish there were 1000 'James' in all of Guatemala (Respondent Mata 16).

Most of the respondents did not have access to this arrangement and instead sold into the general coffee market; some said they felt on the brink of giving up.

In this context, a group of producers in Mataquescuintla had amended the focus of the existing Colisena cooperative to be able to advocate for structural changes in the coffee sector, specifically for greater representation and equity for producers. "What we've tried to do is liberate a movement to support coffee workers" (Respondent, Mata 16). They further described how this advocacy for greater economic equality would support coffee producers in dealing with increasing costs and hardships due to climate change. This was an example of critical-structural adaptation.

In SPN, critical-structural adaptation was a key part of their response to change. The Asasapne cooperative was founded in 1989 to leverage greater equity for small producers in the coffee value chain.

> If we have fair-trade certification, we earn more from our product. And, for the small producer, [this gives us] many opportunities to look for more markets and training opportunities (Respondent SPN 22).

This also included mechanisms to secure financing, such as credit advances, donations, and grants, as well as other organizational supports for producers, some of which supported practical adaptation on the farm, such as, providing new coffee varieties, fertilizer kits, seedlings of shade tree species, or organic fertilizers. The cooperative also supports community resilience, including funding education and women's economic empowerment, and is involved in other global social movements, such as the Slow Food and Fair Trade Organic movements.

5.3. Co-generative adaptation

Co-generative adaptation was less present in the Mataquescuintla sample, but it was found to be important in SPN where respondents relayed a preference for collective organizing. They described how as a cooperative they learned, visioned and prayed together, problem-solved collectively, and supported each other mutually.

> Organization and unity are needed, to have strength, to have weight. Because if not, if you are only one, no... If there weren't others... No. There has to be others, so that when other organizations come along, it can be noted that you are associated, you are organized together. (Respondent SPN 27)

The way this was expressed made it seem like 'being organized' was a self-evident need, which in turn directly supported the other aspects of coffee production. This respondent went on to describe how "one feels that they are not alone, that they are associated like a family," and how this was particularly important in responding to climate change: "It is necessary that we all unite for this cause, so that together the fight against [there being no] pollution is greater" (Respondent SPN 27). This exhibited collectivist values, which may have had links with Mam cosmology or Leftist thought, and in some cases was referred to in a context of Catholic social programs, yet this was not explicitly framed as a political ideology or via Mam cosmology as such.

Other respondents described that among the top benefits of being with the cooperative was the capacity-building and shared learning that was available through it. That social capital was also drawn on to address other issues, whether those issues arose on the farm, in the market domain, or in the family unit. In relation to shared problem-solving processes, for example, one respondent described:

> We first talk about the difficult things people are each facing, each can express how they feel, later after speaking of all the negative things that we are feeling, we consider the Word of God. After that, we search for strategies, each one exposes what they feel they need, and after all that what we do is search for solutions that we know we can do to resolve this problem. . .and then put into practice each of those things. (Respondent SPN 6).

This prayer was pragmatic (integrated into meetings), was interchangeably Evangelical and Catholic, and seemed to provide a way to unify them to each other, with a higher purpose, and to their subsequent actions as a group.

5.4. Personal adaptation

Respondents also described how they individually stayed well in times of change, what I refer to as *personal adaptation*. This differed in kind and emphasis in the two case sites.

In Mataquescuintla, respondents noted this interior dimension inherent in their experience, but placed less emphasis on processes of personal adaptation as such. Some noted strong emotions, such as:

> frustration, sadness; because there is no incentive [to carry on], because one wants to give one's family [a] better [life], he wants to give them a better status, to bring them at least the basics (Respondent Mata 16).

Others carried personal attitudes or positive affirmations, such as "It is unsustainable to just cultivate coffee now; but *hope always lives*" (Respondent Mata 21, italics added). Others conveyed how their personal conviction was helpful as a source of confidence; as one man explained, "When I began the tomato nursery, my neighbours said, 'You are crazy to plant tomatoes in a green house!' But, in my sense of this, *pioneers are always crazy*" (Respondent Mata 11, italics added). Others described their faith as a support, such as one respondent explaining how he "called out to God in the middle of the coffee farm" (Respondent Mata 15) at the height of the leaf-rust crisis. These examples reflect the inherent interior dimension that was present for these farmers; however, these were not descriptions of processes for consciously working with their own interiority when faced with adversity per se.

In SPN, processes for personal adaptation were evident. Some respondents described how they reflected on whether their own actions were in alignment with their awareness. Others explained how they held a positive attitude of resilience in striving to overcome obstacles and personal convictions, including maintaining an "entrepreneurial spirit" (Respondent SPN 6), and others reported educating their children about their own potential to meet adversity. This suggested links between interior adaptive capacities and the ingenuity and tenacity needed for successful practical adaptation.

Some sought interior practices from within their religious-referents. Respondents recounted how their faith (Evangelical and Catholic religions) provided them a personal support through uncertainty and fear, making up a substantial set of codes for personal adaptation. This was to alleviate stress in hard times, to feel centered and calm, as well as a driver and stimulus for agency. One interviewee explained:

> The church alleviates stress. Because to go to church, one feels more relaxed when one returns home, things feel more beautiful. If you have problems and you go to the church, you leave your problems there, and then you return to your house with a different mentality, one of greater reflection about life (Respondent SPN 6).

These quotes spoke to the interior resilience gained through a practice of faith, but also the need for action:

> If we don't have love for God's creation, it is said we don't have love for God. I might say I am going to love and believe, I have faith in God, but if I am not taking care of what he has given, if I am not going to care for it, what is the use of praying? If I am not respecting God's creation, it is of no use to me [to pray]. It is of no use even though I am praying all day, but if I am not taking care [of my surroundings], I am not loving God. That's what I say. . . If we don't have love for God's creation, we don't have love for our neighbor and we don't take care of what God left behind, [but] if we love God, then we [must also] love Nature (Respondent SPN 2).

A respondent in Mataquecuintla also pointed out this need for more than just faith:

> [You may have] faith in God that the following winter may be better, but if [that isn't so] how do you get by? You are going to sell a part of the plot. . .but you are going to have to sell very cheap, because the other neighbor is doing the same! This starts a chain reaction, a domino effect, which realistically leads to poverty (Respondent Mata 16).

Both of these above quotes call for an integration of this personal dimension with that of the other quadrants—linking prayer with action, contemplation with agency—pointing to the integration of the interior and exterior responses to change.

6. Discussion

Here in this study, we find two cases—one, engaging these four faces of adaptation despite higher vulnerability to climate change and other stressors, and the other, privileged by technological and financial supports yet reaching the limits of a primarily practical adaptation in a context in which climate change gives rise to ongoing, unforeseen challenges. At the same time, interior dimensions of adaptation in individuals and groups may also reach such limits if they are not integrated with other exterior adaptive capacities. In this discussion, I consider the extent to which the four faces of adaptation are present and relevant to how people navigate complex change processes due to climate change, reflecting on the causal mechanisms in these pathway case studies and what insights might be drawn from them.

6.1. Benefits and bounds of practical adaptation, toward a critical-structural adaptation

The primary role of practical adaptation to climate change in both sites was notable (see Fig. 4), and yet limitations were also apparent. In Mataquescuintla, while it was the primary adaptation taken and aligned closely with the IPCC definition for adaptation—as "adjustments [made] in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2014, p. 5)—the frustrations voiced by respondents underlined the futile nature of responding to climate change as a technical problem rather than an adaptive challenge (O'Brien & Selboe, 2015). Seen in the quotes by respondents in Mataquescuintla about how they never quite know what problem might arise next and the sense that coffee production teetered on the verge of unsustainability, the data suggest that the bounds of practical adaptation were largely due to it not being commensurate with the complexity and dynamism of climate change—while it helped to manage impacts, it alone was not changing trajectories.

The practical adaptation options for farmers in SPN were bounded by financial and technical limitations as small producers. Rural people there experienced greater migration from the region and greater vulnerability, yet had mechanisms for critically engaging with the developmental trajectory of the region. They were more inclined perhaps to see the "double-edged sword" of predominately practical adaptation measures: namely, that "although these measures may be important, they rarely address the wider and deeper systems and structures that are contributing to risk and vulnerability in the first place" (O'Brien & Selboe, 2015, p. 2). One respondent in SPN exclaimed, "well, one can't be a conformist about this!" (Respondent SPN 2), underlining how adaptation constrained to its practical dimension may inadvertently construe adaptation as *conforming* to climate change, without altering its root causes.

In summary, the benefits of practical adaptation are plenty, but its bounds exist for both pragmatic and ethical reasons. This is not a novel finding per se. However, the resolution to these limits of practical adaptation—suggested here as the integration of more of the other faces of adaptation—may be.

In both case study sites, coffee producers countered the boundaries of a practical adaptation with critical-structural adaptation. In Mataquescuintla, some farmers remained working individually but sought an 'innovative buyer' who had a critical-structural dimension to the company's purchasing policy (i.e., buying at a premium, investing in community development). Other farmers who had no access to that, felt frustrated at their limited capacity to affect systemic change, and so had joined the Colisena cooperative precisely to gain better political-economic leverage. In SPN, cooperative organizing had occurred many years ago, likely along with the rise of farm cooperatives in the indigenous highland region, which now provided a platform for the coffee producers to address climate change. Castillo and Nigh (1998, p. 144) describe how "part of [such a cooperatives'] success has been the ability to adapt competitively to the new 'reflexive economies' of the postmodern era", based less on faceless capital and more on solidarity and symbolic content (i.e. coffee from "the last descendants of the Mayans"). Asasapne has wrought a similar market share, which had connected them with a range of other buyers and with global movements to save native coffee varieties, promote the 'slow food' paradigm, and support organic, fair trade practices. Despite the fact that SPN exhibited characteristics of 'double exposure'—that is, exposure to both poverty and climate change (Leichenko & O'Brien, 2008)—the SPN coffee farmers had had to find ways to participate in disrupting the status-quo market dynamics and thereby were addressing some of the structural, root causes of both poverty and climate change, beyond that of typical practical adaptation practice.

What is common to each of these examples of critical-structural adaptation is the exercising of inter-objective (third-person plural) critical perspectives towards adaptation—in other words, working together in a group of at least more than one, to somehow intervene in the system in which coffee production and sales were occurring. This corresponds with findings in other agricultural communities elsewhere, which had identified a need to move the adaptations carried out by farmers beyond the individual level and towards larger-scale, longer-term, linked-up approaches carried out with other actors (Manandhar et al., 2011), embedding power relations further up the chain of policy development (Nagoda & Nightingale, 2017).

6.2. Transcending the subject-object divide: Integrating co-generative and personal adaptations

Interior adaptations were proportionally less represented than the exterior adaptations in both regions, yet they nevertheless presented an important way that the coffee producers respond to climate change.

Co-generative adaption was present in both case sites, but more substantially in SPN than in Mataquescuintla (Figure 4). Co-generative adaption could be considered a subset of social capital—described as the features of social organization (i.e. civic networks and social trust) that facilitate coordination and cooperation for a mutual benefit (Putnam, 2000)—yet, in popular discussions, the concept of social capital can be fuzzy and applied to almost any social condition (Lang & Hornburg, 1998). With the term co-generative adaptation, I am referring to the intersubjective competencies for responding to the unique challenges of climate change. This intersubjective competency was for members of the Asasapne cooperative a conduit for dealing with complexity together, providing 'strength in numbers' when facing adversity, which they are now able to apply to climate change. A regional analysis of Guatemala in the IPCC 2014 found that participation in organized groups provides various supports and access to information that contribute to adaptive decision-making (Magrin et al., 2014; Tucker et al., 2010). Others have argued that collective intentionality could be a necessary force in fostering structural change in a context of climate change (Manuel-Navarrete et al., 2019), which is also demonstrated by both Asasapne and Colisena cooperatives.

Personal adaptation was also part of the responses to climate change. The quotes above describe how personal convictions, positive attitudes, and prayer—subjective competencies for staying well in times of climate change—offered ways to metabolize difficult emotions, take refuge from hardship, and locate purpose and vision in turbulent times. In Mataquescuintla, this dimension was present in people's experience, yet, I could not discern a deliberate process through which they addressed and worked through their stated emotions of uncertainty, worry, and frustration. In SPN, evidence from respondents' descriptions and participant-observation suggest these were practices or intentional ways that individuals worked with their interiority.

Some of these were faith-based processes. There is a risk that religious narratives may actually be disempowering and lead to fatalistic points of view rather than adaptive action (seen in the quote by Respondent Mata 16 above); yet, other research elsewhere has found prayer can be an adaptation strategy when facing global environmental changes (Pyhälä et al., 2016). The difference here may lie in the quality of awareness brought to bear on the practice and its integration with other quadrants. As the phenomenological practice of prayer is similar to mindfulness and in other studies they have been grouped together (Burke et al.,

2017), here, I will group the prayer practices that respondents referred to under the concept of "mindful climate adaptation," developed by Wamsler (2018). Research in disaster management found that mindfulness and other faith-based practices can have a positive impact and supported coping strategies, improved well-being indicators (such as stress reduction), psychological/cognitive flexibility to adapt to new circumstances, and increased compassion and human potential (Wamsler, 2018). When practiced in organizations, research in climate adaptation has found that mindfulness supported collective and organizational learning with respect to the anticipation of, and coping with, unexpected changes and also enabled the group to access key social resources needed when facing extreme climate events (Becke, 2014; Becke et al., 2012). The findings here suggest that the cooperative in SPN had garnered similar benefits from prayer practices in their organization *when that prayer was integrated with actions in other quadrants*; it was the combination of forms of adaptive responses that together enhanced capacities. Such processes of mindful climate adaptation could be an under-examined way in which people and groups support themselves in dealing with global environmental change.

These interior expressions of adaptation supported other exterior adaptation efforts. This conforms with other research on the importance of the *personal sphere* in generating rapid social change (O'Brien, 2018) and on how certain interior practices can assist individuals and groups in overcoming barriers to climate change adaptation (Gifford, 2011; Moser, 2007). Yet, explains Wamsler (2018, p. 1128), "nevertheless, psychological aspects of climate change and adaptation have so far barely hit the radar of climate change science." The results in Fig. 4 echo this asymmetry towards exterior forms of adaptation over the interior forms. However, these findings also suggest that interior adaptation is nevertheless important and, as Wamsler (2018, p. 1130) said, may assist "individual and collective capacity to deal with increasing risk and uncertainty—through cognitive, emotional, managerial, structural, ontological, and epistemological change processes." In other words, this interior dimension may be inseparable from external action: who we are shapes what we individually intend and what societies we create; "it is the subjectivization process through which subjects produce themselves; what they are and what they can do, how they think, see themselves and others, and how they relate to the world around them" (Manuel-Navarrete et al., 2019, p. 4). These findings underscore the importance of interiority in supporting people's ability to meet and navigate change, and affirm its place in a comprehensive adaptation practice.

6.3. Pathways to and from this moment: Antifragility and transformation

The second step of this pathway case study sought to consider the possible mechanisms for how these two differing outcomes of adaptation—one more inclusive of the four quadrants and one predominantly practical—had come to be in these case study regions. Findings suggested a correlation between the spatial, historical, and ontological aspects in each case and the approaches to adaptation taken. The geographical distance and topology of Huehuetenango had affected its connection with the capital such that it was less modernized and privileged compared to that of the urban center; in other words, perhaps because of this disadvantage, producers had had to secure alternative market arrangements through a critical-structural adaptation. The armed conflict in Huehuetenango (1960–1989) resulted in more community organizing, supported by indigenous, Leftist, and Catholic liberation theology groups, which respondents now drew on as intersubjective competencies. Gender could be another important factor: the higher proportion of women involved in coffee production in SPN may have contributed to a co-generative adaptation, which warrants further study. For example, is this a tentative finding that women have a broader suite of strategies to draw on in climate change adaptation? Also, the implicit indigenous ontology in Huehuetenango could also be an important factor; for example, the fact that the subjective and objective worlds were not-separate is more common to indigenous worldviews, and in turn may have provided the social-acceptance for engaging in a personal adaptation where needed. The lack of emphasis on personal adaptation in Mataquescuintla may have been due to the context (namely, the intricacies of positionality, gender, and power) in which it was less socially-acceptable to admit vulnerability and share emotionally as a man in public, and even less so to a foreign woman. However, also considering the Ladino ontology of the region, with modern worldviews that tend to separate subjective and objective realities, it also raises the possibility that a technical definition of adaptation had been internalized by these producers, placing less emphasis on interiority.

The phenomenon of becoming stronger through adversity may also be key to understanding the pathways of these cases. SPN had met hardship and built critical awareness and action over decades. Some research has found that exposure to stressors, at least up to a point, can activate adaptive responses and create strength, a phenomenon referred to as *antifragility* (Taleb, 2014). In a context of adapting to natural disasters, specifically flooding, the 'wisdom geographer' White (1945, p. 93) described, "while sorrow and frustration also follow the path of lost lives, broken families and disrupted economy that is etched by floods, these losses are balanced against *psychic profits*." Reflecting personally, one respondent in SPN said:

> One must struggle in life, to proceed forward. . .and if something in life makes you fall, you don't stay fallen. You rise up. You show to the rest of the world that you are different, you demonstrate to the world that you are who you are, you are a better person. (Respondent SPN 6).

In the case of SPN, there is a strong possibility that this group of producers, having met and overcome multiple stressors, had gained 'psychic profits' and developed anti-fragility. As a result, these producers had a propensity for a more all-quadrant approach that they are now able to draw upon as they face this new set of challenges presented by climate change.

The important point when moving beyond these case studies is not to attempt to replicate the same spatial, historical, and ontological conditions, but rather to deliberately engage the subjective and objective perspectives, in individuals and collectives, that these conditions fostered. In this way, the Integral adaptation framework could be used by policy-makers and practitioners elsewhere to intentionally integrate all four faces of adaptation; such as designing ways to include subjective practices of personal adaptation, making purposeful space for inter-subjective processes toward a co-generative adaptation, and designing for inter-objective procedures to critically interrogate and consciously participate in the structures in which adaptation is occurring. These three other faces of adaptation can be included by those making policies and developing programs alongside the more typical practical adaptation work, which, while indispensable, is limited when used as the sole mechanism for responding to unpredictable change.

Findings here suggest that coffee producers in SPN were doing more than just conforming or adjusting to climate change conditions. By producing fair trade, organic, specialty coffee, even with the possibility of negative outcomes (i.e. farmers who have committed to organic certification could find themselves with limited pest/fungus control options when hit by *roya*) such decisions are

nevertheless made with deliberate consideration of the developmental trajectory of the region. For example, said one respondent, "the most [negatively] affected is nature and if we do not create awareness about this, we will all suffer; sure, we may be able to adapt [technically], but animals and plants suffer from [us] using so many chemicals. . . if human beings do not become aware of this damage, in a short time we will destroy everything we have, pollution will increase and living beings will die" (Respondent SPN 12). The important point here is not that fair-trade organic is the 'right' path from a normative perspective, it is that the farmers are seeking to consciously participate in the coffee value chain in ways that are more aligned with the values they hold.

In so doing, the cooperative in SPN joins largescale efforts in shifting the trade paradigms for coffee, undergirded by new values for reflexive economies and greater sustainability, and gives producers a sense of their own agency despite the enormity of the climate change issue. Applying Leichenko and O'Brien's definition of transformation (2019), coffee producers in SPN are engaging significant changes in form (i.e. redefining what it means to be a small producer in Guatemala in terms of having agency and resilience), structure (i.e. disrupting the structural dimensions of inequity, exclusion, and unsustainability) and meaning-making (i.e. engaging trade relations on a different set of values, ethics, and meaning). Transformation arises from precisely this kind of "an emergent space for reflection, reframing, and the formation of new pathways for change" (Charli-Joseph et al., 2018, p. 4). By engaging these four quadrants, the very practice of adaptation opened up new ways of viewing the problem and created greater possibilities for transformation.

7. Conclusion

The split between the subjective and the objective has long persisted in society, and particularly in social science, as per the opening Bourdieu (1992) quote. Yet, to maintain it limits the solution-space, which is at best unhelpful and at worst misleading in the face of something as unprecedented in its complexity as is climate change. To reckon effectively with this particular issue, we will need to work on both sides of that subject-object divide. As one such example, I have considered the Integral adaptation framework, demonstrating that the four quadrants of adaptation are present and relevant for how people respond and react to change. These results also suggest that something alchemical is made possible through the synergy of these adaptations as they 'tetra-arise' at the interface of subjectivity and objectivity, in individuals and collectives. Like the adage that says, 'all metal is gold that does not recognize it yet,' adaption when it is realized in a broader and deeper manner may help set the conditions for transformation.

CRediT authorship contribution statement

Gail Hochachka: Conceptualization, Methodology, Data curation, Writing - original draft, Visualization, Investigation, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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On *matryoshkas* and meaning-making: Understanding the plasticity of climate change

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ABSTRACT

Climate change is a complex issue and means different things to different people. Numerous scholars in history, philosophy, and psychology have explored these multiple meanings, referred to as the plasticity of climate change. Building on psychological research that seeks to explain why meanings differ, I present an analytical framework that draws on adult developmental psychology to explore how meaning is constructed, and how it may become increasingly more complex across a lifespan in a nested manner, much like Russian dolls (or *matryoshkas*). I then use the framework to analyze photo voice data from a case study about local perspectives on climate change in El Salvador. The main finding from this analysis is that a developmental approach can help to make sense of why there is such plasticity of meanings about climate change. Using photos and their interpretations to illustrate these findings, I examine how perspective-taking capacities arrive at different meanings about climate change, based on the object of awareness, complexity of thought, and scope of time. I then discuss implications of this preliminary work on how developmental psychology could help climate change scholar-practitioners to understand and align with different climate change meanings and support local actors to translate their own meanings about climate change into locally-owned actions.

1. Introduction

Climate change represents a complex, intractable challenge. It has been met with a spectrum of responses, with some approaching it as a pressing global issue of highest priority and others dismissing it as irrelevant or even non-existent. Underpinning this range of responses are different discourses and meanings held about the issue, which has been referred to by Hulme (2009) as the *plasticity* of climate change. Esbjorn-Hargens (2010) speaks to this, describing climate change as a *multiple object*: something that is objectively real, yet is enacted through multiple perspectives to arrive at markedly different meanings of the issue. Morton (2013) refers to global warming as a *hyperobject* that is so massively distributed in time and space that only a fragment of the issue is able to be cognitively grasped by most people at any one time. Goldman et al. (2018) consider the variance of ontological 'realities' about climate change and question who determines what counts from a critical political ecology perspective. Where these authors concur is in the fact that climate change is complex in part because it is psychologically hard to grasp and meanings about it are near countless. This paper considers this in the context of adaptation, which fast becomes complicated; when actors seek to engage in action regarding climate change impacts, this plasticity of meanings can perpetuate disconnects and also create friction.

Many researchers have called for more in-depth studies on how people make meaning of climate change, including how that in turn mediates and affects understandings, perceptions, and ensuing actions on climate change (Hulme, 2009; Kempton, 1991; O'Brien and Hochachka, 2010; O'Brien and Sygna, 2013; Riedy, 2008; Swim et al., 2009; Woiwode, 2016, 2012). Yet surprisingly little research has been done from a constructive-developmental psychological perspective on how meaning is construed, why meanings differ, and what impact this might have on subsequent climate change engagement. This gap is important to address, as the success or failure of climate change responses in both mitigation and adaptation can often be traced to matches or mismatches between meanings. Here, I examine how this is the case in adaptation projects, where assumptions about climate change can create a disconnect with local meaning-making frames. In the Andes, Scoville-Simonds (2018) describes how, even in seemingly homogenous social systems, local meanings given to climate change often differ markedly, influencing individual and collective priorities and actions for adaptation. In a study of grain farmers in South Africa's Western Cape, Findlater et al. (2018) found mental models of climate change were cognitively isolated from other 'normal' risks, resulting in wavering commitments to follow-through on adaptation strategies. Greater understanding of people's perspectives of climate change is needed, including on how this range of sense-making influences climate

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change engagement (Swim et al., 2009).

