



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

Gail Hochachka

Department of Sociology and Human Geography, Faculty of Social Science, University of Oslo, Postbloks 1096, Blindern, 0317 Oslo, Norway



ARTICLE INFO

Keywords:

Climate change adaptation
Meaning-making
Developmental psychology
Local ownership
Transformation
El Salvador
Photovoice

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

E-mail address: gail.hochachka@sosgeo.uio.no.

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 transcategorical 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, Zervogel 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 (Zervogel 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 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.

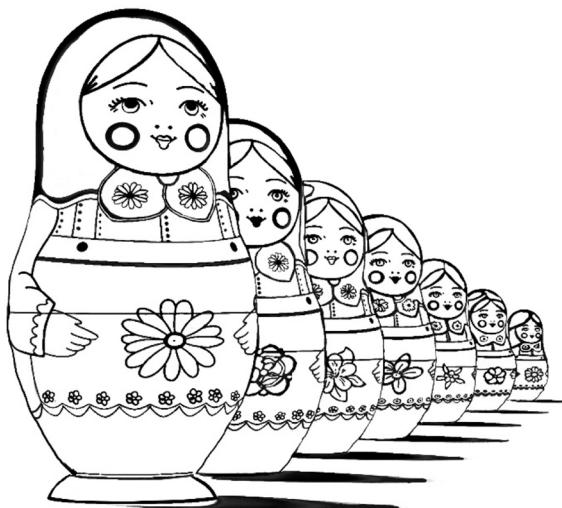


Fig. 1. Meaning-making stages can be best depicted as nested *matryoshkas*.

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, these 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 Wit, 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	Complexity of thought: abstract and networked Object of awareness: subtle Time: past and future (early), multi-generational (late)	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.	Modem / 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 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.

Acknowledgements

This work was supported by the Norwegian Research Council of Norway (grant number 250434), and field work in El Salvador was funded by Canada’s International Development Research Centre in Ottawa (grant number 106282-027). Analysis and writing were conducted at the University of Oslo associated with the AdaptationCONNECTS research project. Photography data was drawn from an action research project carried out in partnership between the Canadian non-profit organization Drishti-Centre for Integral Action and the Salvadoran non-profit organization Fundación Centro Bartolomé de las Casas. Special acknowledgement is given to the Salvadoran field work team, namely Larry José Madrigal, Mónica Flores, Walberto Tejeda, Rutilio Delgado, Roberto Cáceres, Hector Núñez, and Lauren Tenney. Gratitude to Terri O’Fallon for her collaboration in data analysis, to scholars in the AdaptationCONNECTS research group for their help in framing and editing, and to Karen O’Brien, Darcy Riddell, Annick de Witt, Tom Murray, Roland Stanich and Ken Wilber for their excellent edits.

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 it 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	atomistic	present	This photo is from the Sumipul 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 ('cause and effect')	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 "gramoxone." 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	atomistic	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 (operationalized)	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. Daniela 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.
15	El Guapo Struggles with the Heat	2.5	Conformist	concrete	atomistic	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	atomistic	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	atomistic	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 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	atomistic	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. 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.
20	Agricultural Diversification	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.
21	We learned that we need to cut the horns	3	Expert	subtle	networked thinking	present, past	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 distant 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."

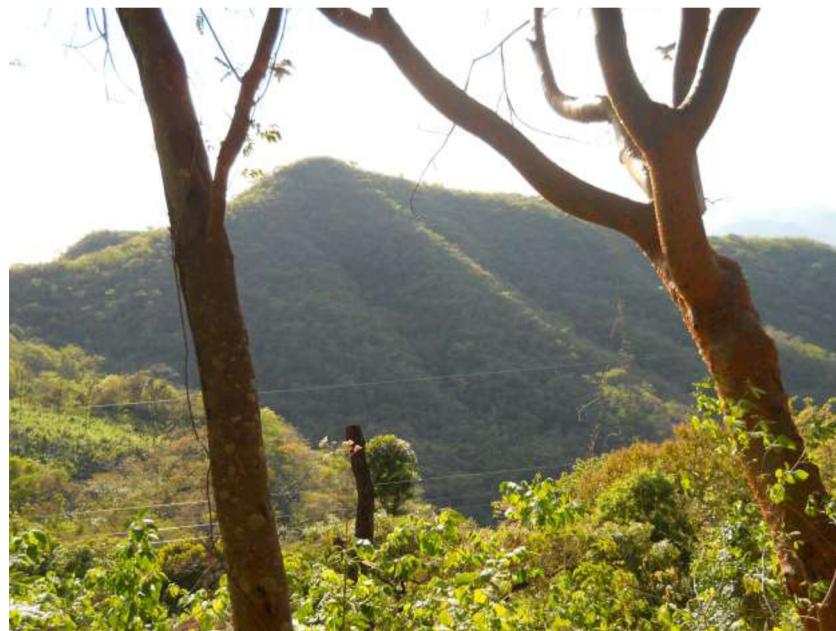
Photo 12: "We Depend on Pesticides"



"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."