In this paper, I focus on "perspectives," highlighting an area of research that has been missing from the climate change literature, namely adult developmental psychology. I show that insights from development psychology about perspective-taking capacities can provide a deeper understanding of differences in meaning-making, including how it tends to develop over a lifespan, and I then consider the implications for climate change adaptation. Meaning-making is defined in psychology as the process of how people construe, understand, or make sense of life events and experiences. I start by a review of the social science and psychological scholarship in the area of meanings about climate change. I then describe the adult developmental psychology literature and its implications for understanding the plasticity of meanings about climate change. Next, I present an analytical framework based on the metaphor of nested Russian dolls, or *matryoshkas*, to describe how and why meaning-making can be so different. I demonstrate the application of this framework using interpretations of photographic data from a case study from El Salvador, conducted as a plausibility probe to illustrate my argument and disclose precise areas for further, more comprehensive research. Finally, I discuss what a deeper understanding of the plasticity of meanings might offer for climate change adaptation.

2. Literature review: perspective-taking capacity discloses the why

The plasticity of meanings people hold about climate change has been attributed to their *content* (i.e. what someone believes about climate change) or explained by the different *contexts* in which they are situated (i.e. a person's discipline, place, or culture). While these explanations are important, they often limit the focus to *what* meanings or mental models are held about climate change. What has received less attention in the climate change literature is *why* such meanings are held. Some research has sought to ask 'why' questions by looking to culture, place and psychological distance (Boillat and Berkes, 2013; Bostrom and Lashof, 2007; Jones et al., 2017), but in this article here I seek to examine the 'why' further, by placing specific focus on the psychological *construct* for how meaning is derived. A psychological construct refers to the system of meaning that humans hold to understand their worlds and experiences (Raskin, 2002). Hulme (2009, p. 5), for example, describes how "climate is a *constructed idea* that takes these sensory encounters [of weather] and builds them into something more abstract." To understand this in greater depth, Wolf et al. (2013) emphasize the need for a robust way to include the intangible, subjective dimensions of adaptation, particularly the *meanings* people attach to the climate and their relationship to adaptation goals.

To date, the existing range of social science and psychological work regarding climate change has been expanding through research that attempts to better understand perceptions of climate change, communication strategies, and other psychological factors (Swim et al., 2009). Much of this psychological scholarship in climate change challenges the normative assumption that a scientific framing of climate change is at the top of a hierarchy of ways of knowing. Rather, it affirms that there are many lay knowledges and different ways that people come to understand climate change (Brace and Geoghegan, 2011; Clifford and Travis, 2018; Hulme, 2017). Some conduct research into this array of meanings by describing what differences exist regarding climate change knowledges, carried out through segmentation studies (Graham et al., 2015, 2014; Leiserowitz, 2007; Roser-Renouf et al., 2009), critical political ecology (Goldman et al., 2018), research on social practices and barriers to inaction (Gifford, 2011; Hargreaves, 2011), influences of cultural and human geography (Brace and Geoghegan, 2011; Geoghegan and Leyson, 2012; Hulme, 2017), psychological distance (Brügger et al., 2015; Chu and Yang, 2018; Jones et al., 2017; Spence et al., 2012), and research into values and emotions (Wolf et al., 2013; Wolf and Moser, 2011). Fewer studies focus on *how* people come to these understandings (Clifford and Travis, 2018).

This is precisely where a constructive-developmental psychological perspective might add value, as it examines both the *how* and *why* of differences in meaning-making. Below, I first consider the psychological and social science scholarship into the meanings of climate change—specifically on 1) mental models and climate knowledges in relation to communication strategies, 2) segmentation studies as typologies of lived values, and 3) psychological distance. In each of these, I point out where and how developmental psychology meets, complements, and perhaps departs from this existing work. Then I briefly explore the literature regarding developmental psychology in terms of the relevance it might hold for climate change research.

2.1. Psychological and social science scholarship in climate change

Psychology and social science scholarship in climate change consider mental models as inference engines or pre-existing lenses that predispose people towards particular ways of thinking about a problem. Bostrom and Lashof (2007) note that, "if we hold in our minds a mental model that wrongly captures what causes a problem, our response to the problem will be equally inappropriate" (p. 31). Findlater et al. (2018) examine whether and how mental models of climate change are well-integrated, and thus actionable, with other categories of human life, including perceptions of risk. Such research suggests that people explain global warming in myriad ways – a finding that can be used to design climate change communication and engagement strategies. In this work, it has been found that certain metaphors align better with people's mental models and thus make it more likely they would support climate policies (Bostrom and Lashof, 2007).

Within this research, the variance in mental models is often framed as "problematic" (Bostrom and Lashof, 2007, p. 32). This research seems to side step the fact that, even with preferable metaphors, the plasticity of such meanings is most likely going to persist. Shrouded in definitional ambiguity, climate change is "an idea of the human mind" (Hulme, 2017, p. 2) and "simultaneously a reality, an agenda, a problem and a context" (Brace and Geoghegan, 2011, p. 285). The question of how meaning about climate change is constructed and integrated with the rest of one's life could help elucidate how people come to the mental models they hold and why certain metaphors resonate more than others—an inquiry that is central to developmental psychology.

Departing from the recognition that people have different psychological, cultural and political reasons for acting based on their varied climate change knowledges, audience segmentation studies have been conducted with various populations. The Six Americas, for example, provide in-depth and detailed demographic, attitudinal, and behavioral profiles of six groups (Dismissive, Doubtful, Disengaged, Cautious, Concerned and Alarmed), including a discussion of underlying barriers to action (Maibach et al., 2011; Roser-Renouf et al., 2009). Such audience segmentation studies, with their roots in marketing and social marketing, recommend a diversity of messages tailored to meet the needs of different target audiences. A similar segmentation study of residents in five Australian coastal communities (Graham et al., 2015, 2013) focused on lived values, "because knowing *what*, rather than *how*, people value about their everyday lives is highly important for achieving fair adaptation outcomes" (Graham et al., 2013, p. 42).

Segmentation studies on values tend to sort populations into *typologies* that reflect superficial—or, as Hine et al. (2014) p. 449 put it, "shallow" features of a given moment, which researchers admit is place-specific and would require periodic continual updating as populations and demographics change (Graham et al., 2014). Graham et al. (2014) mention the significant scope for further research within segmentation studies to explore the links between two levels of values—the content of what is valued (valued things) versus the deeper mechanisms for how value is constructed (value systems)—in the context of adaptation. Berzonsky and Moser (2017) call for a deeper inquiry into the underlying values at play in transformations.

A distinction between value types and value structures has been made elsewhere, pointing out that they are not the same thing (Rohan, 2000). This is where developmental psychology may have insights to share. Further inquiry is needed to understand how and indeed *why* value and meaning is organized as it is. Developmental psychology attempts to examine this at a deeper level, studying the mechanisms and shared patterns for how meaning is organized and how valuing occurs (Graves, 1970). Segmentation studies ask, "*what* do people think or what do they value", whereas developmental psychology studies ask, "*how* are they organizing meaning and *why*?"; I argue in this paper that both such questions are important to consider.

Psychological distance is another key concept in climate change engagement. Research in this area is guided by the theory that the psychological distance one holds about phenomena is directly linked to how one mentally represents it: the more distant the object is perceived, the greater the degree of abstraction (Trope and Liberman, 2010). Climate change is perceived to have high spatial or geographical distance, temporal distance, distance between perceiver and a social target, and uncertainty (Trope and Liberman, 2010). This has lead researchers to study the impacts of such distance on sustainable behaviours, engagement, and risk perceptions regarding climate change (Jones et al., 2017). Some studies suggest that reducing the psychological distance may produce a less abstract and a more concrete mental construct and thus support greater climate engagement (Jones et al., 2017). This has led researchers to consider communication strategies that interpret climate change as personal, local, and already happening, rather than temporally and spatially distant (Leiserowitz, 2007).

However, other research suggests that this relationship is not as straightforward as it may seem. Spence et al (2012) found utility in also expanding the psychological distance to point people to the distant impacts of climate change even though they were more abstract. Other research indicated that a complementarity of levels (employing both an abstract mindset and specific goals, or vice versa) may be most useful in promoting climate-change-related behavior (Rabinovich et al., 2009). Finally, although there may be other reasons to narrow the psychological distance in the context of climate change engagement (such as increasing personal relevance or reducing ideological polarization) (Chu and Yang, 2018), Brügger et al. (2015) found that the complexity of psychological distance is not conclusive in terms of inspiring climate change action.

Brügger et al. (2015) point out that proximizing climate change could actually lead to defensive reactions, such as increased scepticism about the reality and relevance of climate change. It may indeed change the frame of reference through which people think about climate change, but with no consequence for their level of action (Brügger et al., 2015). Brügger et al. (2015) specifically call for more research to better understand the individual and situational factors that complexify how psychological distance relates to mental representation and climate change engagement. It is unclear, for example, how distancing relates to the development of perspective-taking capacity through maturation. Through maturation, there is an increasing tendency to construe climate change more abstractly along with an ability to move more flexibly between proximal and distal mental representations (which I explain further below). In other words, overlaying developmental psychology findings onto data on psychological distance may help in clarifying what might actually be going on for people as they struggle with a problem perceived to be so big and far away.

A recent study by Clifford and Travis (2018), departs from the question of *what* people understand, and sought to examine *how* people understand climate change, taking it as a cultural and social phenomenon as much as a biophysical one. They found that even when local climate knowledge may fail to meet climate literacy tests, it still reflects a robust and intricate understanding that is relevant and important for adaptation. Their findings include: 1) that people engage with climate through proxies (e.g. snowpack level, human migration, and endangered wildlife); 2) that people use (self-designed) rubrics to track climate change (i.e. built from trial and error, traditional knowledge, or intuition); and 3) that people didn't take climate change as discrete phenomena, but construed it through linkages with other factors (i.e. weather variability, migration flows, and changing social practices). This study comes the closest to the nature of my inquiry in this paper. While there are complementary aspects, which I will discuss further below, there are also interesting angles that a developmental psychological analysis would further disclose in their data. For example, considering their third finding, it is not clear from their analysis what kind of "linkages" are being construed: such as, a heap of associated factors, a linear system of cause and effect, or a complex adaptive system? Each of these are derived from very different perspective-taking capacities, yet they are presented in a conflated way in the Clifford and Travis (2018) study.

In their extensive review of research into the range of perceptions of global environmental change, Pyhälä et al. (2016) conclude that a deeper understanding of a wide range of meanings requires addressing the "why?" behind perceptions. Developmental psychology explores the why in rigorous detail, and offers interesting insights for understanding the plasticity of meanings about climate change, including explanation of why people react or respond to environmental changes as they do.

2.2. Developmental psychology explores the why

Since the mid-1950s, psychologists (e.g., Cook-Greuter, 2000; Graves, 1970; Kegan, 1998, 1983; Kegan and Lahey, 2009; Kohlberg, 1981; Loevinger, 1966; O'Fallon, 2013) have focused on understanding "how adults develop from the baby's narrow, 'self' centred view of the world to the mature wisdom and powerful action of exemplary adults" (Cook-Greuter, 2004, p. 276). Research in this area focuses on how "human organisms organize meaning" (Kegan, 1998, p. 29), and describes how meaning-making increases in breadth, depth and complexity over a lifespan through the increasing capacity to take perspectives (Cook-Greuter, 2004; Kegan, 1998). Wilber (2000) synthesizes many of these findings to explain how meaning-making goes from simple to complex, and from static to dynamic, with each later expression characterized as more differentiated, integrated, flexible, and broader in awareness. With greater awareness, what is noticed or what people are aware of expands, thus one has access to an increasingly complex understanding of reality that they can in turn describe, articulate, influence, and change (Cook-Greuter, 2004); this complexification is referred to within this field as transformation.

Kegan (1998) and O'Fallon (2013) describe what actually happens in this maturation and complexification of meaning-making. Namely, as more perspectives can be taken, the object of awareness becomes less concrete and more abstract, and thought becomes less atomistic and more multifaceted and systemic. Earlier in development, meaning-making is fragmented and the objects of awareness are concrete, defined as "things you can put a fence around," such as physical objects and visible emotions. Later, meaning-making becomes more abstract, coordinating within and between categories. Objects of awareness are subtle, defined as "things you cannot put a fence around," such as a system, a plan, a belief, or complex emotions. Even later, meaning-making may continue to develop to become more systemic and trans-categorical and the objects of awareness become even more subtle. This includes, for example, noticing what one is aware of, being aware of how one is organizing meaning, or being aware of being aware, which has been referred to as meta-awareness (O'Fallon, 2018). This complexification of meaning-making also corresponds with a broader perception of time (from no-time, to a view of the present-moment only, to a view predominantly of the past, to a view that includes the past and future, to a multigenerational view, to an evolutionary view, and so forth).

The use of terms such as "stages of development" or "orders of consciousness" in this literature can be problematic, as people tend to carry predetermined, often judgmental perceptions of developmental

sequences applied to human psychological growth. Some interpret these as hierarchical, with later stages seen as "better" and thus elitist; in other cases, there has been a tendency to label stages as unjust and "bad", dismissing them altogether (Hochachka, 2009). Such reactions are misinterpretations of the research and do not contribute to a nuanced, ethical, and useful understanding of how the maturation process affects how people organize meaning across their lives (Riedy, 2008). Though it is necessary to hold interpretations of development critically (Hochachka, 2009; Riddell, 2013; Riedy, 2008), it is also important to take seriously how this field of study might contribute to better understanding the near-infinite plasticity of frames on climate change.

When developmental psychology is considered within the specific context of climate change, it becomes clearer why meanings about the issue are so various. Gifford (2011, p. 291) examines how the human ancient brain cognitively developed to meet immediate, concrete problems that relate with one's self and near others, which can hinder the ability to meet the cognitive demands of global climate change which, "is slow, usually distant, and unrelated to the present welfare of ourselves and our significant others." De Witt et al. (2016) draw on developmental psychology in their examination of four major worldviews—labeled traditional, modern, postmodern, and integrative—and their interface with opinions and behaviors with respect to climate change. O'Brien and Hochachka (2010) provide some preliminary considerations on how such worldviews may approach adaptation differently, including construing the problem-set differently and aligning with unique strategies to meet it. These researchers agree that a developmental lens is intriguing and important for grasping the reasons for the plasticity of climate change; while they also emphasize the preliminary nature of their studies and recommend further research into the dynamics of meaning-making and climate change.

More recently, Ziervogel et al. (2016) drew on developmental psychology from Kegan (1998) and Wilber (2000, 1996) in their examination of the *transformative capacities* needed for climate change adaptation in South Africa. This study also focussed on a lateral growth of meaning, such as developing new skills, adding information, and transferring knowledge from one area to another toward a more robust or complete expression (Ziervogel et al., 2016). The foundational research refers to such lateral growth or horizontal learning as *translation* rather than transformation in which there is increasing breadth or refinement of what is already known (Cook-Greuter, 2013; Murray, 2017; Wilber, 2000). Translation may also offer important insights to climate change engagement, as translating the concept of climate change adaptation within a certain of stage of meaning-making may support more home-grown, relevant strategies.

In summary, while interest has turned to the plasticity of meanings about climate change and what this might mean for engagement and even transformation, what is missing in the climate change literature is a rigorous treatment of the *why*. In the absence of a developmental frame, psychological scholarship in the area of climate mitigation and adaptation often ignores central meaning-making and human maturation processes that are also at work. Developmental psychology offers a way of understanding the deeper reasons underlying the plasticity of meanings regarding climate change and its impacts on climate change engagement.

3. Analytical framework

The following analytical framework emerged from an abductive process of inquiry regarding the plasticity of climate change meanings, based on the Salvadoran case study described below. After the project was completed, I continued to think about the empirical data, including why participants' meanings of climate change differed as much as they did. This brought me to examine developmental psychology as a plausible way to understand this data. I then used developmental psychology to structure an analytical framework and re-analyze the data set, with the objective of probing in a preliminary manner the relevance of this framework for further, more rigorous research. I have found that the integration of insights from developmental psychology into climate change research provides a compelling entry point for understanding the plasticity of meanings; in particular, it helps explain why meanings of climate change vary and how this corresponds with climate action.

Although everyone makes meaning in unique ways, "there are striking regularities to the underlying structure of meaning-making systems and to the sequences of meaning systems that people grow through" (Kegan, 1980, p. 374). In examining these sequences, research in developmental psychology finds meaning is constructed in increasing orders of complexity through life. At any one time, a person is generally coming from, or inhabiting, a certain meaning-making frame. Earlier constructions of meaning making do not disappear, but instead become embedded, as each whole transcends and includes the former parts (Wilber, 2000). This process can be imagined as expanding to a larger Russian doll, inside of which smaller ones are encapsulated. The larger dolls represent more complex constructions of meaning making. One nested whole becomes part of the next whole, and so forth, termed 'holarchy' by Koestler (1967) and Wilber (1996). Thinking about meaning making as analogous to matryoshkas, or nested Russian dolls, helps to visualize the progression of meaning making over a lifetime.[1] The Russian doll metaphor describes how humans develop from baby *matryoshkas* to elder *matryoshkas*, as each concentric sphere of meaning-making transcends and includes earlier ones (Fig. 1). The term *matryoshka* encapsulates the nested and embedded, or the transcended yet included, aspect of these meaning-making frames that is missing from other terms used for "stage," such as "levels" (Wilber, 2000) or "action logics." (Cook-Greuter, 2004, p. 278; Torbert and Taylor, 2008).

Table 1 presents the analytical framework that elucidates the core findings of developmental psychology from some of its prominent researchers (Cook-Greuter, 2004; Kegan, 1998; Loevinger, 1966; O'Fallon, 2013). While Wilber's writing on Integral Theory has previously synthesized these works (Wilber, 1999), this is among the first times it has been considered in a context of climate change adaptation; the figure's overall synthesis and specifically the last two columns are novel contributions to this theory development.

The "backbone" of this framework is perspective-taking capacity. In developmental psychology, perspective-taking capacity is found to have a central role in how humans organize meaning. In Table 1 this is depicted in the numerical title of each meaning-making stage (such as, 1.0, 1.5, 2.0, 2.5 to indicate first-person perspective early and late, second-person perspective early and late, and so forth). With a first-person perspective much of reality is construed in a self-referential way as no other perspective is taken; with a second-person perspective one is able to consider the perspective of another, which is why it is considered a prerequisite for having empathy; a third-person perspective allows for taking an objective view and coordinating between two perspectives and is the basis of rational, scientific thinking; and a fourth-person perspective recognizes the role that context plays in the construction of meaning, which is present in post-modern, critical and contextual thought; the fifth-person perspective is situated even further back and views the constructed nature of reality on the whole (Cook-Greuter, 2004; O'Fallon, 2013; Torbert and Taylor, 2008). Each of these stages of perspective-taking construe meaning differently. In terms of climate change, each would "see" more of the hyperobject climate change, would grasp a larger swath of time, and be able to understand the issue with greater complexity.

Some examples of what actually changes as perspective-taking increases are described in the second to last column (O'Fallon, 2013). Firstly, what people are aware of moves from concrete objects to more and more subtle objects, until at more mature stages one becomes able

[1] Russian dolls are called Matryoshkas in Russian, which relates to the root word Mat, meaning Mother.

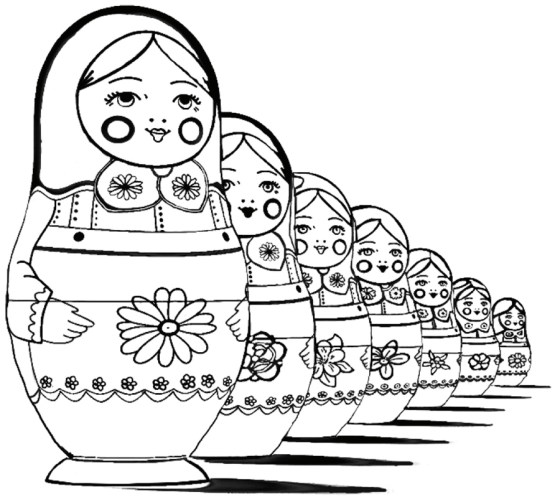

Fig. 1. Meaning-making stages can be best depicted as nested *matryoshkas*.

to notice what they are aware of (i.e. becoming meta-aware). Secondly, thought becomes more complex, going from a fragmented, atomistic, "bits and pieces" thinking (i.e. "a name for every bend in the river but no name for the river itself"), to a more mechanistic, instrumental thinking (i.e. a + b = c), to a more systemic, related, contextual thinking (i.e. "it depends"). Thirdly, the envelope of time broadens in a particular pattern, beginning with the realm of no-time that children live in, until the present moment begins to stretch to include the past, and then further to include the future, with even later stages extending the scope of time into evolutionary time in both directions, and even contemplations of timelessness.

This is a process of increasing hierarchical complexity, where a qualitatively higher order of capacity emerging from the coordination, re-organization, or integration of earlier discrete capacities (Murray, 2017). The perspective-taking capacities that are developed at earlier stages are reflected upon and coordinated at a higher order of complexity of the next stage, such that while one can consider the earlier views and has access to skills that were mastered at those stages, "it never again [fully] regains the view from those earlier rungs" (Ingersoll and Cook-Greuter, 2007, p. 195). For example, for a climate change scientist, it would be hard to entirely regain an earlier view in which, for example, climate change was construed as weather change, and yet he or she likely builds on, coordinates and organizes meaning using those and many other discrete earlier perspectives.

This is important for considering a counterfactual to a developmental perspective. Without a developmental perspective, one would be more likely to assume his or her view is a 'given' that others will eventually come upon with the right training or education and one may be more likely to construe that people are unintelligent or uninformed if they don't agree with his or her perspective. This is important in the context of climate change adaptation, because of how it can lead to ineffective communication (where people miss each other or create friction around their different perspectives), how it can perpetuate dominant views trumping marginalized ones, and how it can further some of the assumptions present in the information deficit model regarding climate change (Leichenko and O'Brien, 2019; Moser and Dilling, 2011; Suldovsky, 2017), such as that merely giving people more and better information will be enough to catalyze climate action.

Instead, a development perspective explains that not only is meaning made differently about climate change at each stage but also that, because of the hierarchical complexity involved in this process, theses stages are nested, and this may have ramifications for adaptation. While this study here shares some empirical data further below, previous research on ramifications for adaptation to date has been speculative. O'Brien and Hochachka (2010, pp. 96–97) speculated theoretically about the type of interpretations of adaptation that might be held by different perspectives. This is included in the last column in Table 1, along with theoretical work by De Witt et al. (2016). For example, as irregularities in weather patterns present themselves, these previous studies suggest that people operating from first- and second-person perspectives would constrain adaptation to local interventions involving immediate behavioural changes. Third-person perspectives would take an instrumental view of climate change adaptation and seek to create technical solutions and scenarios for possible futures, and those with fourth-person perspective-taking capacities would see adaptation to be more abstract, socially-constructed and context-dependent, raising questions of ethics, responsibility and vulnerability, while also recognizing the local interventions and technical solutions of earlier *matryoshkas*. Developmental psychology suggests here that each of these later stages include perspectives from earlier ones, but not vice versa.

Much of this diversity relates to how much of the climate change hyperobject is seen and what complexity of thought is brought to bear on it. That is, a developmental perspective suggests that climate change 'subsists' independent of our awareness of it, and doesn't actually 'exist' for people, until a certain point (Wilber, 2019, personal communication). The ways that climate change comes to exist for people then varies depending on one's meaning-making. While other social science scholarship examines the variance in what people understand about climate change, the theoretical contribution this framework makes is in how it examines the deeper mechanisms behind how meaning is organized and why (i.e. column 1 of Table 1). Thus, its theoretical contribution is to help to explain why there is such plasticity of meanings specifically through an examination of increasing perspective-taking capacities in the construction of meaning.

The sequences of meaning-making systems found empirically from following cohorts across decades demonstrate a maturation process in which what one was subject to at one stage becomes the object of the subject at the next stage (Kegan, 1998). While there is a time and growth component to this, *aging* itself is no guarantee of development; many adults tend to plateau in their growth as they reach a certain age, when family and professional demands prioritize stability rather than change. What helps people move through stages seems to be an array of self-world interactions that provoke the taking of different perspectives and that present new and challenging information, which in turn creates sufficient evolutionary tension that, in a sense, requires development to resolve (Graves, 1970; Kegan, 1983; Murray, 2017; Wilber, 2000).

In the remainder of this paper, an illustrative case study is presented that applies this framework to analyze empirical data from a climate change adaptation project in El Salvador.

4. Case study: perspectives matter for climate change adaptation in El Salvador

4.1. Background

In this section, I analyze photography data from a climate change action research project in El Salvador from 2010 to 2011 using the novel analytical framework described above, with the goal of improving and expanding the pool of ideas about the plasticity of meanings about climate change.

This case study can be considered a "plausibility probe" to determine whether more intensive testing is warranted, or as a "building block" study that is a component part of a larger theory-development (George and Bennett, 2005, pp. 75–76). I acknowledge that small *n*, single case studies face challenges in terms of generalization, relevance and rigor (Schwandt and Gates, 2017; Yin, 2013). Yet, there are several research situations where a single case study can accomplish precisely what a large quantitative study cannot—in this case, an in-depth

Table 1
Analytic framework to describe how meaning is constructed through lifespan, including preliminary application in the area of climate change adaptation.

Meaning-making / action logic (Kegan, 1998; Cook-Greuter, 2000; O'Fallon, 2013; Rooke and Torbert, 2005)	Worldview (Wilber, 2000) Order of consciousness (Kegan, 1998)	What changes through growth and lifespan (based on the STAGES assessment (O'Fallon, 2013)	Examples of how climate change adaptation would be construed and engaged. (O'Brien and Hochachka, 2010; De Witt, 2016)
1.0 Impulsive: Concrete, individual, receptive: "if I bite my finger it hurts."	Magic worldview Imperial mind	Complexity of thought: atomistic Object of awareness: concrete Time: Immediate and momentary (earlier), view of the past (later)	Example: "I peed in the river, and the river is now getting back at me by flooding my home" (O'Fallon, 2018, personal communication).
1.5 Opportunist: Concrete, individual, active: Experience in the immediate moment what is happening to them, everything is an object but all objects are alive: their cause and effect would be perceived as magical.			
2.0 Rule-oriented: Concrete, collective, reciprocal: Opens a social dimension in which there is a more reciprocal way of viewing at the world, with an associated interest to know what others are thinking and a focus on making contracts, rules, and agreements.	Traditional / mythic worldview Socialized mind		Example: With a traditional worldview (or, second-person perspective), the climate change phenomenon would likely be construed as something in the hands of fate and more a matter of faith than science. Adaptation strategies would likely depend on what others were doing or what the rules and principles ought to dictate and would be applied in a parochial sense with localized strategies for survival.
2.5 Conformist: Concrete, collective, interpenetrative: Interpenetrates with principles which they will follow without question. This often includes the law of the land, so if practices related to climate change are the law they will often embrace them (e.g. recycling).			
3.0 Expert: Subtle, individual, receptive: Preliminary ability to take an objective view, such that responsibility, respect and other subtle ideas begin to arise from within the person (as such these ideas are cherished). Begins to see the future and see probabilities of what might happen.	Modern / universalistic worldview Self-authoring mind (early)	Complexity of thought: abstract and networked Object of awareness: subtle Time: past and future (early), multi-generational (late)	Example: A modern worldview (third person perspective), would likely understand climate change adaptation scientifically and economically and seen as a technical problem to be solved or the need for adaptation to be carried out as part of economic or technological progress.
3.5 Achiever: Subtle, individual, active: Can be strategic in planning, prioritizing of self-interests and achievements and with an emphasis on outcomes, results, and goals relating to future time; interested to measure what happens through time (hypothesis and testing, deductive thinking).			
4.0 Pluralist: Subtle, collective, reciprocity: It becomes apparent that the actions and interactions of humans with the environment cannot be separated from their context, and the socially-constructed nature of phenomena is recognized. Cause and effect depends on the situation and the circumstances. It is local, not universal.	Postmodern / pluralistic Self-authoring mind (mature)		Example: A postmodern (fourth-person perspective) would likely seek to co-create and collaboratively work towards climate change adaptation processes, as it is perceived that the future of the planet is in the hands of humanity, would view this critically and with greater emphasis on the power dynamics and systems injustices that create vulnerability and produce climate change.
4.5 Strategist: Subtle, collective, interpenetrative: Able to understand and sort contexts, climate change manifests contextually, but is adaptively complex and interconnected systemically, humans affect and recreate the ways that healthy systems interact with each other, and as such can reverse damage caused by human disruptions of natural complex systems.			

(*continued on next page*)

Table 1 (*continued*)

Meaning-making / action logic (Kegan, 1998; Cook-Greuter, 2000; O'Fallon, 2013; Rooke and Torbert, 2005)	Worldview (Wilber, 2000) Order of consciousness (Kegan, 1998)	What changes through growth and lifespan (based on the STAGES assessment (O'Fallon, 2013)	Examples of how climate change adaptation would be construed and engaged. (O'Brien and Hochachka, 2010; De Witt, 2016)
5.0 Construct-aware: Meta aware, individual, receptive: The constructed nature of reality is recognized on the whole, such that humans are seen not merely as actors in the system but rather their thoughts, ideas and beliefs about the system are constructing and shaping, as well as shaped by, its evolution and trajectory.	Integral / integrative worldview Self-transforming mind	Complexity of thought: systemic and meta-systemic Object of awareness: meta-aware Time: evolutionary both forward and backward in time, (including recognition of timelessness)	Example: An integral worldview would work towards adaptation in a trans-disciplinary manner; seeking to be aware of what people believe and how they construct meaning; ensuring that adaptive strategies can simultaneously meet the population where they are while providing some emergent ground for learning; would likely include researchers and practitioners as part of the process; and would let go of the idealistic desire for everyone to understand climate change the same way.
5.5 Transpersonal: Meta-aware, individual, active: The understanding that "my" belief and belief systems are individually constructed and often limiting—this allows people to go beyond them to individually create/construct unusual and unique solutions with an ethic behind them.			

analysis examining the deeper layers of subjectivity, generated through a participatory methodology (Bailey et al., 1999; Flyvbjerg, 2006).

First, I will briefly describe the project in El Salvador, and then proceed to the current analysis of this data. The project, funded by the Canadian International Development Research Centre, was designed as a pilot project to be followed by a larger study and sought to explore how balanced attention to the experiential, cultural, behavioural and systemic dimensions of climate change adaptation can promote more relevant policies and much deeper forms of resilience. Fieldwork involved two communities and one hamlet in the headwaters of the River Lempa in Chalatenango, El Salvador. Participants explored their own perspectives on climate change and adaptation, by taking photos to respond to three inquiry questions about climate change: *What is climate change to me? What are the impacts of climate change for me and my community? How am I adapting?* The community-photographers sorted and selected their most significant three photos, then discussed them in a one-hour interview and provided an interpretation for each; the group of participants then did pattern-finding on the entire set and grouped them into the 27 photos that reflected the communities' shared view on each of the three questions (Appendix 1). This photo voice methodology was also combined with critical dialogues in which participants discussed the photos, their interpretations, and the larger issues relevant to the community. Photo voice methodology has been used effectively elsewhere in community-based adaptation research (Bennett and Dearden, 2013; Hissa, 2016; McClymont Peace and Myers, 2012).

The data consisted of 27 photos and their interpretations that were transcribed and translated by native Spanish speakers. Participants included 23 rural Salvadorans (13 men and 10 women) who primarily were farmers or were involved in household-level economic activities, and were from low-income families with limited education. The communities, however, were part of a region of El Salvador that is renowned for political resistance and social change engagement, both during and after the armed conflict, and thus several participants had been involved in informal education opportunities, such as awareness raising and capacity building workshops, via NGOs and the Catholic Church. In other words, community members may have participated in prior conscientization work on other themes in this particular region of El Salvador more so than in other regions.

I analyzed the photos and their interpretations (n = 27) for perspective-taking capacity, which was then verified, and corrected if needed, by developmental psychology researcher, Dr. Terri O'Fallon, applying the STAGES assessment (O'Fallon, 2013), upon which the above analytical framework is partly based. The STAGES model of adult development (O'Fallon, 2013) is an extension of the work of Cook-Greuter (2000) on post-autonomous levels of development, which in turn is an extension of Loevinger's (1966) model of "ego development" (later also called "leadership maturity"), all of which have high statistical rigor (Murray, 2017). STAGES assessment is usually carried out as a Sentence Completion Test (SCT) involving 36 sentences. Although useful in a psychology setting, we piloted a modified assessment that could be employed in community-based climate work. Analysis therefore employed the same scoring logic as used with the SCT. Data was assessed for perspective-taking capacity by coding the photo-interpretations according to three themes and considering various variables within each. These included: (1) the object of awareness (concrete, subtle or meta-aware), 2) the complexity of thought (atomistic, mechanistic, context-dependent, or systems thinking); and 3) the scope of time (no-time; present and past; past, present and future; evolutionary), see Appendix 1). This generated scores for perspective-taking capacities ranging from 2.5, 3.0, 3.5, and 4.0 that correspond with *conformist*, *expert*, *achiever*, and *pluralist* stages of meaning-making. This modified STAGES assessment on photo-transcripts cannot statistically refer to the *stage* of the photographer, however it does give insight into the stage of meaning-making represented by the photo-interpretations. Analyzing the photo voice data using this analytical framework is not intended to be a comprehensive analysis nor does it claim to map the stage of the

participants themselves; rather, it is intended to be used illustratively to better understand why there is such the plasticity of meanings and to orient the design of further research. The results are presented in terms of meaning-making stage and worldviews.

4.2. Results

The people in my study area contribute very little to greenhouse gas emissions, and are thus focused on *coping and responding to the changes*, which within the climate change literature is broadly conceptualized as 'adaptation.' For this reason, while the findings in this paper may be useful in a context of mitigation, this article focuses on adaptation. Similar to Clifford and Travis (2018) who found that local people use of proxies to make sense of changes occurring in the climate which were also held as one part of an amalgam of overall community change, in El Salvador several of the photo-interpretations used of proxies, such as increased dry spells, intense rains, and erratic weather patterns to depict changes in the climate and viewed these as related to other social and environmental changes, the details of which I explain further below. Here, this study seeks to understand in the context of adaptation why this might be the case by examining the diversity of ways that climate change 'comes to exist' for people, in a variety of expressions of meaning-making, that in some instances may not correspond with what one might be expecting to see.

In this region of northern El Salvador, the reality of usually reliable weather patterns suddenly becoming erratic and the need to find ways to live within that, alongside other changes occurring in the community, was now part and parcel of their very lifeworld. It was real. Yet, meanings about it were multiple. Participants made meaning of climate change differently depending on their perspective-taking capacity. The 27 photo interpretations, grouped as responses to the three questions, are included in Appendix 1. Analysis shows a range across four stages of meaning-making from Conformist (37%), Expert (26%), Achiever (7%), and Pluralist (29%), that correspond with three categories of worldviews, namely Traditional (37%), Modern (33%), and Postmodern (29%), described in detail in Table 1. In this section, I present data from the photos, consider these aspects of how meaning is organized at each stage, and examine why climate change is seen as it is from these different perspectives.

4.2.1. Traditional worldview: conformist meaning-making

In the data, climate change was referred to in literal, concrete ways in 37% of the photos, which were assessed to be Conformist statements and demonstrated a traditional worldview. This included climate change being described as changes in weather in concrete terms, such as recent epic floods, dry spells, intense rains, unusual storms (e.g. photos 3 "The Storm that Didn't Rain" and 4 "A Dry Well in Los Pozos" in Appendix 2). Other photos made connections between objects, but these objects of awareness all remained concrete, such as, "Warming caused more termites, this led to the death of orange and avocado trees, which did not happen where it was cooler" (photo 2, "New Infestations").

These photos represented an atomistic and immediate view of climate change, with the scope of time focusing mainly on the present, stretching somewhat towards the past, such as:

> "The storm started at midday, everything went dark and cloudy but it hadn't quite started to rain yet. When it arrived in Las Flores, it began to rain very heavily. It is not normal for such intense rain in this time." (photo 1, "A Storm in May," Appendix 2)

When the complexity of thought is atomistic, this can produce simple, concrete behavioural changes which could support adaptation at a local level, even though such actions may not be grouped into the concept of 'adaptation' per se. An example of such Conformist meaning-making referred to changes in their household practices to adapt to drought conditions to save both water and money:

> "When we do the laundry we don't use a lot of water, instead what we do is use two plastic containers, one to soak the clothes and the other to wash them. Doing that we save water, and we use the dirty water for something else. We started to save water, because we had been paying too much for the water bill. Now, we save water and we pay less." (photo 15, "El Guapo Struggles with the Heat")

4.2.2. Modern worldview: expert and achiever meaning-making

A modern worldview was demonstrated in 33% of photo interpretations, consisting of both the Expert (26%) and Achiever (7%) stages of meaning-making. These take third-person perspectives, the objects of awareness become more subtle or abstract, and the future comes more fully into view, therefore disclosing probabilities for what might happen.

The photos assessed as Expert meaning-making included some subtle concepts (such as "diversity") and considered a larger envelope of time stretching from the past and to some degree into the future, were more passive than active (i.e. receiving a training and being taught what to do to adapt), yet was still largely anchored in concrete phenomena (i.e. acreage, trees, compost), such as:

> "This picture is an example of the diversity in our acreage; everything is organic with no chemical use at all. We started this acreage thanks to a training that an NGO called CARITAS came to give us; they gave us the trees to plant and taught us how to make compost." (photo 20, "Agricultural Diversification," Appendix 2)

The photos assessed as Achiever meaning-making demonstrated thinking that was even more abstract and used further subtle concepts (such as, "contamination"), considered relationships and links between things and tended to forecast further into the future. For example:

> "This picture is in 'Colonia Jesús Rojas' in Arcatao, where people have been throwing garbage in the river contaminating the environment. This affects us because the garbage collects water, which harbors mosquito larvae that cause diseases and other problems." (photo 11 "Every Day More Garbage," Appendix 2).

This cause-and-effect logic invites greater agency and responsibility, more consequence of actions are taken into account, and meaning-making would be accounting for the networked ways that increases in temperature, human activities like pollution, and health impacts are all part of the problem. Based on this, adaptation might go beyond concrete steps as in Conformist, and instead may be carried out on several linked fronts (i.e. managing standing water, reducing garbage, and preparing for water-borne illnesses in higher temperature conditions).

The main difference between Expert and Achiever meaning-making is that the latter is using more instrumental thinking, serving as a means of pursuing an aim, organizing meaning in a more linked-up way, and mechanistic in the sense of recognizing cause and effect. As such, Achiever meaning-making construes climate change to be occurring in relation to a series of other environmental changes such as increases in pollution, unsustainable cultivation practices, and unhealthy habits, combined into a logical explanation. For example, photo 12, "We Depend on Pesticides," notices the links between various parts in a system (i.e. infestations, pesticide-use, erosion, and cultivations) as all involved in climate change, across a time envelope that stretches from past through to the future, suggesting an associated understanding of the multiple factors involved:

> "These are bottles of pesticide that we use here in cultivating our crops. When someone uses pesticides the land becomes damaged and erodes more quickly. But the people continue using it because, nowadays, there are a lot of new insect infestations (due to the increase in weather temperatures) so it's hard to cultivate vegetables successfully without using pesticides. In the recent past the people didn't use any pesticide, but then all the people begin using it."

(photo 12, "We Depend on Pesticides," Appendix 2)

Adaptation in this meaning-making frame seems to be taking into account the logical chain of events that is producing environmental changes. The cause-and-effect understanding, alongside a larger sense of time, now includes the consideration of multiple systems in various domains: changing land-use practices, use of industrial agricultural products, and loss of traditional practices are all related to the problem-set. The quote suggests the photographer knows these have an impact on the environment and need to be accounted for in an agenda for adaptation.

As both these meaning-making frames use a third-person objective perspective to make sense of reality, they are among the first meaning-making frames that would inherently understand the science behind climate change on its own terms.

4.2.3. Postmodern worldview, pluralist meaning-making

A final third of the photos represented a postmodern worldview and Pluralist meaning-making. These included multigenerational and cultural impacts, such as photo 8, "They Passed By Here," and included even more subtle or abstract perspectives about climate change, such as ideas of history, intergenerationality, and impermanence:

> "Nothing is as it once was. Dry wells, late rains; clouds gather, but it rains elsewhere. My grandparents passed by here. We need to take care of this mountain or we will lose it." (photo 8, "They Passed by Here," Appendix 2).

Although sometimes describing concrete objects, photos that were assessed to be Pluralist were using subtle processes to make sense of climate change adaptation that are now occurring in a broader contextual understanding, for example:

> "Well, for me to plant a tree is just something urgent I have to do to adapt to the climate change, but I also have to think in the kind of tree I'm going to plant for not to damage the land." (photo 24 "Reforestation," Appendix 2)

The ability to consider context and the multiple causes of a situation also has a further increase in agency and responsibility, which was reflected in these photos, such as:

> "With all this heat we have now, one has to see about how one can adapt. I have built my house using 'adobe' because it is cooler and more refreshing and I also had to make it taller to keep it cooler. If we made the houses with cement, the house feels too hot" (photo 26 "Recuperating Traditional Knowledge").

People holding Pluralist meaning-making also demonstrate linked-up meaning-making, such as in Photo 13, "Forest Fire," to understand climate change as a phenomenon that adds to multiple stressors in the region, such as deforestation, soil erosion and degradation, increased use of pesticides, community health, and so forth. Some of these photo interpretations, such as photo 23, "Recycling garbage," demonstrate early systems thinking, considering how the resilience developed during the civil war may have contributed to being able to adapt to meet current challenges, such as those relating to the environment.

> "Well, I thought that I learned to be adaptable when the revolutionary movement was starting. Before the civil war, we suffered a lot and everything was hard. I believe that is where I developed resilience. This photo I took in the house where I was trying to demonstrate how to recycle bottles. Today, we have many bottles and the best thing I believe is to re-use what we are producing so much of." (photo 23, "Recycling garbage").

Here, adaptation is construed in a way that includes a shift in thinking, moving from a disposable mindset (ubiquitous single-use plastics) to one that is circular and regenerative ("re-using what we are producing so much of"). While it is not directed specifically at climate change per se, it is accounting for environmental changes, of which climate change is seen to be a part, and then attempting to re-orient daily life to adapt and be resilient to such changes.

With even a broader scope of time, accounting for the past and projecting forward into the future and considering how adaptation might shift the trajectory of the community, the Pluralist meaning-making stage notably considers the context in which climate change is occurring: historical, ecological, economic and social.

4.3. Discussion

This study illustrates how perspective-taking capacity, as studied and described in developmental psychology, helps to disclose the mechanisms behind how meaning is organized regarding climate change. The meanings people gave to climate change corresponded with four meaning-making frames, grouped into three worldviews. These meanings differed in number of perspectives taken, complexity of thought, object of awareness, and in the scope of time included in one's view. Those representing a traditional worldview were made up primarily with a Conformist meaning-making, and construed climate change in concrete ways, in 'bits and pieces' of discrete events distributed across space and time, mainly depicted as changes in weather or conditions and as concrete impacts, as depicted in photos 1, 3 and 4 in Appendix 2. There is a passive sense to these photos and their interpretations, that this variable, unpredictable weather is happening to them, but less acknowledgement of the human role in such changes.

Those representing a modern worldview were made up of Expert and Achiever meaning-making, and tended to construe climate change in terms using more abstract or subtle terms, such as 'diversity' and 'contamination,' with mechanistic, logical causes and effects. As depicted in photos 20, 11, and 12 in Appendix 2, here 'climate change' is depicted as more than just the weather events, and there is an effort to represent causes or contributing factors to overall environmental changes that are seen to be a part of the problem, and may play an instrumental role in adaptation. These photos try to draw lines between more dimensions of the issue—changes in land-use practices, social changes, and behavioural changes. Depicting a sense of the human-made contributions to these changes, these photos reflect a greater sense of agency and responsibility.

Those representing a postmodern worldview were made up of Pluralist meaning-making and construed climate change with even more subtle terms as resilience and adaptability, viewing multiple variables, causes within causes, the contextual aspect of a situation, and system interactions. Photos 8, 26, and 24 in Appendix 2 illustrate this contextual understanding and are more self-reflexive into the multiple contributing factors into climate change and adaptation, of which the photographer sees he or she play a part—these were the few photos in which the photographer actually got into his or her photo. That increase in self-reflexivity seemed to occur along with a greater degree of agency and responsibility, for example, considering how one might build their housing differently, how to rediscover traditional practices, and how to reforest carefully tending as much the plant as the future ecosystem it will be a part of. These tended to view climate change in a systemic way or as one among multiple stressors, considered the impacts on multiple generations forward and backward in time, and began to link the disparate pieces of information and experience into a larger, dynamic whole.

Similar to the findings of Clifford and Travis (2018), most actors in this community construed climate change adaptation not in a discrete manner, but through linkages with other change processes, such as changing social practices, shifts in land-use, and altered consumer habits. A developmental psychology analysis brought clarity to how these "linkages" were being construed, parsing out the range of ways that connections were being made and finding that this differed in relation to meaning-making stages. With the Conformist photo-interpretations climate change was construed as a heap of associated factors that, in a

sense, were not connected (i.e. increased rains, unusual weather, dry conditions); the Expert and Achiever photo-interpretations represented linkages in a linear system of cause-and-effect with more lines drawn between factors (such as the relationship between pollution, increasing temperatures, insect populations, and their subsequent health impacts, and so forth); and Pluralist photo-interpretations construed linkages in a more contextual, systemic manner (i.e. historical, ecological, and social dimensions of the issue and how to meet it) (see photo samples in Appendix 2). This finding may help researchers and policy makers to grasp the nuance into the range of ways that 'climate changes'—and, indeed, 'adaptations'—might become manifest in communities.

Brace and Geoghegan (2011) concur with this range of understandings, and refer to how people hold climate change as, "simultaneously a reality, an agenda, a problem and a context" (2011, p. 285), and yet a developmental psychology perspective would say that each of those meanings unfold in a nested way through maturation. As illustrated in Appendix 2 and described above, the results in this study find that for the Conformist stage, climate change is primarily a reality, and largely described as weather variability or concrete impacts. With the Expert and Achiever stages, it becomes that, and also an agenda and a problem, understood as an effect of a logical array of causes relating to changing practices in the community, to which mechanistic problem-solving may be applied. For the Pluralist stage, climate change is all of the above, as well as a context-dependent issue, seeing structural dimensions across generations. How people construe this meaning of climate change will co-arise with adaptive measures that make sense to them: from more discrete practical steps one might take with a Conformist understanding (i.e. saving water), to more technical, instrumental adaptations with an Expert and Achiever understanding (i.e. agricultural diversification), to a more contextual, systemic and reflexive adaptive strategy with a Pluralistic understanding (i.e. returning to traditional building practices and projecting forward with ecologically-sound reforestation efforts).

In considering the notion of hierarchical complexity of learning, it is interesting to note that holding climate change as a context in a systemic manner (Pluralist), presupposes that climate change is also understood as a concrete reality (Conformist) *and* as an abstract agenda or problem (Expert and Achiever). Or, in other words, in order to put together the Pluralist photo-interpretations, the photographer in some way was reflecting upon and coordinating between other discrete perspectives from earlier stages (such as, the concrete interpretations of climate change as weather variability, and the more abstract mechanistic interpretations of climate change as an effect of a series of causes such as land-use changes, social changes, and changes in environmental practices) into a higher order contextual understanding. While without a developmental frame, these photo-interpretations could be understood as multiple positions, what this paper argues is that those multiple positions are not able to be accessed by everyone. Later photo-interpretations, such as those demonstrating a Pluralist stage, included the earlier perspectives and coordinated them in the construction of meaning, however this was not vice versa: that is, in no cases were Conformist photo-interpretations, for example, construing climate change as a context. If these are in fact demonstrating co-existing nested perspectives on climate change, the implications that might have for adaptation are important to consider.

4.3.1. Alignment of meaning

This variance in climate meanings raises a question of how actors working in adaptation might better align with how local people make meaning of climate change. External actors and technical experts who take, for example, a modern worldview, based on an expert or achiever stage, as something given and assume that all others construe climate change in their way, may end up missing a large portion of the population they intend to engage. Rosengren (2016) describes research with the Matsigenka tribe in the Amazon, and found that modernist definition of climate change as a global phenomena masked alternative perspectives—some which do not even have the word, "climate," in their language. Findlater et al. (2018, p. 188) describe a mismatch between the climate change risks presented by experts and the experiential learning that normally shapes local farmers' decision-making in South Africa's Western Cape. They describe how this incongruence led to an uneasy addition of climate change into their mental models, one that was cognitively isolated from other cognitive frames they use regarding 'normal' risk management. As such, the farmers remained uncertain and skeptical of climate predictions and it affected their willingness to stay committed to adaptation strategies.

This relates to the debates in the literature that recognises multiple epistemologies particularly in the area of Traditional Ecological Knowledge (TEK), as well as the politics lying behind distinctions between 'expert' and 'lay' publics (Scoville-Simonds, 2018; Vinyeta and Lynn, 2013). Although TEK was not a particular lens I brought to this study and is outside the scope of this paper, developmental psychology may add some interesting questions to these debates. Such as, to what extent has TEK gone through its own complexification of meaning-making? If, through increasing perspective-taking capacities, present-day traditional ecological knowledge-systems reflect upon and coordinate earlier TEK perspectives into higher order TEK-wholes, what (possibly unrecognized) potential might such indigenous knowledge systems have for meeting complex issues like climate change? This warrants more study. In any case, the findings of nested meaning-making about climate change may contribute in a relevant way to the politics between 'expert' and 'lay' climate knowledges that is related to the TEK debates. Specifically, these findings may help in mitigating against the dominance of one knowledge system over another, since a developmental perspective recognizes a spectrum of meaning-making stages as real, valid, and necessary to skillfully include in climate change action.

Accepting the notion of there being plural 'climate changes,' developmental psychology is concerned with *how* meaning is organized and *why*, and these insights can provide a broader, deeper understanding of such plasticity of meanings. The more simplistic, concrete meanings given to climate change are, in a sense, no less real than later ones. While 'weather changes' (photos 1, 3, and 4) do not equal 'climate change' and 'lack of beans' (photo 2) is not the same thing as, 'food insecurity', this paper suggests there are many (concrete, subtle, and meta-aware) derivatives of the multiple object that is climate change or that there are is a range of partial glimpses of the total (possibly ungraspable) hyperobject. It may be preferable to connect better with the frames people do hold and fill out meaning from that point, for more locally-owned adaptation initiatives, which is resonant with the theoretical speculations of O'Brien and Hochachka (2010) and De Witt et al. (2016) and would warrant more rigorous study.

Policy makers could benefit from understanding the deeper mechanisms of meaning-making about climate change; going deeper than the transient content of "valued things" as described by Graham et al. (2014), to better grasp the "value systems" in which meaning is being construed. Rather than relying primarily on single-frame metaphors or on typologies of surface-values in segmentation studies, for example, communication could be crafted in a developmental manner to resonate with the various stages of perspective-taking capacities that are predominant in a region. That is, to craft communications by considering the deeper layer of meaning-construction: rather than what is valued, to account for how value is being coordinated and constructed. In so doing, it encourages less hubris among the climate experts which, in turn, could make it easier to connect meaningfully with local populations about climate change and possibly lead to a more locally-owned, effective adaptation on the long term.

4.3.2. Translation-based process

As discussed in the literature review, studies have found that psychological distance matters in climate change engagement, and this study here concurs. However, there are mixed findings in the literature

on how it matters—while some studies suggest that reducing the psychological distance may produce a less abstract and a more concrete mental construct and thus support greater climate engagement, other studies found that increasing the psychological distance is preferable in that it helps to point people to the distant, albeit abstract, impacts of climate change—such that Brügger et al (2015) suggest that the role of psychological distance on climate change action is inconclusive. A developmental psychology perspective can contribute to this inquiry on psychological distance, primarily because such distance is one of the characteristics of meaning-making that changes through development, moving from concrete to more abstract. By explaining why this psychological distance is present—namely, as a function of the perspective-taking capacities that increase through growth—a developmental psychology understanding would take into account what psychological distance people are holding about climate change, so to help them to translate their sense-making in meaningful ways. That is, a developmental perspective suggests that perhaps there isn't a one-size-fits-all prescription for the preferable psychological distance to best foster climate engagement, but rather there is a need to shape climate engagement according to the psychological distance available to the various meaning-making stages in the audience.

The project findings suggest that there is a link worth studying further between how better understanding of local interpretive frames might give rise to a more locally-driven action. Elsewhere, researchers have suggested that embedding a project within local viewpoints may support adaptive action (Pelling, 2011). Findlater et al. (2018) recommend adaptation among farmers in South Africa to consider how climate change is similar and compatible with other risks they routinely manage, and to "expand farmers' notion of climate variability to account for the newly dynamic and uncertain nature of the climate variables for which they are already deeply familiar" (p. 188). This study's findings further illustrate such an idea for how local people might interpret this complex, dynamic, and uncertain concept of climate change out of cognitive isolation and into their own lifeworlds (Habermas, 1984), through what I referred to as translation here in this paper. A translation-based process would seek to anchor climate change action in local meaning-making.

Supporting local actors to maintain an interior sovereignty over climate change meanings may, in turn, support more committed climate change action. In this study, for example, a Conformist meaning about climate change translated into a series of practical yet discrete actions as a strategy for adaptation, such as using two plastic containers for soaking and washing clothes to save water (photo 15). A pluralist meaning of climate change, on the other hand, translated adaption in a way that considered the ecological and social parameters, the larger context, multiple drivers of vulnerability and even the possibilities for maladaptation, such as in "Reforestation" (photo 24), "for me to plant a tree is just something urgent I have to do to adapt to the climate change, but I also have to think in the kind of tree I'm going to plant so as to not damage the land," and "New Crops" (photo 25), which included consideration of reforestation, plant horticulture, diversity of crops, harvest for subsistence as well as for additional income generation. These findings pose the possibility that sovereignty over one's own climate meanings may prove important for sustaining the commitment, involvement and action, and warrants further study.

5. Conclusion

Social scientific research acknowledges a spectrum of ways in which climate change can be known and understood. Many studies report *what* these differences entail. Yet, *how* and *why* these meanings are made about climate change in such markedly different ways is understudied and holds potential. In their review of human dimensions research in climate change, Goldman et al. (2018, p. 10) conclude that, "some of the most promising work is pushing the ontological boundaries further still by exploring…what it means to talk about multiple existing realities (including multiple manifestations of climate change)." This article takes a tentative, first step in precisely that direction.

The are some important take-aways in terms of what developmental psychology brings to climate change adaptation. It assists in describing how different perspective-taking capacities arrive at different meanings about climate change, based on the object of awareness, complexity of thought, and scope of time. A developmental psychology perspective explains how these change across life and are referred here to as meaning-making stages or *matryoshkas*, synonymous terms including levels or action logics. With increasing perspective-taking capacities at each stage, essentially more of climate change can be seen, linkages can be made in more complex ways, further dimensions of the issue can be considered, and a broader sense of time gives rise to greater understanding of consequences, responsibility and agency.

This undoes the "myth of the given", a term coined by Sellars and Rorty (1997), by recognizing that a singular climate change cannot be assumed as a "given", but rather there are many ways meaning is constructed about this phenomena. Recognition of this not only helps to examine why there is such plasticity of meanings about climate change, but also fosters better alignment among different climate change meanings. This corresponds with Clifford and Travis' (2018) finding that while even when local climate knowledge fails to meet climate literacy tests, it can still reflect a rich, intricate understanding that is relevant and important for adaptation. Developmental psychology helps to explain why that is the case—namely, that people translate (i.e. express or fill out) the meaning they hold about climate change in ways that are congruent with their matryoshka. This insight encourages external actors to hold open the space in which meaning is filled by local actors, which in turn honours and includes alternative understandings and adaptations.

Finally, an interesting preliminary finding here in this study was the increase in self-reflexivity that seems to have been present in the later meaning-making stages. Further study into this would be interesting, along with more research into what developmental psychology could contribute regarding the dynamics of conscientization and transformation in climate change adaptation.

While this illustrative case study was limited in scope, it articulates some insights that a developmental framework could bring to complement other psychological and social science scholarship in climate change engagement. Through presenting a novel analytical framework and demonstrating its application in a case study, this paper makes the case that a deeper understanding of perspectives as nested *matryoshkas* of meaning-making can help to make sense of why there is such plasticity of meanings about climate change and may have important implications for adaptation.

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Appendix 1 Photo titles, interpretations, and stage assessment for each statement, sorted as responses to each question

#	Photo Title	Meaning-making stage		Object of awareness	Complexity level	Scope of Time	Photo Interpretation (English)
Question 1: What does climate change mean to me?							
1	A Storm in May	2.5	Conformist	concrete	atomistic	present, nominal inclusion of past	It's unusual for storms during these months of the year. Everything is unusually green for this time of year, but is not supposed to be like this at this time. Obviously things are changing and I can see this right in front of my house and in the mountains surrounding the community.
2	New Infestations	2.5	Conformist	concrete	atomistic	present, nominal inclusion of past	For a long time, we there were a lot of orange trees in front of our house and we used it to sell oranges. But then, gradually, they died out due to an infestation of termites. These termites increased as the temperatures got hotter. In the higher areas of the community where it was cooler they didn't have this problem. But where we are, for 2 years now, this infestation always affects the orange and avocado trees.
3	The Storm that Didn't Rain	2.5	Conformist	concrete	atomistic	present	The storm started at midday, everything went dark and cloudy but it hadn't quite started to rain yet. When it arrived in Las Flores, it began to rain very heavily. It is not normal for such intense rain in this time.
4	The Dry well in Los Pozos	2.5	Conformist	concrete	atomistic	present, inclusion of past	Today, these wells have water only during rainy season not during the dry season, which starts in November. However, throughout history until 1981, these springs never dried in any season. The seasonal drying up of the wells today Is not only the case with just one well, rather most of the wells are in the same situation.
5	A Disaster of the River	2.5	Conformist	concrete	atomisitc	present	This photo is from the Sumpul River. The day I took the photo, we were going to Gujuataya with my sister, and I said to her, that tree is sprouting. As we walked further on to the other side of the tree, I realized the tree was actually dying because of the fire. It looks like someone burned it up just to damage the tree. She hadn't seen the tree when it was green, like I had, and now with ashes all around, it probably going to die.
6	The Tree Took Years to Grow, They Cut it Down in a Day	3	Expert	subtle	more linked ("consequence")	present and inclusion of the recent past and near future	They set fire to this tree to prepare the land for cultivation and then for planting they put a chemical fertilizer called "gramozone." Is horrible especially because in the hill there's no more trees and now as a consequence, there are frequent landslides.
7	We are Causing Climate Change	3	Expert	subtle	more linked ("cause and effect")	present and inclusion of the recent past and near future	This machine is taking land from a small hill that had been reforested for a municipal field in San José neighborhood. This will cause an erosion problem, the earth won't have the same amount of fertilizer as it does now, agricultural planting will be less possible, and in the summer the dust will cause more diseases.
8	They Passed By Here	4	Pluralist	subtle	networked (linked up thinking)	present, distant past and distant future (grandparents)	I felt when I took the photo that I was doing a good job with this theme, I had actually seen and observed the changes taking place in the majority of photos I took. For example, there was a well that previously was always full with water—a 74 old man told me that these wells always have water in abundance—so I was very surprised to see that the heat was drying the water in these very wells. My grandmother, Juana 83 years old, says the change is substantial, she says that before, during these months there would already be rains. Now, we can see the rain clouds form in the sky, but the rainstorms are falling in other places. I realized this when I was taking the pictures; I realized what was happening. Now, I think I have more knowledge about climate change. Nothing is like it once was. My grandparents passed by here. I think a lot about if we don't take care of this mountain, what I am seeing today is going to disappear.
Question 2: How am I affected by climate change?							
9	There are no Beans	2.5	Conformist	concrete	atomisitc	present, inclusion of past	This picture is about what we are eating at dinner, there are eggs, cheese and tortillas. Last year the rainy season was very short and we couldn't plant beans for the first time in history. For this reason, we don't have beans for dinner in the photo. When we can't harvest our own crops, we have to try to find beans elsewhere to buy. But, they are very expensive for most families to buy. In my family, We have beans because my dad, who lives in Carasque, has a field with a water source. From my dad's field, four families were supplied with beans and still we have excess. Those who have no family to help them, have to buy them or don't eat beans this year. For me, this is climate change, because before, by this time, it would have already rained and we would have sown the bean crops.
10	Climate change affects my granddaughter	3	Expert	subtle	more linked (cause-and-effect thinking)	present, past and future (but considered from within the present moment)	Look, this affects me a lot because there are many of us on our way out, we are old, and we don't think in future generations. For example, my granddaughter, Daniela, has to go without a t-shirt because of the heat these days. Daneila is 7 years old and she won't have water in the future. This worries me a lot, because I love her.
11	Every Day More Garbage	3.5	Achiever	subtle	linear systems-thinking	present, past and future (operationalized)	This picture is in "Colonia Jesús Rojas" in Arcatao, where people have been throwing garbage in the river contaminating the environment. This affects us because the garbage collects water, which harbors mosquito larvae that cause diseases and other problems.
12	We Depend on Pesticides	3.5	Achiever	subtle	linear systems-thinking	present, past and future (implied not directly spoken to)	These are bottles of pesticide that we use here in cultivating our crops. When someone uses pesticides the land becomes damaged and erodes more quickly. But the people continue using it because, nowadays, there are a lot of new insect infestations (due to the increase in weather temperatures) so it's hard to cultivate vegetables successfully without using pesticides. In the recent past the people didn't use any pesticide, but then all the people begin using it.

13	Forest Fire	4	Pluralist	subtle	more complex systems-thinking used here	present, past and distant future (grandmother)	I took this picture of the bamboo plantation that was burning near the ravine. Changes in the bamboo plantation affect us because the bamboo stalks are very useful. We use them to construct houses and for arts and craft. People intentionally set fire to their lands to kill weeds and fertilize the land. I was here in the house, resting in the hammock when I saw the smoke. I went to see what was going on and took the photo. This worried me, because the smoke affects my grandmother, she is old and it causes her harm. I love her so much and of course it worries me to see her sick. I don't want anything bad to happen but people light fires without thinking how many of us are harmed.
14	The Fire Got out of Control	4	Pluralist	subtle	more complex systems, and contextual thinking	present, past and future (viewing situation as a whole)	The fire was near the earthen well, which makes the water recede deeper into the ground and that is why we have all this drought. At that time, I was in the community council and I was appointed the health and environmental promoter. The fire is good for cultivation, because it eradicates all the mouse hovels which reduce the mouse population and it is the mice that are eating the corn crops. However, the problem with these fires is that when it rains on the sides of the mountains, there are landslides and erosion, and a lot of weeds move in. At this time, the municipal office was permitting people to light fires on their lands but I told them do not to do it anymore. Only three people listened. It was afterwards that all the problems with burning the land began to appear.
Question 3: How am I already adapting to climate change?							
15	El Guapo Struggles with the Heat	2.5	Conformist	concrete	atomisitc	present, inclusion of past	When we do the laundry we don't use a lot of water, instead what we do is use two plastic containers, one for soak the clothes and the other to wash them. Doing that we save water, and we use the dirty water for something else. We started to save water, because we had been paying too much for the water bill. Now, we save water and we pay less.
16	Refuge	2.5	Conformist	concrete	atomisitc	present	The road to El Portillo is quite tiring. As people are walking and climbing the mountain, they usually stop to rest in this place. I think they choose this place because it is very refreshing, since there are many trees that provide shade and coolness.
17	The Gualcinga River	2.5	Conformist	concrete	atomisitc	present, inclusion of past	This picture is from the Gualcinga River, in Los Pozos; but for this time of the year, it should have more water. I used to go to do the laundry in this river, when I lived with my mother in law 20 years ago, and I remember this was a big river, with a lot of water. Now we have a water system in our houses for laundry and also the river is much smaller.
18	Landslide in the Bean Crop	2.5	Conformist	concrete	atomisitc	present, recent past	A landslide cause by torrential rains at the end of the winter rainy season, in September 2010, caused the loss of beans crops.
19	Sustainable Production	3	Expert	subtle	networked thinking	present, past	These are tomato crops that we use to eat, and also to grow our own sustainable production for consumption.
20	Agricultural Diversification	3	Expert	subtle	networked thinking	present, past	This picture is an example of the diversity in our acreage; everything is organic with no chemical use at all. We started this acreage thanks to a training that an NGO called CARITAS came to give us; they gave us the trees to plant and taught us how to make compost.
21	We learned that we need to cut the horns	3	Expert	subtle	networked thinking	present, past	This cow is sick with a disease we call "Hollow Horn" (the horn is dead inside). According to the agronomists, this is because the cow is not getting enough calcium. However, we never had this problem before, and we believe it came from Honduras side. We've learned that if we don't cut the horn, the cow eventually dies. Before we learned this technique, at the beginning of the disease, a lot of cows died because we didn't know what was wrong with them. But the more one learns from experiences, the more one knows; we learned that we have to cut the horns so they don't die.
22	The Garbage has History	3	Expert	subtle	networked thinking	present, past	Garbage collection is done every 3 months; it helps to reduce the impacts of the climate change and improves health because it reduces pollution. The most common diseases here are gastritis, parasites and heart problems; I believe that all these diseases are caused by pollution.
23	Recycling Garbage	4	Pluralist	subtle	complex adaptive systems-thinking	present, past and future (viewing situation as a whole)	Well, I thought that I learned to be adaptable when the revolutionary movement was starting. Before the civil war, we suffered a lot and everything was hard. I believe that that is where I developed resilience. This photo I took in the house where I was trying to demonstrate how to recycle bottles. Today, we have many bottles and the best thing I believe is to re-use what we are producing so much of.
24	Reforestation	4	Pluralist	subtle	complex adaptive systems-thinking	present, past and distant future	Well, for me to plant a tree is just something urgent I have to do to adapt to the climate change, but I also have to think in the kind of tree I'm going to plant so not to damage the land.
25	New Crops	4	Pluralist	subtle	contextual thinking ("it depends")	present, past and future	These are coffee plants we are intending to plant to reforest our acreage. In this picture, the seedlings are in the nursery and when they are big enough, we'll plant them in the soil. It's the first time we are going to try planting these acreages with coffee trees. I've also planted banana trees, cacao trees, tropical fruits like "paterna" and "jocote". I use organic fertilizer only, no pesticides at all. We eat most of the fruit ourselves but, depending on the harvest, we may be able to sell the rest.
26	Recuperating Traditional knowledge	4	Pluralist	subtle	contextual thinking ("it depends")	present, past and future	With all this heat we have now, one has to see about how one can adapt. I have built my house using "adobe" because it is cooler and more refreshing and I also had to make it taller to keep it cooler. If we made the houses with cement, the house feels too hot.
27	Prohibited for Health	4	Pluralist	subtle	contextual thinking ("it depends")	present, past and future	Cigarette smoking affects us because it polluted the environment and cause fires (on land that is already too dry and susceptible to fire), when people throw away burning cigarettes. It also causes diseases like cancer. It destroys nature.

Appendix 2 Photo samples for meaning-making stages

Traditional Worldview (Conformist meaning-making):

Photo 1 “A Storm in May”

“It’s unusual for storms during these months of the year. Everything is unusually green for this time of year, but is not supposed to be like this at this time. Obviously things are changing and I can see this right in front of my house and in the mountains surrounding the community.”

Photo 3 “The Storm that Didn't Rain”

“The storm started at midday, everything went dark and cloudy but it hadn’t quite started to rain yet. When it arrived in Las Flores, it began to rain very heavily. It is not normal for such intense rain in this time.”

Photo 4 “A Dry Well in Los Pozos”

“Today, these wells have water only during rainy season not during the dry season, which starts in November. However, throughout history until 1981, these springs never dried in any season. The seasonal drying up of the wells today Is not only the case with just one well, rather most of the wells are in the same situation.”

Modern Worldview (Expert and Achiever meaning-making)

Photo 20, “Agricultural Diversification”

“This picture is an example of the diversity in our acreage; everything is organic with no chemical use at all. We started this acreage thanks to a training that an NGO called CARITAS came to give us; they gave us the trees to plant and taught us how to make compost.”

Photo 11: “Every Day More Garbage”

“This picture is in “Colonia Jesús Rojas” in Arcatao, where people have been throwing garbage in the river contaminating the environment. This affects us because the garbage collects water, which harbors mosquito larvae that cause diseases and other problems.”

Photo 12: “We Depend on Pesticides”

“These are bottles of pesticide that we use here in cultivating our crops. When someone uses pesticides the land becomes damaged and erodes more quickly. But the people continue using it because, nowadays, there are a lot of new insect infestations (due to the increase in weather temperatures) so it’s hard to cultivate vegetables successfully without using pesticides. In the recent past the people didn’t use any pesticide, but then all the people begin using it.”

Postmodern worldview (Pluralistic meaning-making):

Photo 8, “They Passed By Here”

“I felt when I took the photo that I was doing a good job with this theme, I had actually seen and observed the changes taking place in the majority of photos I took. For example, there was a well that previously was always full with water—a 74 old man told me that these wells always have water in abundance—so I was very surprised to see that the heat was drying the water in these very wells. My grandmother, Juana 83 years old, says the change is substantial, she says that before, during these months there would already be rains. Now, we can see the rain clouds form in the sky, but the rainstorms are falling in other places. I realized this when I was taking the pictures; I realized what was happening. Now, I think I have more knowledge about climate change. Nothing is like it once was. My grandparents passed by here. I think a lot about if we don’t take care of this mountain, what I am seeing today is going to disappear.”

Photo 26: “Recuperating Traditional Knowledge”

“With all this heat we have now, one has to see about how one can adapt. I have built my house using ‘adobe’ because it is cooler and more refreshing and I also had to make it taller to keep it cooler. If we made the houses with cement, the house feels too hot.”

Photo 24 “Reforestation”

“Well, for me to plant a tree is just something urgent I have to do to adapt to the climate change, but I also have to think in the kind of tree I’m going to plant so not to damage the land.”

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III

Sustainability Science
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SPECIAL FEATURE: ORIGINAL ARTICLE

The "How" of Transformation: Integrative Approaches to Sustainability

Finding shared meaning in the Anthropocene: engaging diverse perspectives on climate change

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Abstract
The scientific evidence of climate change has never been clearer and more convergent, and calls for transformations to sustainability have never been greater. Yet, perspectives and social opinions about it remain fractured, and collaborative action is faltering. Climate policy seeks to forge a *singular* sense of climate change, dominated by an 'information deficit model' that focuses on transferring climate science to the lay public. Critics argue that this leaves out certain perspectives, including the *plurality* of meanings uncovered through participatory approaches. However, questions remain about how these approaches can better account for nuances in the psychological complexity of climate change, without getting stuck in the cul-de-sacs of epistemological relativism and post-truth politics. In this paper, I explore an approach through which we might find shared meaning at the interface of individual and collective views about climate change. I first present a conceptual framework that describes five psychological reasons why climate change challenges individual and collective meaning-making, and also provides a way to understand how meaning is organized within that. I then use this framework to inform the use of photo voice as a transformative (action-research) method, examining its ability to overcome some of the meaning-making challenges specific to climate change. I discuss how participants from a coffee cooperative in Guatemala reflected first on their own climate meanings and then engaged in a meaning-making process with other actors in the coffee value chain. Findings suggest a psychosocial approach to climate engagement—one that engages both subjectively and intersubjectively on the complexities unique to climate change—is helpful in acknowledging an ontological pluralism of 'climate *changes*' amongst individuals, while also supporting a nexus-agreement collectively. This may in turn contribute to a more effective and ethical process of transformation.

Keywords Psychology of climate change · Meaning-making · Constructive-developmental psychology · Photovoice · Ontological pluralism · Transformations to sustainability

Introduction

Global environmental challenges, which are characteristic of the Anthropocene, evade resolution in part because they challenge our meaning-making. Climate change is a prime example. Both the complexity of climate change and its enmeshment with self-identity, culture, values, ideology and beliefs, result in not only a crisis of meaning, but a crisis of *shared* meaning (Hochachka 2019; Hulme 2009; Kahan et al. 2011; Morton 2013; Norgaard 2011; Stanovich et al. 2013; Stoknes 2015). Populations end up very divided about what climate even is, let alone what to do about it (Graham et al. 2014; Maibach et al. 2011; Roser-Renouf et al. 2009). Such varied meanings on climate change can exacerbate existing misunderstandings and contribute to ongoing

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conflicts between actors with differing worldviews and values (de Witt 2015; Madden and McQuinn 2014). At the same time, the Intergovernmental Panel on Climate Change (IPCC) has put out calls for fundamental, *transformative change* across society to reckon with the climate challenge (IPCC 2018), and 'climate change engagement' is increasingly becoming synonymous with engaging with transformation. Yet at the moment when climate science has never been clearer and the calls for transformations to sustainability never louder, the 'value-action' gap between what people say and what people do regarding climate change persists and opinions remain fractured (Blake 1999; Climate Action Tracker 2019; Stoknes 2014). In this paper, I propose that better integration of the plurality of individual and collective meaning-making is needed in public engagement strategies, which I argue may in turn support processes of effective and ethical transformations to sustainability.

To date, a common response to the plasticity of climate change meanings has been to assume people simply do not understand climate science correctly. A prominent engagement strategy, therefore, has been to forge a singular, universal understanding of the phenomenon using the 'information deficit model' or the 'empty bucket theory,' where more and better climate science is transferred to lay publics in a unilateral manner (Stoknes 2015; Suldovsky 2017). This approach has been found ineffective, as it tends to become patched onto prevailing mental frames that either don't relate with existing ideologies and risk becoming rejected (Feygina et al. 2010), remains cognitively isolated from the inherent knowledges that already exist on the matter (Findlater et al. 2018), or forecloses on the possibility of meanings with alternate ontological or normative underpinnings (Macnaghten 2020). When it comes to climate change, people do not tend to take the findings at face value in the same way they would a more straight-forward issue; rather "'evidence' around climate change is searched, remembered, and assimilated in a way that dovetails with people's own political loyalties and their worldviews" (Hornsey et al. 2016, p. 625). A strategy that people use to understand climate change is to apply heuristics (self-educating techniques), yet these often don't conform with what a person may cognitively understand about the climate science as much as they seek to placate emotional and cultural knowledge of the situation (Hagerman and Satterfield 2014; Norgaard 2006a). As a result, engagement efforts that insist on proceeding from, and converging others into, a *singular* climate science frame do little to change the underlying worldviews that inform how facts are selected and how the problem is characterized in the first place.

Proceeding from a singular climate frame, which in turn may be used to impose sustainability transformation on publics who have had little say in its design, is also considered unethical (Bennett et al. 2019; Manuel-Navarrete and Pelling 2015; O'Brien and Leichenko 2003). Some scholars call for more participatory, inclusive approaches, moving from individual "multiple cognitions" of personal meaning to interrelated "distributed cognition" of shared meaning (Pahl-Wostl et al. 2007, p. 3). This more relational, reflexive engagement with scientific concepts—i.e. a co-production of knowledge—is argued to be an important manner by which transformation might occur in society (Wynne 2015). Stirling (2014) described how "the most effective modes for radical change often lie in spontaneous collective bottom-up 'culturings' of knowing and doing" (p. iii), that "entail[s] more plural, emergent and unruly political re-alignments" (p. 1) and may even contribute to shifting the focus from technocratically-controlled 'transitions' to a more bottom-up transformation. Indeed, proponents of such social learning methods suggest these are not just among the deepest hopes for transformation, but also its necessity (Leach et al. 2007; Stirling 2014). However, this paradigm has its own share of persistent puzzles. Scholars warn "against knee-jerk calls for more local, community or public participation which simply replace one set of generalised appeals with another" (Blake 1999, p. 257), as this may risk reproducing some of the very logics that this "pluriverse" tries to side-step (Mercier 2019, p. 9). Pluralizing meanings about climate change may also inadvertently enable an epistemological relativism (made even more fraught in today's post-truth contexts), where everyone's subjective truth can be placed on par with everyone else's, including the scientific ones (Wilber 2017). When this social-learning paradigm attempts to "go beyond the individual level" so as to secure collective outcomes (Vinke-de Kruijf et al. 2014), it may miss important psychological complexities *within* the individual—and unique to climate change—that warrant deeper consideration and integration.

Here, I consider how to make room for a multiplicity of perspectives, not by reducing them into a singular meaning nor by pluralizing all meanings as absolute truths, but rather by asking: "How can a psychosocial approach to individual and collective meaning-making help address different, possibly conflicting, perspectives to realize greater justice and sustainability, specifically when it comes to climate change?" Situated within a larger call for transformations to sustainability, I examine how to integrate five key areas of the psychological scholarship on climate change in a community engagement process using photo voice methodology. I then explore and demonstrate the value of a constructive-developmental perspective in understanding the differences in the ways meaning is organized. Through this empirical example, I propose a possible way to animate existing *means* for transformation in a different *manner*—a manner that honours differences in what climate change means to people within a larger network-understanding in a group. The study site is in the highland coffee region of Guatemala, in which coffee producers live subject to the impacts of

climate change and also interact within global value chains with multiple actors from different positions, cultures, and perspectives. This presents somewhat of a microcosm for the larger 'wicked' *problematique* that this study addresses. Processes are needed by which people can metacognitively take climate change as an object of awareness, reflect on what it means to them individually, and then identify a more 'distributed' cognition as a collective, which in turn supports effective and ethical transformations to sustainability.

Literature review

Five ways climate change challenges (social) meaning

The 'value-action' gap and social inertia distinctive of the climate challenge, is in part due to a complex interplay of individual and social meaning-making processes (Brulle and Norgaard 2019; Westerhoff et al. 2018). Some scholars posit that this (inter)subjective bottleneck may indeed be equally or more important than the technical one when it comes to climate change action and ought to factor centrally into transformative change processes (Gifford 2011; Grothmann and Patt 2005). Below I review the extensive literature on why climate change is subjectively and intersubjectively challenging, grouped into five categories, summarizing solutions from each category.

1. Climate change is *psychologically distant*, in both space and time; often understood to be happening elsewhere and in the future (Brügger et al. 2015). Unlike the immediacy of weather, which provides context-specific information in the present moment (i.e. sweat on the back, rain on the face), the distant nature of climate change requires people to use mental representations to construe it (Trope and Liberman 2010). Rather than rendering its full complexity, often proxies are used that are psychologically closer and more concrete, such as, snowpack levels, rainfall changes, and losses of local animals and plants (Clifford and Travis 2018). Yet, this matter of distance is complex, and caveats are warranted. For example, as personal values are themselves distant, drawing climate change closer may paradoxically also draw one's attention *away* from the larger landscape of their values and into some challenging proximate considerations, such as trade-offs, risks, and costs, that are consequences of climate action (Brügger et al. 2015). Threatening information can be overwhelming when it is made proximate and can trigger defensive reactions (Brügger et al. 2015), requiring processes for working with these strong emotions. On balance, bringing climate change closer—for example, through considering the personal relevance and connection in one's daily life—seems to be called for, as long as attention is paid to these caveats.
2. Climate change also presents higher requirements for *abstract* mental representations (Chu and Yang 2018). However, the capacity to create abstract representations differs depending on people's meaning-making capacities, and varying degrees of abstraction lead to varying mental models and frames on climate change (Breakwell 2010; Hochachka 2019; Weber 2010). This helps explain confusions between 'weather' and 'climate'—the former is more accessible to people in part because it is less abstract—and some scholars argue that greater understanding of these meaning-making capacities (specifically as studied in developmental psychology) is needed (Hochachka 2019; Lynam 2019). To assist people with abstract concepts, Social Representations Theory (SRT) recommend a two-part process of: (1) *objectification* which entails making what was abstract into a concrete object, "sufficiently dense with meaning," such that it becomes a natural part of thinking about the issue, and (2) *anchoring* which involves categorizing and linking that new object with pre-existing cognitive frameworks (Breakwell 2010, p. 866).
3. Climate change is *entangled in our affect, self-identity and culture*. For example, Norgaard (2011) finds cultural-identity is set upon certain social values and emotional norms that co-define people's stable sense of themselves. Threats to that stability by global warming can result in the "social organization of denial" (Norgaard 2006b, p. 374) and even "cultural trauma" (Brulle and Norgaard 2019, p. 1), in which even if people understand the climate change predicament, they may edit their thinking on the issue so "to protect themselves a little bit" (Norgaard 2006b, p. 372). The result of this can be to diminish or deny its implications. Some scholars call for "active open-mindedness," leaving the cognitive space open for longer to lessen the tendency of collapsing into preexisting opinions (Kahan and Corbin 2016, p. 1). However, these same scholars found that individuals highest in open-mindedness were still polarized on issues like climate change, which seems to have become "tragically entangled in the social dynamics that give rise to pointed, persistent forms of political conflict" (Kahan and Corbin 2016, p. 4). Beliefs about climate change are used by people to express and define themselves and to signal which social group they are a part of, rather than to convey cognitive understanding, and this ought to be carefully accounted for in climate engagement (Kahan 2015).
4. Climate change, and its associated calls for behavioural and social change, is *contested in relation to clashing narratives, values, and interests*, which can lead to

complicated trade-offs both intra-psychically as well as interpersonally and politically. Competing narratives about climate change have been advanced, some aimed to protect fossil fuel investments and to deliberately encourage people to hold tighter to beliefs that deny or dismiss the extent of human-caused climate challenge (Moser 2010). This is possible, in part, because people attend to cultural meanings in a parallel manner to the information-content about climate change (Kahan et al. 2011). Moser and Dilling (2011) suggest that democratic citizens would be well served by active engagement on the issue, participating in framing the climate narrative in a culturally congenial manner and rendering more visible the vulnerability of certain groups to climate change.

5. Climate change can get crowded out by other immediate, concrete issues, such that it doesn't appear on one's 'salience landscape'—the mental frame a person cognitively holds to determine relevance and allocate attentional, metabolic, temporal, and behaviour resources (Vervaeke and Ferraro 2013). Inundated by information, people have to expend attentional resources carefully, and climate change can be seen as a *low-salience issue*. This is not new or unique to climate change, and there are known ways to raise the salience of an issue. Much of Freire's (1970) critical consciousness work sought to facilitate processes by which people could name the world so to transform it—or, rather than living 'subject to' a state of oppression, his approach encouraged people to take those dynamics as objects of awareness. Once seen—or made salient—such dynamics could then be acted upon and transformed. In developmental psychology, Kegan (1998, p. 34) explains this process, "mak[es] what was subject into object so that we can 'have it' rather than 'be had' by it" and he goes on to say, "this is the most powerful way I know to conceptualise the growth of the mind." This appears similar to how Verveake and Ferraro (2013, p. 39) describe "mindfulness" as being "important for comprehensively transforming and improving the framing of situations so as to avoid becoming trapped in self-defeating construals of situations and problems." The common thread between these scholars is how to make an issue salient, be that through raising awareness about it, making what was subject into object, or attending to it consciously and mindfully.

Towards a psychosocial manner of climate engagement

Scholar-practitioners who seek to engage populations on climate change tend to encounter these interlocking meaning-making challenges that are particular to climate change. Often, these challenges are 'dealt' with by reducing them into singular climate science ('one'), which can marginalize important, alternate perspectives, or they are pluralized into multiple meanings ('many'), which can have an unintended result of undermining science and even paving the way for climate denial. In other words, neither of these approaches are complete, rendering valid an inquiry in climate change communications on how to best support individual and collective meaning-making about such a complex topic.

Finding shared meaning about climate change can be complicated because climate meanings are construed differently by different people, and these constructs have changed over time (Breakwell 2010; Esbjorn-Hargens 2010; Hochachka 2019; Lynam 2012, 2014, 2019; Lynam and Walker 2016). Scholars in the mental models literature emphasize the need to, "unpack the elements that make up the construct of climate change" (Breakwell 2010, p. 859). Constructive-developmental psychology—the study of meaning-making activity (Kegan 1983, 1980)—does so by considering *why* meaning is being organized as it is, beyond the content of *what* is understood about (in this case) climate change. Preliminary research using this approach in climate change suggests that climate meanings are construed differently depending on the complexity of thought that is employed, the object of awareness that is taken (i.e. concrete, abstract, or meta-aware), and the scope of time that is available (present moment, present and past, near future, distant future) (Hochachka 2019). One's meaning-making apparatus plays a meta-role of coordinating and organizing other data about climate change that are disclosed by the five aspects described above. As such, one's meaning-making process influences the *distance* at which perception can be wrought out, the *abstraction* of the phenomena in question (from concrete to more subtle to meta-aware), and the extent to which that phenomena "exists" in one's awareness as *salient* (Hochachka 2019, p. 5). It is also through one's meaning-making stage that one conceives of their self-identity and how far one's reach of compassion and care extend, influencing the degree and kind of entanglement in one's *self-identity and culture* (Graves 1970; Kegan 1980) and one's *values and worldviews* regarding sustainability (Lynam 2012, 2019). The compound result of these above processes is a mental construction of 'what climate change means to me.'

Esbjörn-Hargens (2010, p. 148) explains "there is not a clear, single, independently existing object [of 'climate change'], nor are there multiple different objects [but rather] there is something in-between: *a multiple object*." Greater recognition of this "ontological pluralism" may open to greater potential for addressing such multifaceted climate change realities in an integrated way (Esbjörn-Hargens 2010, p. 164). "Translating" climate change meanings from existing meaning-making frames may also forge more ownership

over such terms, helping to bridge the value-action gap (Hochachka 2019, p. 4). However, while there is extensive research in constructive-developmental psychology in education, leadership, and organizational development (Brown 2011; Cook-Greuter 2004; Torbert and Barker 2014), it has only minimally been considered in climate change engagement (Hochachka, 2019, 2020). Yet a constructive-developmental lens may help to further explain why people can disagree often vehemently about the issue—namely, *they are seeing different climate changes*. This is a gap I contend with in this paper, in so far as it may help to map collaborative pathways through a plurality of climate meanings.

Seeking to invite *subjective* views as well as support *intersubjective* processes (which I will refer to here as *inter/subjective*), arts-based and participatory approaches, and other transformative action research methods could provide ways to work through these psychosocial challenges particular to climate change. I selected one such method—photovoice—which, when coupled with the following conceptual framework, may bode helpful in enacting the meaning of climate change as "more than one—but less than many" (Mol 2002, p. 55) such that individuals and groups can meaningfully locate themselves in shared climate action.

Conceptual framework

Meaning-making about climate change operates in a rich, layered context of human dimensions, of which at least these five aspects above make climate change psychosocially challenging. Greater acknowledgment of what is affecting individual meaning-making processes at any given time, and thereby indirectly—but importantly—influencing interpersonal processes, may support improved communication and collaboration. I designed Fig. 1 based on the above literature review. The above five dimensions (i.e. distant, abstract, entangled, contested, and not-salient) generate data about climate change, which is then organized by people's meaning-making apparatus. The latter—namely, how meaning is organized—is less apparent in climate change research and warrants brief description here.

According to constructive-developmental psychology, meaning is organized in increasingly more complex ways through one's life, enabled by an increasing ability to take more perspectives on reality (Cook-Greuter 2000; Kegan 1998; Wilber 2000). Preliminary research in a climate change context suggests that more aspects of climate change can become seen with more perspectives taken on it (Hochachka 2019). In Fig. 2, I draw on the STAGES model to describe how these perspective-taking capacities complexify regarding the issue of climate change. The STAGES model is somewhat unique in the broader canon of work on adult development in that it uses assessment logics that focus

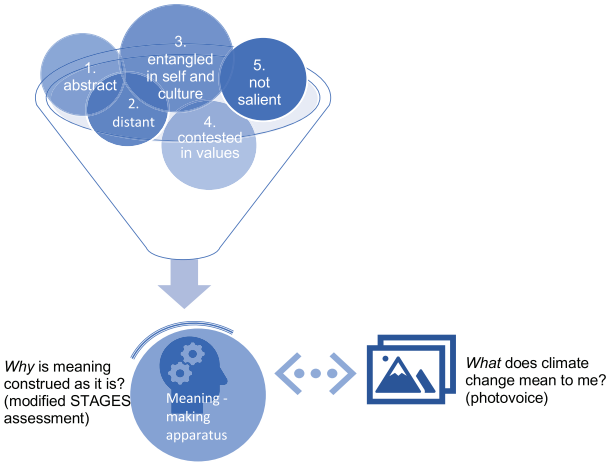

Fig. 1 Conceptual framework on how certain aspects challenge people's meaningmaking processes, leading to a diverse, often contested spectrum of meanings about climate change, which then come together in complex ways in groups

less on the content of expression and more on the demonstrated perspective-taking capacities that can be seen in the structure of the text (O'Fallon et al. 2020). For example, rather than focusing on *what was said*, much can be understood about the way that a person is organizing meaning that is deeper (or more structural) than the content of the text itself by analysing *how it was said*—namely, demonstrating what subtlety in the object of awareness, degree of complexity of thought, and breadth of time. These perspective-taking stages are titled to approximate the way meaning is construed (i.e. rule-oriented, conformist, expert, achiever, pluralist, and so forth), and, while each have unique characteristics, they are also related to one another in a nested, linked-up way. A developmental perspective honours this spectrum of unique meanings while also recognizing that some contain more complexity than others, as "later stages include perspectives from earlier ones, but not vice versa" (Hochachka 2019, p. 5).

Asking *why and how* meaning is organized as it is, and acknowledging that people construct meaning differently, may provide climate scholar-practitioners with novel entry-points and tools for working with the differences in *what* climate change means to different people. For example, developmental psychology helps to explain one of the fundamental drivers of fragmentation in social groups, namely: *few recognize that their own view of the matter at hand isn't shared by all*, or that there isn't a single meaning to which others need to simply get behind. Rather than proceeding from that assumption, developmental psychology instead shows the "*human* being is *meaning making* [and that] for the human, what evolving amounts to is the evolving of systems of meaning" (Kegan 1980, p. 374). Typically

Stages of meaning-making		*Meanings of climate change*
Concrete	*Rule-oriented 2.0* *Conformist 2.5*	Meaning of climate change is described as changes in weather in **literal, concrete, immediate terms**, such as epic floods, dry spells, intense rains, unusual storms; Makes some connections between objects, but these objects of awareness all remain concrete; Represent an **atomistic** and immediate view of climate change, with the scope of time focusing mainly on the **present**, stretching somewhat towards the past. Rule-oriented 2.0 is more passive and attending to follow what the rules dictate; whereas conformist 2.5 is more active and attending and aligning what other people expect and what social norms dictate.
Subtle	*Expert 3.0*	Meaning of climate change starts to include **some subtle concepts** (such as "diversity") and considers a larger envelope of time stretching from the past and to **some degree into the future**; is more **passive** than active (i.e. receiving a training and being taught what to do to adapt), yet was still largely anchored in concrete phenomena (i.e. acreage, trees, compost).
	Achiever 3.5	Meaning of climate change demonstrates thinking that is **more abstract** and use further subtle concepts (such as, "contamination"), considers relationships and **links between things** and tends to forecast further into the future; Employs **cause-and-effect** logic therefore accounts for the networked ways that increases in temperature, human activities like pollution, and health impacts are included; Employs **instrumental** thinking, organizing meaning in a more **mechanistic** and **logical** way.
	Pluralist 4.0	Meaning of climate change is even **more subtle or abstract**, including ideas such as history, inter-generationality, and impermanence; Includes a **broader contextual understanding** and **multiple causes or contributing factors**; Demonstrates **linked-up** meaning-making, and **early systems thinking**, and a higher propensity for **self-reflection**.
	Strategist 4.5	Meaning is derived from an able to **understand and sort contexts**, understood as **complex and interconnected systemically**; Includes an understanding that people **affect and recreate** the ways that healthy systems interact with each other, and as such humans can reverse damage caused by human disruptions of natural complex systems; The **role of humans** therefore in a social-ecological system is perceived in both the **causes and the resolution** of this issue.
Meta-aware	*Construct-aware 5.0*	Meaning is understood with **an awareness of the constructed nature of reality** on the whole, such that people are seen not merely as actors in the system but rather their **thoughts, ideas and beliefs about the system are constructing and shaping, as well as shaped by**, its evolution and trajectory.

Fig. 2 Modified STAGES assessment framework. Describes why meaning is organized as it is assessed by the object of awareness, complexity of thought, and scope of time—based on how much of the complex hyper-object of 'climate change' can be seen, at what complexity, via what meaning-making apparatus—drawing on developmental psychology theory as well as empirical findings in a climate change context. Climate meanings are based on Hochachka (2019), whereas stages 4.5 and 5.0 are drawn from applications of developmental psychology in organizational development (Brown 2011; Cook-Greuter 2004; Torbert and Barker 2014)

people are not cognizant they are organizing meaning—"our meanings are not so much something we have, as something we are" (Kegan 1980, p. 374)—and so for the most part people move through these layered meaning-habitats employing *intuitive* communication skills to connect and understand each other. Yet, this becomes more complicated when working with a hyper-complex concept like climate change. I use this two-part conceptual model (represented in both Figs. 1, 2) to place meaning-making more centrally in a climate engagement process and to examine the inter/subjective factors involved in finding shared meaning about climate change.

Research design and methods

I sought a research design for this study that could examine the psychological as well as social aspects of meaning-making. I selected photo voice as my main method for its inclusion of subjective and intersubjective processes as well

as its ability to reveal the viewpoints of people that may otherwise go unnoticed, thus legitimizing popular knowledge in the face of other dominant discourses (Bennett and Dearden 2013; Hissa 2016; Hochachka 2019; McClymont Peace and Myers 2012; Myers et al. 2012). With photovoice, people use photography to disclose their own subjective perspectives as 'insiders' to a region or an issue and to draw those insights into community dialogues, which can then be presented to policy-makers and other actors as a socially- and politically-engaged praxis (Sutton-Brown 2014; Wang and Burris 1997). It has been used after natural disasters to assess local perceptions and to better understand where and how social divisions might arise in rebuilding (Hissa 2016). Most directly relevant to this paper, photo voice was found useful in understanding differences in climate meanings in northern rural El Salvador, by engaging a subjective process of inquiry, an intersubjective process of dialogue, as well as using a modified-STAGES assessment of meaning-construction (Hochachka 2019).

Using photo voice, and its associated methods of interviews and focus groups, I carried out qualitative research with a coffee cooperative, *Association of Agriculturalists "El Esfuerzo"*[1] *of San Pedro Necta* (ASASAPNE), in Huehuetenango, Guatemala, during July 2018 and July 2019, for which ethics approval was granted by the Norwegian Center for Research Data.

Research participants ($n = 11$; 9 women and 2 men) were small producers, meaning they produced coffee in a family-run manner on less than 50 manzanas of land (1 manzana = 7056 square meters, or 1.7 acres). The region is located at approximately 1500 m above sea level, has a largely Indigenous Mam population, and *Arabica* coffee production is a mainstay of the local economy. The cooperative sells a portion of their coffee in a global value chain of a prominent wholesale retailer in North America, with sales also to Taiwan and Italy. The group of participants was diverse in terms of religion (30% Catholic versus 70% Evangelical, which according to Jonas (1991) may have also indicated a difference in past and present political affiliations), gender (82% women and 18% men), culture (36% indigenous Mam, 63% Ladino), age (late-20 s to late-50 s), educational levels (illiterate and minimal education to college-educated), exposure to capacity-building training (i.e. from some being recipients to some being facilitators of such trainings), and differences in cross-cultural and urban–rural experiences (i.e. some being very local and agrarian through to others with extensive cross-cultural, metropolitan experiences including international travel).

Participants took photos in response to two questions about climate change: "What does climate change mean to me?" and "How am I adapting?" I had tested the use of those questions in a previous pilot study and found that they were well-suited to support reflection on climate change in a non-threatening and unique manner. The emphasis 'to me' in the first question also carries an epistemological stance of maintaining the "inquirer in every inquiry," which Montuori (2013, p. 4) described helps to limit possible tendencies toward projection or groupthink, and which French sociologist Edgar Morin (1992, p. 87) reflects is an important "inquiry of oneself on oneself, on reality, and truth." The photographers spent three days considering the first question and taking photos in response to it. Then, they selected their most significant three photos, downloaded them, and participated in an interview (30 min-1 h) about their photos, providing an interpretation and title for each image (which taken together I refer to as 'photo-texts'). Then, this occurred again for the second question. The photo voice data consisted of 33 photo-texts for question one and 27 photo-texts for question two. These photo-texts were recorded, transcribed, and translated by native Spanish speakers, and checked by me for accuracy. Transcripts were also checked by the participants.

I then held a series of focus groups, including: (1) a 'photo forum' focus group, in which each photographer shared his or her photo-text, and (2) a 'pattern-finding' focus group, in which the participants reflected on the entire set of photos, grouped them according to common themes, and engaged in critical dialogue. That was followed by (3) a 'synthesis' focus group on these themes and on the process itself held with the photographers, and (4) a 'sharing' focus group held in Guatemala city with other actors in the value chain (a very diverse group consisting of a buyer, two exporters, two technical experts, one person from marketing, and the producers from ASASAPNE).

Analysis of the photo voice data began inductively, with a participatory pattern-finding focus group. Such pattern-recognition is well-established in group learning processes (Dozois et al. 2011), and supported reflective, 'double-loop' learning on the topic (i.e. examining some of their underlying assumptions) (Argyris and Schon 1978; Mitchell et al. 2012). The analysis then continued deductively using a modified STAGES assessment (Fig. 2) to understand *why* meaning was organized as it was, providing insight into the depth of diversity of these perspectives (Hochachka 2019). 20% of the sample was analyzed by two analysts (myself and Dr. Terri O'Fallon) using the modified STAGES assessment in a blind comparison, resulting in inter-rater validation of within 0.5 of a stage. Finally, I did a qualitative analysis of the focus group data (notes and transcriptions) in NVivo.

[1] The direct translation is "The Effort" but that English translation fails to capture the sense of struggle and liberation that is also part of the term's meaning, which is why I chose to leave it written in Spanish.

Limitations of the research design

Two limitations in the research design warrant brief discussion. While I had sought a sample that emulated the *complex social terrain* that is distinctive of the climate change discourse, for the photo voice work I selected a sample of research participants from an existing *cooperative* organization. This may have introduced a bias to my findings due to the possibility that the cooperative's structure predisposed them to work effectively through complex issues, unlike other social groups. However, after reviewing the diversity of this sample (above) as well as considering the benefits of working with a group that was committed, open and interested in the photo voice process, I decided that the pros of using photo voice with a prior-organized group like ASASAPNE, outweighed the cons of them already having an effective cooperative structure. I bore in mind the possibility of this bias in my analysis.

Another limitation was the reliance on linguistic expression for participants to convey meanings about climate change, given the possibility of some language barriers (mainly between Spanish and English; and also, two participants spoke Mam as a first language and then Spanish in a professional setting). I sought to address this limitation in four ways. First, the use of photography helped to bring a non-linguistic lens to the issue of climate change, providing the research participants visual prompts and ways to draw on embodied reflections regarding when, where and why they took their photos. Second, although I have spoken Spanish since 1998, I contracted a Guatemalan research assistant to assist me in understanding any unique phrases or accents. Third, I had a professional translator translate the photo-text interviews, and then reviewed the translations carefully myself. Fourthly, I gave the full transcriptions to the participants for them to check (Birt et al. 2016). However, despite my efforts to mitigate this linguistic limitation, it is reasonable to assume that it could persist in some degree in this study. For this reason, I encourage the reader to understand these results as more of an illustration of the complexifying range of perspectives brought to bear on climate change, viewed in a cross-sectional slice in time, rather than as a fixed, immutable dataset.

Results

In this section, I share three groups of results from this study: (1) the ten common themes that participants identified in the 60 photo-texts, which show the range of views on *what* climate change means to producers, (2) the six meaning-making stages found in this sample of photo-texts that disclose the depth of diversity in terms of *how* and *why* meaning was construed, and (3) qualitative results from the focus groups on the process itself.

Finding common themes in a multiplicity of meanings

The photo voice process resulted in 60 unique viewpoints on the meanings of and adaptations to climate change. Within those, participants identified ten common themes (Fig. 3) (seven themes pertained to photos on the *meaning* of climate change, and three themes pertained to *adaptation*). While many photo-texts were grouped under "Lack of rain," the largest category was "Creating awareness and understanding so to take action." Most other themes examined the climate change issue through its social-ecological linkages, examining for example the effects of climate change on both flora/fauna as well as people, the effect humans have on nature, and the ways in which nature give life to humans. Two remaining themes took stock of how resilient people are in the face of hardships born of climate change and considered such hardships for future generations. Themes regarding the question on adaptation were split between three groups, the largest of which was practical adaptation, including how producers are adapting on their farms, with other themes noting the role of understanding (personal adaptation) and advocacy/action (political adaptation).

Depth of diversity in the constructions of meaning.

Six distinct stages of meaning-making were identified (Figs. 4, 5) in the 60 photo-texts that had been taken, titled, and interpreted by the participants. These findings demonstrated the complexification of how meaning is organized about climate change, from more concrete, atomistic organization of meaning through to more subtle, abstract, and networked ways of construing meaning, with the scope of time also differing across the sample. Below, I have presented these six stages in their early and late expressions (2.0 and 2.5 together, 3.0 and 3.5 together, and 4.0 and 4.5 together).

Photo-texts that demonstrated Rule-oriented (2.0) meaning-making construed climate change in a concrete manner, with isolated 'bits and pieces' of information that were loosely (if at all) connected to other concepts, largely seen from within the present moment. This meaning-making reflects the static, rule-bound aspects of reality, as this being 'the way things are', demonstrated well in the phrase, "And if there are no clouds, the water can't be gathered up. That's why. Clouds gather water" (*The Clouds Gather the Water*, Fig. 5). Photo-texts that demonstrated Conformist (2.5) meaning-making construed climate change with a concrete reciprocity, within the present moment, often with a traditional, conventionalist framing—such as, "She was born there. And there she is

Question 1: What does climate change mean to me? (Title of the theme, followed by a photo-text example)		% of total
1	***Lack of rain*** reflected on the variability of rainfall for this region and season, particularly towards less rain and more drought conditions. "Lack of rain: Here, in previous years when it's the rainy season…it rains in the morning or in the afternoon or at night, but every day. This year, we haven't seen as much rain. [This] affects us because in the case of the people that are producers, all they have are their crops. But if there isn't any rain, they can't grow their produce because the plants burn." (Respondent SPN 41)	19.5%
2	***Effects of climate change on plants, animals and people*** reflected on the social-ecological linkages related to climate change. "Coffee and Climate Diseases: This is of the diseases that there are on the coffee… due to the heat and the [lack of] water, all these diseases." (Respondent SPN 27)	17%
3	***Creating awareness and understanding so to take action*** reflected on how climate change involves our understanding and alignment with action. "Aligning Words with Actions: I was at home, and I saw… all of the organic waste, [thinking] what a shame, [I saw how it] starts its decomposition and… that one could take advantage of, could benefit from, it could be re-used… But my parents do have some land! and I [arranged to] give them all that so [my Mum] could apply it to her squashes, lemons and other crops that she has. [Now,] I have in mind to duplicate this idea, to gather both [organic and inorganic] here in the office, now I want to put this in practice here as well. And maybe…to other people too so they can adapt, to spread the word…with the neighbors." (Respondent SPN 6)	24%
4	***Human actions affect the environment*** reflected on how human practices are part of the problem and possible solutions. "Breaking the Balance: They logged a lot of trees and for that reason there aren't a lot of trees anymore, and well now it is very hot. Or the winter is very strong because there aren't any trees, there is no more balance… These [trees] are the ones that attract water, bring the water and purify the air. They purify the air. They serve us. They serve us because they give us oxygen. Without the trees we can't live. Nor can they live without us as well. It's that the oxygen that they give us allows us to live and what we breathe out, serves them. Yes, it serves them. Then that is called equilibrium, balance…That is what this [photo] has [said]: we are disrupting the equilibrium, breaking the balance. (Respondent SPN 27)	9%
5	***Nature gives us life*** reflects on the centrality of nature for human beings and life itself. "Because of Nature we can Breathe: We live because of the plants. Because if there weren't any trees, or there weren't any the plants, then we can't breathe. And one of the most important issues is the environment, to take care of the trees…" (Respondent SPN 22)	7%
6	***Concern for children and their future*** reflected on the ways that the next generation will carry the consequences of climate change. "Memories from childhood: Everything used to be very beautiful. And now I look at the river and it makes me sad because that river didn't used to be like that." (Respondent SPN 6)	9%

Fig. 3 Ten common themes found in 60 photo-texts

growing up now. And there she is going to live" (*Granddaughter Below the Shade of the Trees*, Fig. 5)—as well as seen in the use of the pronoun 'we' rather than 'I'—for example, "we fight for the coffee not to have coffee rust" (Fig. 5).

Photo-texts demonstrating Expert (3.0) meaning-making showed a concrete cause-and-effect logic with more links made between concepts, using some subtle objects of awareness (i.e. "environment," "enduring," and "adapting," in *Fighting for Life*, Fig. 5). These were construed

7	***Overcoming obstacles (resilience)*** reflected the various ways that despite hardship, people managed to get by with resilience. "Even the House of God harvests its own fruits: The people here are fighting for even their food. This is a church. And there are corn plants, there are a lot of trees, there also are fruit trees… so I saw that it is not only *campesinos* (small farmers), but also the churches, that have their two or three corn plants [to provide for their own food needs]." (Respondent SPN 10)	9%
Question 2: How am I adapting?		Percentage of the total
8	***Personal adaptation*** (in both individuals and collectives) reflected 'personal' changes (in individuals or in groups) for adapting or responding to climate change. "Understanding, the foundation for adaptation: We are already taking measures in relation to climate change. We are seeing how or what to do to adapt. We are learning and each person is giving their point of view, this is what I consider here in this photograph. Understanding is the foundation to be able to adapt… If we understand and we know how it works, what we should do, [then] we are going to adapt. But if we don't even understand nor know what to do, we are never going to live adapted." (Respondent SPN 6)	13%
9	***Practical adaptation*** reflected practices and techniques for adapting, such as adding fungicides, irrigating, retaining soil humidity "Technique for the development of the plant: This technique helps to maintain the development of the coffee plant in case the drought hits hard. We give [the plant] coffee pulp as organic fertilizer. This helps conserve the humidity and helps with nutrients. The [cooperative] members share [ideas, practices] amongst themselves. (Respondent SPN 29)	80.5%
10	***Political adaptation*** reflected on how addressing the structural dimension and root causes of climate change is important. "Purification of the air: Before this hill didn't have any trees. [Now] we are adapting, people have now become aware that they should plant trees. The children participated in school. Committees of indigenous authorities (COCODES) from the communities. They came with all of the communities to reforest this area. On behalf of the municipality and all the teachers through the kids from here the urban area went to plant trees there so there wouldn't be any erosion of the ground, so that it doesn't wash away with the rain. And these trees give us oxygen. They help us purify the air. So, this here would be how we are adapting. (Respondent SPN 2)	6%

Fig. 3 (continued)

in the present moment with only a slight stretch into the past and future and demonstrated the participants' own internalized ideas about something, such as: "The idea that I have here is that despite the things that are happening in the environment, the people are enduring, are adapting to the changes" (*Fighting for Life*, Fig. 5). Photo-texts demonstrating Achiever (3.5) meaning-making projected thinking further into the future, using instrumental, cause-and-effect, abstract logic, and demonstrating awareness of subtle concepts and considered different scenarios in a linked-up manner. For example, in *Disappearing, Contaminated Water* the text considers interlocking aspects of this problem, from quantity of rainfall through to drainage into the rivers, consider subsistence crops, coffee plants, and the economy overall, and considers the state of this system in this moment in comparison with previous years.

Photo-texts demonstrating Pluralist (4.0) meaning-making construed climate change with more context-awareness, such as is seen in the phrase, "not everyone is the same, we don't all think the same thing, each person has their priorities… So, *it depends* on each of us as people" (*Awareness*, Fig. 5, italics added). With a sense of context, these photo-texts also demonstrated a capacity to see multiple sides of an issue depending on the vantage point; *The Two Faces of Climate Change* from Fig. 5 encapsulate this very well in the phrase, "now coffee is able to be cultivated higher up, and that, although [people benefit from that] it is something that is actually not good." Photo-texts that demonstrated

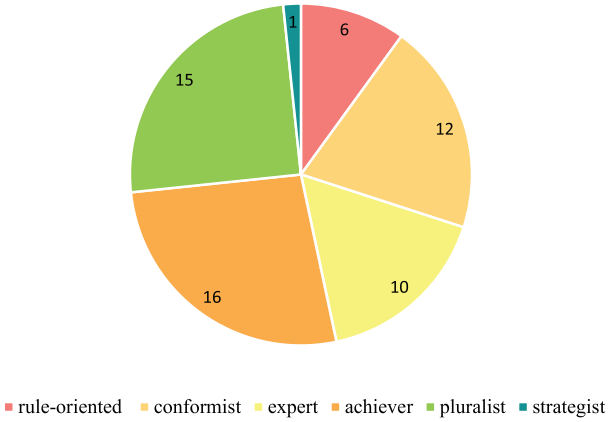

Fig. 4 Meaning-making stages represented in the photo voice data for What does climate change mean to me? and How am I adapting? (analyzed with the modified STAGES assessment, $n = 60$)

Strategist (4.5) meaning-making construed the issue as part of a complex adaptive system, organizing meaning in a broader scope of time and space as well as extending one's sphere of consideration or care for 'other' (such as, including river and sea animals, and their ecosystems, humans and other species in *Taking Life from the Rivers*, Fig. 5). Photo-texts demonstrating Pluralist and Strategist meaning-making tended to show greater self-reflection, with the texts including expressions like, "This makes me stop and think" (*Awareness*, Fig. 5).

This data showed that even within a small cooperative, there are still differences in perspectives on climate change, both in terms of what was meant (i.e., the 60 viewpoints reflected in the photos) as well as why meaning was organized as such (i.e., the six meaning-making processes used to construe those meanings). These data also showed that, although participants had had no formal climate education, 42 out of 60 photos (70%) demonstrated either key meaning-making strategies used in climate science (Expert and Achiever) or those that are employed in climate justice and in complex-adaptive systems approaches to climate change (Pluralist and Strategist). Yet approximately a third of the sample were organizing meaning in a way that would not necessarily be resonant with either climate science or climate justice approaches.

The role of an inter/subjective approach for processing complexity

The focus-group transcriptions were analyzed to examine how this psychosocial approach—namely, this two-part conceptual framework combined with the use of an inter/subjective method like photovoice—related with the unique meaning-making challenges of climate change (i.e. distant, abstract, entangled, contested, and not-salient, Fig. 6).

Some quotes noted how this approach enabled them to bring what was *distant*, something only heard about in passing, to consider it in their own direct experience.

> "It is a very good technique to be able to analyze and observe how the change has affected the environment and how this change also affects our lifestyle, our crops. We have also learned to contribute and take action to cope with change in different areas of our lives." (Respondent SPN 2)

This made climate change close and personal, and seemed to do so in a way that kept it connected with what was important to people.

Through contemplating the question 'what does climate change mean to me?', participants made climate change less *abstract* by considering the felt-sense and concrete ways that climate change manifests in one's life:

> "It is a technique to have proof to show that climate change is true and to know what is affecting us. To have proof of the changes in rivers, crops, and climate. We can think about living better and having children live well in the future." (Respondent SPN 27)

Both the photo voice exercise and the dialogue process helped participants visualize the abstract concept of climate change in concrete ways, within their lives.

Other quotes described the ways in which they came to see how climate change was *entangled* with oneself and one's culture, bound up in one's own emotions and also linked with broader changes in society across time.

> "[Through this process] I learned important things about nature. There are subjects that we avoid but that bring problems. In order not to pollute we must think individually about our actions as they affect ourselves and others. The people of today no longer want to work, they burn the trees, and don't think about the animals and plants that live there. Before the climate was cool but now there is a lot of heat." (Respondent SPN 41)

This approach provided space to express the emotions that global warming can provoke, such as fear. As one participant said, "There is a lot of clamour about how the climate has changed; we are *afraid* to think about the little ones [children and youth]" (Respondent SPN 25, italics added).

This psychosocial approach also let participants discuss and problematize such 'avoided' or *contested* aspects of climate change. Some noted that climate change was also the result of corporations and industrialized countries who produce pollution; others also noted the unequal distribution of

Meaning-making	Description and example	Number of responses
Rule-oriented (2.0)	"*The Clouds Gather the Water*" "It's got water, it's got cloud, it wants to rain. Yeah, well, it wants to rain… The clouds gather the water. And if there are no clouds, the water can't be gathered up. That's why. Clouds gather water. When it comes together, it brings down the rain. When it's raining, we can plant beans, corn, coffee." (Respondent SPN 25) "*Gives Life to the Human Being*" "There are also pomegranates close to my house as well. I also water it too. If I want to go rest a bit, I can go sit under the tree, the fruit is edible, at the same time its medicine. Medicine, food, shade." (Respondent SPN 43)	6
Conformist (2.5)	"*We Fight for the Coffee Not to Have Coffee Rust*" "Here, he's fumigating so the coffee doesn't get *roya*… so that the coffee is good, so that the coffee is happy there. So, this man is fumigating with buckets and gloves and a mask and goggles to protect himself. He's fumigating to confront the leaf rust; we fight for the coffee not to have coffee rust." (Respondent SPN 8) "*Granddaughter Below the Shade of the Trees*" "She's my granddaughter. 'Take my picture,' she said, 'with your coffee tree.' Alright, I told her... She is in front of the coffee tree. She already knows how to pick coffee. When the coffee is mature then she goes to pick with me… She was born there. And there she is growing up now. And there she is going to live. She is already from that place. She won't go to live in another part anymore. There, she is going to live… When there is a lot of summer, there is a lot of sun, then she goes to play underneath the coffee tree where she is there standing, you see, in the shade. So, there she sits down to play… 'What are you doing little one,' I say to her. 'Ah I am playing in the shade.'" (Respondent SPN 25)	12
Expert (3.0)	"*Fighting for Life*" "I took this photo in a house where you see all these green things, there are orange trees, lemon, avocado, mandarin and pomegranate, even pomegranates...! I saw that in this house they have their patios full of gardens… Just look at all of his plants that right there [in their yard] they are harvesting their lemons, oranges…and there are flowers, there are planters. And so that's why it impressed me… The property isn't very big, but it has everything—a small tree here, another over there, and there are lemons and oranges. The idea that I have here is that despite the things that are happening in the environment, the people are enduring, are adapting to the changes. So, these are the ideas that come to my mind when I see it." (Respondent SPN 10) "*I Feel Sad for the Plants*" "What we want to say [about] this photo [is there is] a lot of *roya* [leaf 'rust' fungus] on the coffee, it is yellow. I feel sad for the seeding. Yes, a lot of *roya* … it has a lot of worms among the roots… some plants are very nice and other plants have *roya* that is why some become sad. When one comes to look at the plants, the plant is sad with a disease that is hitting it and, at times, there	10

Fig. 5 Six stages of meaning-making about climate change. Note these quotes are from self-selected photos taken by participants, and titled and interpreted in their own words. The stages reflect the meaning-making demonstrated in these photo-texts

vulnerability and risk for the supply-side of the value chain. As explained by one participant:

> "I believe we have woken up the observer! Because we are now observers! …now with this, there is something we can do. We know how to change ourselves. To be an example. Some things can be avoided but I believe the contamination is very very broad. And this isn't something only due to us, the greater polluters are those from industrialized countries, from the

	are worms among the roots and the plants die. If I feel very happy, it is because the coffee plants do not die and when one arrives, all the plants are so happy, just as when we [people] have not exhausted the good—for our heads, throats, stomach—then we are happy, but if we have a sickness, we going to think sad. This is just like the plants, it gives sadness because it has a disease, it has *roya*, there are some animals that hit under the branches… We are sad for the coffee if the plants aren't happy. Those are my words about that photo. I still haven't fumigated. I will see this week. I want to fumigate, like fumigate really well, so that the coffee is now happy with its medicine. Yes, their medicines, yes." (Respondent SPN 8)	
Achiever (3.5)	"*Hygiene and Recycling*:" "Here, we can note that all of the bottles are recycled. But they are people who have knowledge about this, that if there is trash in their coffee fields or in their houses, it is going to affect us [negatively]. So, this person knows that the trash should be recycled. For example, the cans, these cans, they go together because they can be sold. They sell them per pound, a *quetzal* per pound of cans. That recycling earns us an income… We know that the trash should be recycled. And, [this] can earn us an income… The theme would be, "hygiene," perhaps? Yes, yeah because…if all the trash is thrown all around us, we also get sick. So, for that reason, everything is recycled." (Respondent SPN 22) "*Disappearing, Contaminated Water*" "This is a stream, but look it is so small. In previous years this stream was huge with a lot of water. But now we can notice that this only has a little bit of water. So, it is already disappearing. And that also affects our community. Because before there was a lot of water and now there isn't anymore. The place needs water and now when there isn't water, the plants dry up. I noticed that the corn was very dry. The same with the beans. And these two crops are the ones that help people out in the economy. So, yes, it is affecting the farmers because there isn't a good harvest anymore. In other places, it's not so hot so the plants still look really nice and they are already very green. In contrast, here the coffee is already wilting and it's turning a yellowish color. In some places, rain is needed. Here I was asking around, and I chatted with some kids that went by yesterday. The kids tell me sadly that was a very big stream here [before] but now it has disappeared. It stayed that way, like a dry place, without water, now it doesn't have water. And before it was a big stream that used to go through. That's also where the drains let out, which also contaminates the water. For example, this stream before, we could drink it because it was clean water, however now we can't anymore because they put the drainage pipe in, so now the water is contaminated. Recall the river that I was telling you about, when all the drainage pipes were put in there, it also changed it. Before this place used to look very beautiful when one would walk by that path, ah wow that stream and the water crystal clear, crystal and beautiful—but now it looks empty and contaminated." (Respondent SPN 41)	16
Pluralistic (4.0)	"*The Two Faces of Climate Change*:" "What I can see in this photo is that we were in the month of July and we were walking. Before, things like that couldn't be done before because in the month of July there used to be a very strong rain, winds and too much mud in the path. And so, to pass an afternoon [like this], we can see it as something positive…because it is a change that hadn't been lived before. But if we go into the negative, it's also shows [what] the plants are missing at this moment. Especially given that now is the time to fertilize all the coffee and there should be rain. So, this called my attention… what is this? It's climate change. So,	15

Fig. 5 (continued)

	we can see it as a beautiful afternoon for us, but for the plants, it's not beautiful because they are wishing for rain… I consider this the positive and negative of climate change; the two faces of climate change. Similar to what I was saying…about how now coffee is able to be cultivated higher up, and that, although [people benefit from that] it is something that is actually not good." (Respondent SPN 6) "*Awareness*" "This makes me stop and think, if we all thought the same way, had the same ideology, everything would be different, but not everyone is the same, we don't all think the same thing, each person has their priorities… So, it depends on each of us as people." (Respondent SPN 41)	
Strategist (4.5)	"*Taking Life from the Rivers*" "The river's water is contaminated now, it has been contaminated with trash, with the sewage from the drains, the water is contaminated… All these rivers are going to give to the sea carrying all this this trash, [and] contaminants in the water. All this is draining to the sea. And so,…as much the river animals here as the sea animals [further downstream], these species have disappeared. I remember that…there used to be fish,…crabs,…big snakes called *mazacuates*... But now they've disappeared…because of the contamination of the rivers. So, that loss would be one [reason I took this photo]. But this contamination would be the other. That [contamination] has contributed to there being a climate change because all this dirty [water] is going to end up in the sea and it pollutes, it pollutes lakes, the air, and if there are people that use the water, then they too are contaminated, it hurts their health, their skin, and if it's used to water plants, they are now contaminated. Taking life from rivers! We are taking life from the rivers, from all the beings that live there… Because water is life. Without water, we cannot live. But we are taking it, which is to say we are stealing life from the rivers." (Respondent SPN 2)	1

Fig. 5 (continued)

large factories, from mining companies. And also the fabrication of all that plastic! We have become habituated to using it, the majority use it because we see it is easier, but on the long term it is actually damaging. But, despite that, they keep fabricating it! They keep making it! So, these other countries should have taken [the responsibility to change]. But at least we can start with ourselves. What we've started here, maybe we can become accustomed to it and adopt in other places." (Respondent SPN 2)

Another respondent echoed this, musing on the use of specifically photo voice in advocacy:

"After this, there will be a history to put into practice in our community or in other regions or countries. We can present the project to the government and other organizations and we can receive more help for the community…to be able to put the study into practice." (Respondent SPN 12)

One respondent noted the value in this approach for disclosing their own local reality and hearing about others' realities:

"We will present the research in our own way and others will present [to] us on climate change in their own way. This is an idea to present the reality of our people." (Respondent SPN 27)

Rather than ignoring the issue, this approach made climate change *salient*, which in turn became important for group learning and action:

"One ignores many things but when seeing the photographs, we realize the reality. It is the truth that the most affected among us is nature and if we do not become conscious about this, we are [all] going to suffer." (Respondent SPN 42)

"Analyzing the process, is like discovering the problems that exist and becoming aware. Now we know that we must look for solutions since we have the evidence of the problem." (Respondent SPN 12)

Five Aspects	How photovoice addresses the five aspects:
Distant	– Draws climate change closer to be considered in one's camera lens and through one's direct experience; makes it personal and close, rather than impersonal and distant; and yet does this in a way that connects with what in a localized place is important to people, providing a process through which to work with emotions if need be.
Abstract	– Provides a question on climate change in which the photographer reflects and considers in concrete ways in his or her life, increasingly personal relevance and reducing the abstraction; this provides ways for knowledge on climate change to be translated from an abstract concept into its lived expression; refers to Breakwell's (2010) explanation of objectification and anchoring.
Entangled	– Encourages photographers to consider the ways in which climate change relates with self and culture, not to untangle it as such, but acknowledge and feel its entanglement. The cultivation of denial in a way comes from not wanting to feel, turning away, from an uncomfortable or threatening feeling; photovoice in a sense can do the opposite in that it turns towards and provides a space to work through the feelings.
Contested	– Brings these photos and interpretations forward in the group allows other people to hear and see others perspectives on climate change, and creates a space in which difference can be discussed and the issue problematized. With the photovoice 'product', the group can engage in dialogue with other actors.
Salience – (Critical awareness)	– Puts question to be contemplated in lived ways that are relevant to people, acknowledging people's attentional resources are limited and that, for example, climate change is often not-salient. As such, photovoice surfaces existing knowledge on the issue by making it more salient and construed as an 'object' of observation, rather than living 'subject to' its impacts, which is part of the definition of critical awareness.
Construed variously – (Personal Transformation)	– Allows for a space in which different meanings of climate change are encouraged and common ground can be found across the variance of meaning-making stages. Also, a defining indicator of a transformation in meaning-making is when a person who had been subject to a phenomenon, demonstrates an ability to take that phenomenon as an object. Photovoice provides a process for this subject-object shift, in which participants can become conscious about an issue in a new way and act upon that phenomena in a manner that was not previously available; this indicates that for some participants photovoice could support personal transformation.

Fig. 6 Findings on the usefulness of a psychosocial approach to meaning-making, in this case using photovoice, in learning about climate change in a group

> "My view of photo voice is that it is about education and information. When I take the picture, I think about what I can capture and what I can make known in a photo [with] words [that] complement the photograph. The person who listens also learns a lot and captures the meaning of what I want to make known. We find a variety of photography [here] and…by listening to [each] artist's message you can learn about what he wanted to make known." (Respondent SPN 6)

Respondents remarked that recognizing this issue in this way then called for action. Respondent SPN 41 said, "now that we have learned about the subject, we have to share what we have learned," or as Respondent SPN 25 put it, "now, we know and understand about climate change—we are aware and we are going to plant more trees and work more on the coffee—now we understand how we can live better."

When the actors on the retail side of the value chain bore witness to the perspectives disclosed by producers, in terms of the interlocking stressors of climate change, they came to understand the realities present in the coffee sector in a new way. A buyer who attended the final multi-actor focus-group reflected that the commonality within the variance of views is the central role that humans play as the cause of climate change: "Everyone sees it in a different way, or they see it from a different perspective, but if we take this as a whole, the only one who is responsible [for the fact] that climate change exists is the human being" (Respondent GUA 38). Another respondent, who is a technical expert regarding climate change, was surprised about the producers' existing climate knowledge and mused on the value of photo voice "as a technique that was not a [formal] technique" (Respondent GUA 36) regarding its capacity to informally and implicitly—but effectively—generate climate awareness and understanding. Indeed, the actors in the value chain had

come to know about climate change in a new way through this process, both surfacing existing knowledge—"these are things we knew but didn't [know we knew]" (Respondent SPN 2)—and extending it across other areas of life—"I have learned during the process that I must take care of the environment, starting with myself and then with my family" (Respondent SPN 22).

Discussion

This study examined a climate-engagement process that acknowledges the extent to which climate change challenges individual and collective meaning-making, and that might assist in finding shared agreements amidst plural views. The results suggest that the use of photo voice, when carried out in consideration of the psychosocial processes that press upon people as they coordinate their sense-making, is able to honour and include individuals' meanings as well as convene a network-consensus between multiple actors. This coffee cooperative demonstrated an extensive and 'deep' diversity of views about climate change, within which participants convened a shared message that they then brought into generative dialogue with the retail-side of the coffee value chain. In this discussion, I reflect on how this psychosocial approach—one that engages people inter/subjectively, such as was found with photovoice—supported this process of finding shared meaning. I consider first, in Sects. "Bringing climate change closer—reducing distance and abstraction" and "Raising salience by engaging with entangled, contested realities of climate change," the five aspects that challenge climate meanings; then, in Sect. "From 'information deficit' to developing wisdom," I discuss three types of 'awareness' that supported meaning-making; and finally, in Sect. "Creative tensions in collective meaning-making," I reflect on the coordination of shared understanding within a multiplicity of views on climate change. An approach like this may become increasingly important as climate engagement dovetails with transformations to sustainability and a more effective and ethical manner of community participation is sought.

Bringing climate change closer—reducing distance and abstraction

Participants considered a typically distant, abstract term like 'climate change' and interpreted it through their lived realities through the photo voice process. By phrasing the question in the first-person, participants drew the concept of climate change closer and rendered it at a level of abstraction that was available to them. Mental models research claims that this type of process is important in order to honor peoples' "intuitive understanding" of climate change within a complex interacting system of beliefs (Breakwell 2010, p. 859). Through what social representation theory calls objectification and anchoring, participants in this study encountered their subjective meanings of climate change as situated within their own cases and contexts. This helped to give 'density' to such an abstract concept and helped to bridge the gap between lay and expert knowledge at that individual/collective interface. This collective component is important: "SRT states that objectification and anchoring are not individual processes…[rather they] involve social interaction and the establishment of shared meaning and consensus through communication among people" (Breakwell 2010, p. 866).

In this embrace of multiple cognitions, experts' scientific knowledge ought not to be displaced, but it does need to map onto existing belief systems, which in turn has been found to support decision-making and action (Breakwell 2010). In this sample, it was notable that, climate science (for example demonstrated in the IPCC materials) is written for meaning-making frames from Expert and later, and the SDGs are considered late-Modern worldview (late Achiever) (de Vries 2019); here, without formal education on climate science as such, over 70% the participants were organizing meaning in a similar way as these large international bodies. Where participants misunderstood aspects of the science of global warming, an inter/subjective method like photo voice could be helpful. For example, in *Contaminated River*, the respondent demonstrated insight in linking plastic pollution with the same fundamental drivers of the climate change issue, yet it appears that there is some confusion on the link between emissions in the atmosphere, plastics, and climate change.

> "The river right now almost doesn't look clean anymore, now everything is contaminated. Before, we used to go down to that river to fish a bit further up. Today, not anymore. I think climate change is coming from the same [place] as the trash, as the plastic, which we thought would protect us, but we know now that *the atmosphere covered the plastic on Earth*. Such that, now here we are [with climate change]." (Respondent SPN 29, italics added)

Considering the meaning-making dynamics at play, this approach helped to first honour the insight present in this statement and then to identify where and how further learning about climate science might be needed.

The risk representation literature suggests "correcting and completing" lay knowledges about a complex issue be carried out in precisely this way: by proceeding from how people mentally construct the issue (Atman et al. 1994, p. 779). For example, in their presentation to the multi-actor focus-group, producers demonstrated the full extent to which they comprehended climate change, not

through discrete impacts on coffee production alone, but as a larger suite of impacts on human wellbeing and the natural systems that support life. This eschewed the primary role of climate science to 'deliver' this technical understanding, bringing the technical expert to express surprise that the producers had somehow arrived at climate change understanding through the lived inquiry of this photo voice "technique that was not a technique." This did not mean that the technical expert had nothing to share—on the contrary—but she did so lightly, within the existing latticework of lay-knowledge that had been built through the presentation. This suggests that a psychosocially-informed process like photo voice could provide a synthetic approach, in which climate science meanings become woven within already existing meanings.

Raising salience by engaging with entangled, contested realities of climate change

This climate-engagement process made visible just how *invisible* climate change can be as one goes through their daily life. As one respondent put it "there are subjects that we avoid," indicating climate change as one of them. That suggests not that people are unaware of such an issue, but that they avoid their own awareness of it. Due to its size, complexity, and the timelines it operates on, climate change can be pushed to the background by other persistent, simpler, and near-term tasks. This, in part, is due to the fact that attentional resources are finite (Weber and Johnson 2009) while the many demands of life can feel infinite (as the main character in the novel *Flight Behaviour* says, "getting the kids to eat supper, getting teeth brushed…There's just not room at our house for the end of the world" (Kingsolver 2013, p. 283)). Global warming can get crowded, or selected, out of relevance somewhat as an attention-saving mechanism (Whitman et al. 2018). Shared learning gains in small-scale, highly-deliberate processes may not last once participants return to day-to-day tasks and complicated media landscapes (Findlater et al. 2020).

One of the key successes of this psycho-social approach was its ability to provide a space and process to foreground and observe climate change as an 'object:' first, by mooring attention on the central inquiry-questions; then, creating a clearing to examine climate change through photography and dialogue. As climate change moves from what is normally merely 'part of the water we swim in,' to a specific object to be considered, different kinds of analysis become available in what is referred to as critical awareness. Participants' comments on the political dimensions of climate change, such as the role of industrialized countries and the larger structural factors at play that make responses to this issue difficult, led to problematizing the issue more broadly. When the producers presented their photo-texts in the final focus, the other actors in the value chain were deeply impacted by the images. It brought up emotions like sadness and a sense of responsibility, seeing the role of humans in global warming and the range of impacts it was causing, affirming that "to name the world, is to transform it" (Freire 1970, p. 88).

From 'information deficit' to developing wisdom

While action research, and photo voice within that, is known to contribute to raising the above Freirean 'critical awareness' about the theme in question, results also suggest that this psycho-social process brought forth other *kinds* of awareness as well. For example, one respondent exclaimed, that "these are things we knew, but didn't [know we knew]" suggesting that a *metacognitive awareness* arose through this process. Metacognition refers to a knowing about knowing, which is a higher-order thinking than bare perception. Researchers have argued that the 'volatility, uncertainty, complexity and ambiguity' (VUCA, or 'wicked problems') that are characteristic of today's global issues will require the capacity to "think about thinking" (Fazey 2010, p. 7) or to employ "complex higher-order thinking skills" (O'Fallon et al. 2020). Various innovations in organizational development have precisely ventured in that direction (Conklin 2005; Wilber and Watkins 2015); the field of climate change could do the same, this inter/subjective approach being one possible way.

Secondly, this process engaged people's sense-making systems in a different way than for example an 'educational' training workshop would have (Stedman 2004), something more akin to an "aha" moment that Vervaeke and Ferraro (2013, pp. 28–29) describe as *an experience of insight*. For example, one participant, in contemplating the first question, suddenly recognized that he was holding a 'larger frame' on all the questions, one which was guided by the role model of St. Francis of Assisi (the Italian saint who loved nature). This became his first photo—meta to the remaining six photos—that he explained oriented him to the wisdom that he sought to emulate:

> "[St. Francis] was the first to call Earth, Mother Earth, and called for us to respect nature… His is a story for us to take on, for us to adopt… He travels with us, like the header of all the other photos; a bigger frame." (Respondent SPN 27)

It has been said that "by taking the perspective of the sage, one comes to have a salience landscape that is similar to that of that sage" (Ferrari and Weststrate 2012, p. 43). Photo voice—at least carried out in a manner supported by this conceptual framework—provided a scaffolding beyond 'educating' on climate change to that of developing wisdom about it.

Thirdly, some participants not only shifted their vantage point but also shifted their perspective from being 'subject to' climate change, to reflecting on it objectively. The enduring effect of these subject-object shifts—i.e. dis-embedding from reality and re-establishing awareness from a new perspective—is a central part of the process of *personal transformation* in developmental psychology (Kegan 1998; Wilber 2000). In this study, some participants described how photo voice led them to consider how to embody and apply the new (or newly surfaced) climate understanding, suggestive of an actual personal transformation. Such as, "I have learned during the process that I must take care of the environment, starting with myself" (Respondent SPN 22). The extent of that transformation was not part of this study design but could warrant further investigation.

Creative tensions in collective meaning-making

The psychosocial application of photo voice in this study provided a space in which people shared their individual constructions of meaning about climate change, and the group overtly acknowledged that range of meanings, pinned across two walls of the meeting room. Within that, participants found the 'center,' a set of common themes, which did not serve to erase the other meanings but rather found their overlap.

Seeing all these meaning-systems as essential parts of a whole process of group understanding—which is a central tenant of developmental psychology—changes the quality of the discourse to one of honouring and including, rather than competing and excluding. For example, rule-oriented, conformist, and expert meanings about climate change in this study were crafted in the present moment and considered concrete phenomena with only some links made between concepts; later stages, such as achiever, pluralist, and strategist meanings, were coordinating abstract/subtle concepts in cause-and-effect, context-dependent, and systems-thinking logics, and included the past, present, and distant future. While these later stages included the components of the earlier systems of meaning-making (i.e. concrete objects, present moment), *that was not* vice versa—and yet, *all* these viewpoints contributed unique and important perspectives. This study presents a way in which this can be understood *not as a hierarchy* in which the singular climate-science meaning resides 'on top' (and at risk of being unethical and ineffective), *nor as flat* in which all meanings are 'on par' (and at risk of epistemological relativism), but rather as a *holarchy*—where earlier whole-systems of meaning become the very parts of later whole-systems of meaning (Koestler 1967; Wilber 1996). Understanding the plasticity of climate meanings as a spectrum of 'whole-parts' lessens the charge regarding earlier meaning-systems as being wrong or incorrect, since *they are the parts out of which later wholes are constituted.* The inquiry, therefore, becomes, 'in what way is this perspective true (even if it is also partial)?', so to find room for it in the larger whole of group-understanding.

This insight could be helpful for climate change communicators and policymakers working to convene social agreement in multi-actor settings. For example, the broad societal uptake of behavioural- and systems-changes during the COVID-19 pandemic has been more effective than responses to the climate crisis (to date), in part because the pandemic communication strategies captured more of the earlier stages of meaning-making in their messaging (Hochachka 2020). That is, honouring that multiple 'climate changes' exist across a linked-up spectrum of views may help to craft a path toward improved collaboration and shared action.

As such, the findings in this study regarding meaning-making suggested that social consensus may be an erroneous target, and rather that what is within reach is *a network-agreement, forged in the center of our overlapping meanings*. This echoes Esbjörn-Hargens (2010, p. 164):

> "it seems unlikely that that there will ever be a 'global consensus'—rather there will be networks of understanding that contain dissenting views and opposite opinions at various scales and within a range of contexts… Climate change is likely just the first of a long string of global issues we will face as a planetary community, so there is an ethical imperative to learn how to address such multifaceted realities in a complex and integrated fashion."

The final focus group represented the possibility for such a community. With perspectives distributed across many contextual-dimensions—position, gender, income-bracket, cultural background, education level—let alone across a spectrum of meaning-making, the group found each other in the center of those overlapping worlds, bringing care and awareness to discuss what—rendered as 'more than one, but less than many'—climate change means and what should be done about it.

Conclusion

Climate change is understood diversely. Using a singular sense of climate change in large-scale transformations to sustainability is neither effective nor ethical, and an alternate, more versatile manner of engagement is needed which can honour the plural views of climate along with that of climate science. This is particularly true at the individual-collective interface, where friction between different views can occur. I brought together certain key areas of the psychosocial climate change literature that explain aspects of why climate change is hard to understand and why it can lead to

fractured social opinions, and then used that inter/subjective approach to climate change engagement in a diverse community setting. The study found that by accounting for at least these five psychosocial dynamics as well as the spectrum of ways in which meaning is made, this approach was able to assist participants in holding climate change as both one-and-many, making room for a plurality of perspectives alongside the insights of climate science, while convening a network-agreement for climate action.

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Intelligence Briefing

Unearthing insights for climate change response in the midst of the COVID-19 pandemic

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Non-technical summary

The COVID-19 pandemic can be considered an experiment forced upon the world community and, as such, responses to the pandemic can provide lessons about socio-ecological systems as well as processes of transformative change. What enabled responses to COVID-19 to be as effective as they were, right at a time when climate action is notably lagging behind what intergovernmental panels have called for? This paper examines key differences in the COVID-19 response compared to that of climate change, examining the 'deeper' human dimensions of these global issues. Unearthing insights into the responses to both issues provides important lessons for climate change engagement.

Technical summary

In the first half of 2020, a dramatic, fast and widespread series of changes occurred in response to the COVID-19 pandemic, in behaviors, mindsets, culture, and systems. Yet, despite the intergovernmental calls for precisely this kind of fundamental, transformative change across society regarding global warming, public opinion on climate change is fractured and collective action is slow. More research is needed on the psychosocial dimensions of climate change, to better understand what the bottlenecks are for realizing transformative change. In this paper, I examine what occurred in the COVID-19 pandemic response that could be learned for the climate crisis. I focus on three psychological aspects that made the COVID-19 response accessible and actionable in a way that climate change is not: the mental demands for understanding complex issues; psychological distance and its impacts on motivation and agency; and finite attentional resources that can render certain issues as non-salient. Lessons for climate engagement include: (1) the usefulness of concrete, simple, and personally-relatable messaging; (2) more diverse and democratized climate understandings and stories; (3) greater recognition about how psychological distance affects meaning-making and sense of agency; and (4) appreciation of attentional crowding and the need for sense-making strategies about complex issues.

Social media summary

Lessons from the deeper human dimensions of COVID-19 response help inform climate change engagement and transformation.

1. Introduction

> 'Scientists: You should wash your hands because of the coronavirus.
> People: I'm gonna stop flying, hoard masks, work from home & totally re-arrange my life.
> Also Scientists: The Climate Crisis will kill millions – we must use clean power and change how we get to work.
> People: No way. (Coronavirus meme, March 4, 2020)
> 'Climate change needs to hire coronavirus' publicist.' (Coronavirus meme, March 12, 2020)

As the coronavirus outbreak – and COVID-19, the disease it causes – spread across the planet, two memes about this pandemic set the responses to coronavirus next to those of climate change. Although these were intended to make people laugh, they also contained an uncomfortable truth about how limited responses have been to the climate crisis, lagging far behind what climate science has found warranted. COVID-19 provoked a rapid large-scale systemic disruption, which may contain longer-term transformative potential. One by one, nations have risen to meet this pandemic, with governments reallocating resources, medical units deploying emergency measures, businesses closing or shifting online, educational institutions shifting to virtual learning platforms, and the majority of populations changing their behaviors

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almost overnight. Enacting such widespread changes was underpinned, at least in part, by an alignment in values/worldview and a sufficient degree of cognitive buy-in that this was indeed a crisis worthy of such changes in actions and systems. On balance, enough of the population grasped the contours of the COVID-19 crisis and made meaning of it in such a way that supported behavioral changes (such as maintaining 2 m distance, not socializing in groups larger than six, and staying home). This, in turn, also enabled a broad social agreement by which governments made systems changes (such as required health assessments, instituting shelter-in-place, and dramatic social investments to mitigate the economic impacts of the pandemic), some of which have long-term implications and may influence further development trajectories.

Change as broad and swift as this has not happened with the climate crisis. Intergovernmental scientific panels on global environmental issues have noted the need for transformative change across society, meaning fundamental, system-wide reorganization across technological, economic, and social factors (IPBES, 2019; IPCC, 2018). Yet, how to carry out such transformation to sustainability, and how to assess whether it has occurred, remains unclear (Feola, 2015; Salomaa & Juhola, 2020). In the search for pathways forward, it has been noted that some of the key climate change puzzles are in the realm of the social sciences, such as psychology, sociology, and human geography (Overland & Sovacool, 2020). More comprehensive models for transformation in a changing climate have been proposed (such as Fazey et al., 2018; O'Brien, 2018; O'Brien & Hochachka, 2010), specifically that better integrate knowledge of psycho-social changes in meaning-making and culture (interior) with more techno-managerial shifts in practices and systems (exterior) (Shrivastava et al., 2020, p. 333). It is this former category – namely, the psycho-social change processes or 'deeper' human dimensions – that I focus on here, not only as it is less-well integrated with other dimensions of change regarding global warming but also because it may have been a key catalyst for COVID-19 response.

With this point of departure, I reviewed the literature as to what aspects made this response to COVID-19 occur as it did and what insights can be learned for (possibly more transformative) responses to climate change. COVID-19 was largely perceived by the public as an *acute* problem with immediate health risks and economic costs, whereas climate change is often not perceived by laypeople as urgent (Berge, 2020). Citizens were asked to carry out *temporally close* behavioral changes regarding COVID-19, ones that are imminently within reach of the present self-concept; whereas for climate change, citizens are essentially asked to plan for and conceive of an uncertain future self-concept that is not clear for many people or may even be rejected because it hurts short-term interests (Pittis, 2020). This body of research finds that the human brain is hard-wired for short-term thinking, presenting difficulties for planning on long timelines; this could help explain the effective response to the pandemic to date, as well as the reluctance to work on the longer timelines of climate change (Hershfield, 2011). COVID-19 is also a conceptually *simple* problem – although a 'novel' virus, it can be contained by well-known, accessible strategies of face masks, social distancing, contact tracing, and, hopefully, immunization (Wiersinga et al., 2020) – quite unlike the 'wicked' problem that is climate change (Trembath & Wang, 2020). These commentaries raise important points when we compare these two global phenomena, but they only lightly examine why COVID-19 being acute, close, and simple matters in terms of human cognition and response.

Here, I build on this to take a closer look at three psychological aspects that made it harder to comprehend and garner collective action for climate change, compared to that of COVID-19. These include: (1) the mental demands for understanding complex issues; (2) the psychological difficulty of relating to an issue that is distant in both space and time; and (3) the finite attentional resources that can lead people to render certain issues as non-salient. Although these pertain to the interior, personal dimension of transformation, they have an integrated relationship with the uptake of new habits and practices and larger-scale systems change. The pandemic is an experiment forced upon the world community and, as such, teaches us about real-world dynamics which in turn may improve the science of socio-ecological systems as well as processes of transformative change. Understanding the differences between climate change compared to COVID-19 on these three points may bode helpful in understanding the effective drivers and the tenacious sticking-points for transformations to sustainability. I discuss each of these three lenses in turn below, concluding each section with implications for climate change communications and engagement.

2. A deeper look at responses to change: three key lenses

2.1. Complex issues are more fully understood via a complex meaning-making structure

How people make meaning of the world around them matters. According to developmental psychology, the perspectives a person can take on phenomena enable them to organize meaning about it (Cook-Greuter, 2013). This organization of meaning changes across a lifespan, moving further away from egocentric perspective-taking capacity, to increasingly broader perspectival embrace (O'Fallon et al., 2020; Wilber, 2000). Regarding global warming, people organize meaning in varying degrees of complexity, from concrete and simplistic meanings through to more subtle and multifaceted, to construe different 'climate changes' (see Table 1) (Hochachka, 2019). What this research suggests is that the profound complexity, high abstraction, and immensity (in both space and time) of climate change makes it difficult to *fully* comprehend; rather, people grasp some fragment of the whole, from which they construct a sense of what climate change is.

Over these past months, anecdotally I have noted a similar series of increasingly complex stages of meaning-making regarding COVID-19 (examples in italics in Table 1). Yet, the meanings about it seemed to more easily converge than they have with climate change, such that the collective response to the pandemic became, at least in a short-term frame, structural. This is not the case with climate change; rather perspectives remain diverse, often divisive, and collective action lags behind what climate science has called for. Although there is possibly a similar spectrum of meanings about COVID-19, it seems that populations gained a sufficient fundamental grasp of the issue and saw that it warranted a change in behaviors and societal systems, at least temporarily. What made COVID-19 easier to cohere meanings around, so to more effectively assemble collective action about it, and what lessons could be learned for climate change?

With COVID-19, citizens were asked to comprehend and act upon something that pertains to their own physical body on the short-term; that is, something egocentric, concrete, right now,

Table 1 Spectrum of meaning-making about COVID-19 and climate change

Perspective-taking capacity	Complexity of thought	Object of awareness	Scope of time	*Examples of COVID-19 response (based on anecdotal evidence to illustrate this concept)*	Examples from climate change adaptation based on O'Brien and Hochachka (2010) regarding adaptation; De Witt (2016) regarding worldviews; and from Hochachka (2019) regarding meaning-making
1st-person perspective	Atomistic, bits-and-pieces; ego-centric	Concrete	Present moment	*Pastor Howard-Browne a prominent religious leader on the Christian right in the USA, who claimed the virus is a hoax, or that it can only be defeated by supernatural means, rather than solid healthcare policy, was arrested for not following Florida social distancing policies* (Wilson, 2020)	With a first-person perspective (magic worldview), people organize meaning in an atomistic bits-and-pieces manner, with isolated views that seem disconnected from other views about climate change; it may fuse subject and object in a form of magical thinking
2nd-person perspective	Parts seen but not coordinated into a whole; socio-centric	Concrete	Present moment, recent past	*An organized movement in Canada, involving more than 30,000 members who offer help to others within their communities, particularly those who are more at risk of health complications related to coronavirus, as part of a 'caremongering' trend across the country* (Gerken, 2020)	With a second-person perspective (traditional worldview), people organize meaning about climate change using concrete objects of awareness (i.e. more rain) rather than subtle objects (i.e. increased precipitation), and consider what other people in their social group are doing or what the rules and principles ought to dictate. Meaning-making takes an immediate view of climate change, with the scope of time focusing mainly on the present, with a slight stretch toward the past
3rd-person perspective	Parts coordinated into a system of cause-and-effect mechanisms; world-centric (early)	Subtle	Past, present, and near future	*Examples could be found in data dashboard webpages tracking the exponential increase in COVID-19 cases, hospitalizations, deaths, and recoveries within and across nations* (Public Health – Seattle and King County, 2020)	With a third-person perspective (modern worldview), people organize meaning by linking various concepts together logically using cause-and-effect and instrumental logics. Climate change is construed to be occurring in relation to a series of other changes, such as increases in pollution, unsustainable practices, and certain habits, combined into a logical explanation
4th-person perspective	Parts and processes coordinated into systems, using self-reflective and contextual understanding world-centric (late)	Subtle	Past, present, near and increasing distant future, multiple generations	*An example of this would be a blog article by* Homer-Dixon (2020) *applying systems-thinking to consider an array of variables and systems-interactions in a measured assessment of the tradeoff between 'lockdown' versus 'let it rip' COVID-19 scenarios*	With a fourth-person perspective (postmodern worldview), people organize meaning about climate change using subtle concepts that are now seen to occur across past, present, and into the future, demonstrating an ability to consider context and the multiple causes of a situation, and also demonstrate a further increase in agency and responsibility. Climate meanings place greater emphasis on the power dynamics and systems injustices that create vulnerability and (re) produce climate change. Later, meanings are construed using systems thinking and view climate change as a complex adaptive system

(*Continued*)

Table 1 (*Continued.*)

Perspective-taking capacity	Complexity of thought	Object of awareness	Scope of time	*Examples of COVID-19 response (based on anecdotal evidence to illustrate this concept)*	Examples from climate change adaptation based on O'Brien and Hochachka (2010) regarding adaptation; De Witt (2016) regarding worldviews; and from Hochachka (2019) regarding meaning-making
5th-person perspective	Parts and processes coordinated into self-aware systems of constructions of meaning. (cosmos-centric)	Meta-aware (awareness of one's awareness)	Past, present, near and increasing distant future, multiple generations, evolutionary timelines (and even timelessness itself)	*An example could be found in the description of 're-gnosis or form[ing] a loop of knowledge in which we include ourselves and our inner change in the future [such that a] 'Future Mind' is created… [in which we] are able to anticipate not only the external 'events', but also the internal adaptations with which we react to a changed world'* (Horx, 2020)	With a fifth-person perspective (post-postmodern, integrative, or integral worldview), people organize meaning about climate change acknowledging that meaning is constructed and employing a meta-awareness (being aware of one's own awareness). Climate change may be seen as something that presents us with opportunities to grow and develop our potential, and can be seen as an important trigger for transformation. Deliberate, conscious change is seen as possible and as a potential opportunity in response to the climate crisis

and within one's own direct experience. That is, the request from public health experts, although it seemed extreme on masse, actually amounted to a handful of basic cognitive prerequisites to support comprehension and action, which were able to be met (for the most part). More abstract concepts were presented in R_0 values (i.e. the basic reproductive rate of an infection in a population) and exponential rates of infection and community-spread across time, globally, yet the actions requested by government didn't depend on citizens to construe the pandemic in a highly abstract manner, across an expansive scope of space/time. Moreover, everyone had a direct personal experience of getting a flu, most people know an older person or perhaps a health care worker, and, even though the risk to younger age groups was less, COVID-19 was nevertheless present for oneself and one's families and friends. All of these helped people to convene an immediate and self-oriented connection with the coronavirus, which in turn supported their uptake of COVID-19 protocols. In other words, one way to understand the success of the widespread behavioral changes is to see that the COVID-19 crisis did not challenge meaning-making in the same way that climate change does: it was imminently within cognitive reach of a vast swath of the population in a way that climate change has never been.

Seen through a developmental psychology lens, the meaning-making demands are found to be more straightforward for COVID-19 and more complex for climate change. Modern life at the best of times presents complex cognitive demands on people – such that as Kegan (1998) notes we are largely 'in over our heads' – but this is all the more the case regarding climate change. Weber (2010, p. 333) explains how 'climate change is a phenomenon that is not easily and accurately identified by the lay public, using their normal tools of observation and inference'. It is a statistical phenomenon, inherently abstract, and highly distributed in both space and time, such that it is not easily detectable by personal experience. It is also worldcentric; although discrete impacts may have an egocentric relevance, its causes and impacts can really only be fully understood when the global dimensions are perceived. It has been referred to as a hyperobject and a wicked problem, and it is not easy to get one's mind around (Morton, 2013). In fact, only parts of the entire hyperobject are available to many people's meaning-making apparatus, which is one explanation as to why *climate* is so frequently misunderstood to be *weather*; the latter is more concrete, directly experienced, egocentrically accessible, and occurring in the present moment (Hochachka, 2019). Although COVID-19 is also global, it was sufficiently graspable in terms of meaning-making by the majority of populations (at least to render reluctant factions in a society as outliers).

Yet, even without having (full) cognitive understanding, emotional impacts of global warming can and do move people to act. For example, as can be seen with the recent school strikes, climate change increasingly gives meaning to the lives of many (young) people, as a key ingredient of a missing grand narrative. Weber (2010, p. 333) explains how learning from personal experience relies on associated, affective reasoning, whereas learning from statistics requires analytic processes, and these lead to very different perceptions and actions. Associative, affective reasoning is quick and more basic, whereas analytic processes are slower and require cognitive effort. Although some areas of psychology suggest these run parallel to each other (Marx et al., 2007), developmental psychology would also see that the affective organization of meaning (i.e. concrete operations) is transcended and included in the analytic organization of meaning (i.e. formal operations),

but not vice versa (Wilber, 2000). Which is to say, not all of the analytic processing that guides later-stage meaning-making would be available to earlier meaning-making capacities. This understanding could help explain why action becomes motivated when abstract risks about climate change are concretized and brought into emotional experience (Marx et al., 2007) – perhaps when such risks were construed using concrete operations, they were made more accessible to people's meaning-making.

In terms of *how* to support meaning-making about a complex issue, two recommendations can be found in responses to the pandemic as well as from the climate change literature. First, the COVID-19 responses to date suggest that messaging is most effective when it relates to early meaning-making capacities to which more of the population has access. Regarding climate engagement, Stoknes (2015) recommends keeping climate messaging connected to the *present moment*, couched as a health risk (*self-centric*), framing it in supportive ways with new narratives that are *more positive*, and sharing simple ideas that are *within reach* – all of which are accessible to early meaning-making capacities. Climate change communications should not rely entirely on analytic processing (using formal operations) in their messaging, lest they end up talking 'over the heads' of their audiences. Keeping the affective and analytic styles of information-processing connected in a nested manner – as seems to have occurred with COVID-19 response – may provide a longer-standing support for climate action, precisely because they will resonate with more of the meaning-making capacities present in a population.

Second, the discourse around the COVID-19 response made room for a spectrum of meanings about it (Table 1). Climate engagement could learn from this. Ghosh (2016), in his book, *The Great Derangement*, analyzes that storytelling about climate change has gone in an individualist-bourgeois direction, representative of the modern worldview, providing limited ways to understand global warming from other worldviews. Ghosh, and others (Milkoreit, 2017; Veland et al., 2018), call for greater imagination and a broader set of narratives from other worldviews to which more of the global population can relate. Developmental psychology scholars on this matter would agree, and have suggested that more 'stories' about climate change are needed that take into account the spectrum of ways that people are making meaning about it (Cook-Greuter, 2020, personal communication). Crafting multiple climate change stories from different meaning-making stages would better reflect the multiple 'climate changes' that exist. This may require challenging the politics of knowledge and adding to the dominant climate science 'story' to allow for more epistemological diversity. For example, responses to the question, 'Are you worried about climate change?' often include statements like, 'No, God will help me/us through this', which is frequently heard outside the modern worldview and yet isn't easily accepted in the dominant (modern) discourse. De Vries (2019, p. 11) suggests that the modern worldview 'no longer offers satisfactory principles and rules for the relationships of human beings with each other and with the natural world in the Anthropocene' and underlines the important role of storytelling, values and beliefs, and more inclusive dialog regarding sustainability issues.

2.2. *Psychologically close* versus *distant*

The COVID-19 pandemic is close in a way that differs from how climate change is typically perceived. Although coronavirus is similar to climate change in how it is massively distributed globally, it also differs in that it is perceived as close both in time and space – it is happening now and it is happening to you. Climate change, however, is perceived as 'psychologically distant' in both time and space (Brügger et al., 2015, p. 1031). This notion of psychological distance comes from construal-level theory (Trope & Liberman, 2010), and explains how 'people use different levels of abstraction to think of an event or an object (i.e. mental construal) based on their perceived distance from the self' (Chu & Yang, 2018, p. 174). The process of cognitively encountering this 'distant' issue results in a great variance of meanings about climate change – described by Mike Hulme as, 'near-infinite plasticity' (Demeritt et al., 2011, p. 136). This occurs in part (as described above) because people have different capacities for organizing meaning about abstract concepts, and so they end up constructing different 'climate changes', rendered at different cognitive distances (Hochachka, 2019).

Some studies have shown how lessening the psychological distance of climate change evokes greater concern and action (Jones et al., 2017). Chu and Yang (2018) found that framing climate change as spatially close and familiar helped to reduce ideological polarization, when compared to it being framed as distant and novel. People also often seek to understand it in a familiar frame, embedded in their experience of place. For example, Clifford and Travis (2018) found that people use close, concrete proxies to track changes – such as hotter temperatures, abnormal rain, less snow-pack, and so forth – holding climate change as a social-ecological-atmospheric construct. Familiar metaphors that are close and concrete – such as to describe the increase of carbon dioxide in the atmosphere as a 'thickening blanket' that 'traps heat' – has been found to help people to support climate action (Bostrom & Lashof, 2007).

However, there are other issues at play with psychological distance. For example, it could also be due to a lack of the *linkage* made between (close) unpredictable weather and the (distant) phenomenon of climate change. As climate change wreaks greater havoc with long-held weather patterns, already people are experiencing the impacts of global warming more directly. Through making this link clearer, it could be that climate change becomes less distant and therefore more a concern to populations as well as more of a stimulus for climate action. However, to date the research findings on this are mixed. Rather, regarding:

> 'the extent that experiencing severe weather results in higher levels of support for climate adaptation policy, *only near-term events seem to matter*. This suggests the effect of severe weather on opinion towards the merits of climate adaptation is transient, and is consistent with the idea that psychological distancing has a temporal, as well as spatial, dimension' (Ray et al., 2017, p. 109).

Referred to as the 'decay effect', these findings showed that the experience of more recent weather events increased support for adaptation measures, but longer periods failed to do so.

A related (possibly explanatory) aspect of this is the psychological experience of the self across time. Large time-periods are, in general, more difficult to consider in planning. As the time-span horizon increases, 'psychological connectedness of oneself in the present with oneself in the future grows more tentative' (Hershfield, 2011, p. 4). In other words, the problems with intertemporal decision-making may occur not just because of an inadequate linkage made regarding climate change and its impacts, but also because perceptions of self are not continuous

over time. Temporally distant selves are remote and harder to identify with in the present moment, which can de-emphasize future planning objectives set against present ones.

The issue of psychological distance is also related to scale. It has been argued that the underlying drivers of change in environmental systems are too *global* and too complex to unravel beyond the relatively *local* scale (Wilbanks, 2006). For the majority of people, the sustainability of one's own neighborhood matters more to them than sustainability in distant neighborhoods (Wilbanks, 2015). Yet, 'it can be argued that no place is sustainable if other places with which it is related are not sustainable' (Wilbanks, 2015, p. 6). The issue of scale also highlights the tension between agency and structure – where agency means intentional human action, and structure means the set of institutions and systems within which such action takes place. Wilbanks and Kates (1999, p. 603) describe how 'the scale of agency – of direct human action – is often intrinsically localized while the scale of structure is almost always more encompassing [distant]'. What people feel they have control over and access to with regard to their own actions is perceived as something close; whereas addressing the larger, encompassing structure is perceived as distant, occurring on a broader, often global scale. This is sometimes a reason why actions regarding climate change don't occur; people can perceive that climate change is beyond their control.

These perceptions of reality and meaning regarding climate change can be influenced if not determined by scale (Wilbanks, 2007, 2015). The importance of working out the dynamic interplay of multi-scale interventions for sustainability informed the approach taken by the Millennium Ecosystem Assessment (2005), and is now incorporated into the translation of the Sustainable Development Goals in local contexts (Tan et al., 2019). Considering multi-scale responses will clearly be an ongoing aspect in addressing the climate challenge. In this, I recommend consideration be given to the underlying issue of psychological distance – rendered noticeable with the COVID-19 response – namely, in terms of how people construct abstract meaning about climate change, hold (or not) a future self-concept in planning climate actions, and galvanize their agency to confront the structural complexities of the issue.

The COVID-19 pandemic doesn't encounter challenges with psychological distance in quite the same way for several reasons. It is more psychologically proximate – even though you can't 'see' the virus and may not yourself get it, everyone has experienced having a fever and a cough – such that policymakers and lay-people are working with a common construct (for the most part). Also, COVID-19 gets around the issue of temporal distance, by being seen by many as a possible risk to the *present self* now. However, climate change is typically seen as something that will probably happen to a *future self* – a self that, for many, fades in perception on the long horizon of time – even if or when current unpredictable weather bears down on daily life. The tension between agency and structure is also less apparent with COVID-19, due to the fact that regardless of what measures are instituted structurally, an individual can still decide to take measures to protect themselves. In extreme cases where national leaders have failed to move ahead on health policies regarding COVID-19, individuals faced structural challenges but their agency remained intact in, for example, wearing masks and practicing physical distancing. However with climate change, an individual's avoided emissions can seem puny and irrelevant when dealing with industrial-scale, structural emissions.

The tension between multiple scales (local *versus* global) appears to be less acute with the coronavirus: although there are local differences in COVID-19 response, the measures to limit its spread are fairly common across contexts (Wiersinga et al., 2020). The communities, regions, and nations who have reacted differently did so in terms of the resources or political will to move on such measures or the degrees to which they were instituted, but didn't come up with an entirely different set of measures per se. Rather, efforts at the local scale for the most part combined with those at the national, regional, or global scale, rather than working against each other as can happen with climate change. For example, alongside domestic response, many governments allocated foreign aid resources for a COVID-19 vaccine (once available) through COVAX, a global procurement initiative meant to ensure fair, equitable, and timely access to vaccines for less wealthy countries (COVAX Facility, 2020). Canadian prime minister Trudeau was quoted saying, 'This pandemic can't be solved by any one country alone because to eliminate the virus anywhere, we need to eliminate it everywhere' (Harris, 2020). This echoes precisely the same conundrum as Wilbanks' (2015) sustainability (and climate change within that) quote above, and yet doesn't carry the same trade-off, where it is either my neighborhood sustainability or the global one. In other words, to date at least, we have not seen a widespread NIMBY ('Not In My Backyard') phenomenon with COVID-19 (a possible exception being the current Trump administration in the USA). For the most part, the global population watched the coronavirus sweep across the world, regardless of neighborhood or national borders, and viewed it as a collective problem that cut across scales.

In terms of *how* to deal with the psychological distance of climate change (and the related issues of multiple scales and agency-structure), engagement strategies could create a more spacious process in which people can come to know what climate change is to them, drawing it as close as their approach to making-meaning allows, and construing it in ways that make more sense to them. Ways to do this include asking people, 'What does climate change mean to you?' and then encouraging reflection and group discussion on their meanings; this resulted in participants' uncovering their own constructions of 'climate change', enabled a form of meta-cognition (i.e. discovering what they didn't know they knew about climate change) and supported collaboration (Hochachka, 2020, unpublished observations). Bostrom et al. (1994) recommend finding out what people already know about climate change, through a mental models interview which allows for the expression of beliefs disclosed at different psychological distances, so to proceed with greater information about the public's knowledge and to better anchor public messages in relation to that knowledge. Marx et al. (2007, p. 56) recommend retranslation of 'statistical information into concrete experience' which they suggest can greatly facilitate an intuitive understanding of complex processes in global warming. Problematizing and discussing the issue in its local-global and agency-structure dimension are also important and may be key ingredients for lessening that distance and supporting transformations toward sustainability (O'Brien et al., 2019). Finally, for climate communicators and policy makers to expand climate change beyond its definition as a CO_2 problem and to recognize it as being constructed and entangled with other change processes (i.e. social, cultural, and psychological), could help bring it closer to the experience and understandings of lay people (Hulme et al., 2009; Scoville-Simonds, 2018):

> 'Valuing people's everyday experiences of climate change and diverse ways of knowing climate (even when they might be scientifically imprecise) provides the possibility for people and communities to act on climate change through the knowledge and experience they already have'. (Rice et al., 2015, p. 254)

Processes by which people can encounter their understanding of climate change at whatever psychological distance makes the most sense to them could lead to more sustainable climate action in the long term.

2.3. Is this, or is this not, on one's salience landscape

A third way in which climate change is hard to get our minds around is the fact that it simply doesn't make it onto our salience landscape. 'Salience landscape' is a term coined by Vervaeke and Ferraro (2013, p. 28) to refer to the mental frame a person cognitively holds to determine relevance and to allocate attentional, metabolic, temporal, and behavioral resources. This is partially related to worldview, but is mainly a way to manage the onslaught of unprioritized information: people need ways to determine what is salient and worthy of their attention. How this attention-management works is important because climate change can often end up low on that list. Regardless of what statistical evidence for global warming is presented or how compelling the anecdotal accounts of climate change might be, these will only influence subsequent perceptions and actions *if the public attends to them* (Weber, 2010).

As it turns out, attention is a finite resource (Weber & Johnson, 2009). There are various psychological mechanisms by which people sift and sort through phenomena to allocate those scarce attentional resources. Regarding climate change, Whitman et al. (2018, p. 384) find that 'attitudes about climate change are associated with attentional biases determining how likely an individual is to see climate-related information in the environment'. The example given is the extent to which a person parses through crowded visual scenes, such as a news broadcast, to notice climate-related words is associated with his or her level of existing concern about climate change. In some sense, this is an attention-saving mechanism – to track and attend to that which you already believe in.

For many people, coronavirus has been pushed front and central into their salience landscape. Although there is a crucial role here for opinion leaders in the media, often such leaders are found on multiple, contradictory sides of an issue, such that what is also needed is greater sense-making capacity of audiences – something that appears accessible regarding COVID-19 in a way that it hasn't been for climate change. With COVID-19, perhaps because it is perceived as an immediate crisis, people are unusually forced to make orderly meaning out of chaos, honing, and attending to what is salient to them, to find their way through a sea of exponential graphs about COVID-19 cases, deaths, and recoveries. The perceived non-urgency of climate change can set it on the back-burner of what requires immediate attention now. With COVID-19, people have had to find immediate ways to use their attentional resources wisely, sifting through the extensive and quickly changing information about it – how to prepare, who to believe, and what to do if one gets it – to attend to what is most relevant in an enormous glut of largely un-prioritized perspectives on the matter.

I argue this sense-making in contexts of high complexity is an acute and critical skill today. Although prior generations were guided by education curricula that *provided information* about the world, today school curricula ought to be (if it isn't already) oriented to *how to make sense* of that information. Climate change is likely an issue that will eliminate significant depth of consciousness present in the world today, at the greatest scale we have seen – in other words, it ought to be seen as urgent and high on our list of priorities – and yet it doesn't make it onto the salience landscape of many. So, instead, people may end up giving their attention to less important information, like cute cats or last night's dinner, rather than the issue that may take down both of those, and much more, if left unattended. In other words, the difference perhaps between the COVID-19 response compared to that of climate change, may have been that the former was forced to be salient, whereas the latter has been crowded out of a sense of acute relevance by lesser but more distracting issues. Adjusting that balance is a necessary part of an effective climate change engagement.

Considering *how* to adjust that balance raises the question, *who is to force an issue to be salient?* It would seem political leaders and the media have a key role in this, yet they can only venture as far as their voting base extends, which means that climate change communicators and educators have a role here too. The current media landscape is markedly different than it used to be and global issues are increasingly complex; more capacity building for making sense of information is needed. Rather than joining in the cacophony of opinions, climate communicators could instead impart sense-making strategies, both to politicians (who influence the larger structures in which individuals live their lives) as well as to citizens, for how to sort out perspectives on phenomena and more consciously curate their salience landscape to track issues of significance. Examples include Lynam and Fletcher's (2015) research into sorting complexity and multiple perspectives using a tool called SenseMaker, and Moloney *et al.*'s (2014) work with social representations theory to explore constructions of climate change in socially-oriented solutions and communications campaigns. This could start in school, it could be a public-service resource, or it could be contained within community-engagement sustainability projects; one way or another, people need opportunities to develop the skills to more effectively navigate complicated and contested media messages and identify what is most salient.

3. Conclusion: lessons from COVID-19 for climate change

Comparing the COVID-19 response to that of climate change through these three lenses, it becomes apparent that the meanings people make about coronavirus make it accessible and actionable in a way that climate change is not. The psychological complexity and distance of coronavirus, being concrete and proximate, makes it feel immediate and present, and thus within reach cognitively and behaviorally. For that reason, people have a felt-sense of the loss that co-arises with this issue. That then supports COVID-19 taking a central place on people's salience landscapes, displacing other more minor phenomena that are constantly pulling at their attention. In turn, the world has witnessed a globally coordinated shift in awareness, behavior, culture, and systems in approximately 2 months.

In the case of climate change, however, those dimensions operate in the reverse. Its developmental complexity and psychological distance make climate change abstract, distant in both space and time, and thus hard to construe in its totality. That requisite cognitive complexity alongside the psychological distance compound to push climate change away from some people's sense of what is

salient, displacing what is the major and possibly most relevant issue today with lesser but more distracting issues. Although there are other psychological layers that influence climate change response – such as ideology, contested values, difficult trade-offs, strong emotions, and so forth – in terms of the cognitive component of grasping the extent and contours of the issue, the three aspects discussed here combine in important ways to slow down timely and meaningful behavioral- and systems-change responses to global warming.

What lessons can be learned for transformation? The pandemic evoked *broad and swift* shifts in mindsets, actions, culture, and societal systems. The extent to which they will be *lasting* remains to be seen. Certain aspects of the decisions taken (or not taken) to date may leave an indelible mark on the developmental paths of some nations. For example, Canadian policy-makers have noted that COVID-19 made visible crucial vulnerabilities in the society and politicians are now focusing on 'building back better', weaving into pandemic recovery other social aspects such as paid sick leave and building a more resilient economy that empowers women, fights climate change, and addresses systemic racism (Privy Council Office, 2020). Many of these changes incur massive financial debts that extend far into the future; in other words, the price tag on COVID-19 measures are not insignificant and nor are they fleeting, and yet – in part due to the three reasons I presented above – national constituencies to date have accepted them. Notable exceptions here provide important lessons. For example, in the UK and the USA, the neoliberal wave of anti-public sector sentiments that tended to weaken the response-options to the pandemic may provide insights for climate change; namely, with respect to being prepared in terms of public sector organization and decision-making, as well as to not underestimate the influence of such sentiments underpinning political attitudes. Similarly, there will be much diversity in terms of how sustained COVID-19 responses are and whether rebuilding efforts stretch to include other global issues. For now, the COVID-19 responses to date provide a template for how change across multiple dimensions of society can occur.

For engaging such a multi-dimensional change process regarding climate change, the response to the COVID-19 pandemic sheds light on the usefulness of concrete, simple, and self-centric or personally relatable messaging about the issue. It also underscores the value of adding to the climate-science definition to make space for more democratized climate understandings and stories. It also discloses the need for climate communication strategies in which people are encouraged to encounter their understanding of climate change at whatever psychological distance makes the most sense to them, rather than imposing a certain level of abstraction that they may or may be capable of rendering. Also, greater understanding is required of the nature and degree of attentional crowding people experience, and the need to impart sense-making strategies for how to sort out perspectives on phenomena and more consciously attend to issues that are most significant.

Learning from the differences between these two responses provides important insights into climate change communications and engagement, and may give hope that large-scale system transformations regarding climate change, involving people's cognitive, behavioral and cultural change, as well as global coordination, is very much possible.

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