References

- Bailey, C., White, C., Pain, R., 1999. Evaluating qualitative research: dealing with the tension between "science" and "creativity". *Area* 31, 169–178. <https://doi.org/10.1111/j.1475-4762.1999.tb00182.x>.
- Bennett, N.J., Dearden, P., 2013. A picture of change: using photovoice to explore social and environmental change in coastal communities on the Andaman Coast of Thailand. *Local Environ.* 18, 983–1001.
- Berzonsky, C.L., Moser, S.C., 2017. Becoming Homo sapiens sapiens: mapping the psycho-cultural transformation in the anthropocene. *Anthropocene* 20, 15–23. <https://doi.org/10.1016/j.ancene.2017.11.002>.
- Boillat, S., Berkes, F., 2013. Perception and interpretation of climate change among Quechua farmers of Bolivia: indigenous knowledge as a resource for adaptive capacity. *Ecol. Soc.* 18. <https://doi.org/10.5751/ES-05894-180421>.
- Bostrom, A., Lashof, D., 2007. Weather it's climate change? Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change. Cambridge University Press, Cambridge, pp. 31–43.
- Brace, C., Geoghegan, H., 2011. Human geographies of climate change: landscape, temporality, and lay knowledges. *Prog. Hum. Geogr.* 35, 284–302. <https://doi.org/10.1177/0309132510376259>.
- Brügger, A., Dessai, S., Devine-Wright, P., Morton, T.A., Pidgeon, N.F., 2015. Psychological responses to the proximity of climate change. *Nat. Clim. Change* 5, 1031–1037. <https://doi.org/10.1038/nclimate2760>.
- Chu, H., Yang, J.Z., 2018. Taking climate change here and now – mitigating ideological polarization with psychological distance. *Glob. Environ. Change* 53, 174–181. <https://doi.org/10.1016/j.gloenvcha.2018.09.013>.
- Clifford, K.R., Travis, W.R., 2018. Knowing climate as a social-ecological-atmospheric construct. *Glob. Environ. Change* 49, 1–9. <https://doi.org/10.1016/j.gloenvcha.2017.12.007>.
- Cook-Greuter, S.R., 2013. Nine Levels of Increasing Embrace in Ego Development: A Full-spectrum Theory of Vertical Growth and Meaning Making 36. pp. 275–281.
- Cook-Greuter, S.R., 2004. Making the case for a developmental perspective. *Ind. Commer. Train.* 36, 275–281. <https://doi.org/10.1108/00197850410563902>.
- Cook-Greuter, S.R., 2000. Mature ego development: a gateway to ego transcendence? *J. Adult Dev.* 7, 227–240. <https://doi.org/10.1023/A:1009511411421>.
- De Witt, A., de Boer, J., Hedlund, N., Osseweijer, P., 2016. A new tool to map the major worldviews in the Netherlands and USA, and explore how they relate to climate change. *Environ. Sci. Policy* 63, 101–112. <https://doi.org/10.1016/j.envsci.2016.05.012>.
- Esbjorn-Hargens, S., 2010. An integral overview of climate change: why truth is not enough. *MetaIntegral Found. Store 5*.
- Findlater, K.M., Donner, S.D., Satterfield, T., Kandlikar, M., 2018. Integration anxiety: the cognitive isolation of climate change. *Glob. Environ. Change* 50, 178–189. <https://doi.org/10.1016/j.gloenvcha.2018.02.010>.
- Flyvbjerg, B., 2006. Five misunderstandings about case-study research. *Qual. Inq.* 12, 219–245. <https://doi.org/10.1177/1077800405284363>.
- Geoghegan, H., Leyson, C., 2012. On climate change and cultural geography: farming on the Lizard Peninsula, Cornwall, UK. *Clim. Change* 113, 55–66.
- George, A.L., Bennett, A., 2005. Case Studies and Theory Development in the Social Sciences, Fourth printing edition. The MIT Press, Cambridge, Mass.
- Gifford, R., 2011. The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *Am. Psychol.* 66.
- Goldman, M.J., Turner, M.D., Daly, M., 2018. A critical political ecology of human dimensions of climate change epistemology, ontology, and ethics. *Wiley Interdiscip. Rev. Clim. Change* 9, e526. <https://doi.org/10.1002/wcc.526>.
- Graham, S., Barnett, J., Fincher, R., Hurlimann, A., Mortreux, C., 2014. Local values for fairer adaptation to sea-level rise: a typology of residents and their lived values in Lakes Entrance, Australia. *Glob. Environ. Change* 29, 41–52. <https://doi.org/10.1016/j.gloenvcha.2014.07.013>.
- Graham, S., Barnett, J., Fincher, R., Hurlimann, A., Mortreux, C., Waters, E., 2013. The social values at risk from sea-level rise. *Environ. Impact Assess. Rev.* 41, 45–52. <https://doi.org/10.1016/j.eiar.2013.02.002>.
- Graham, S., Barnett, J., Fincher, R., Mortreux, C., Hurlimann, A., 2015. Towards fair local outcomes in adaptation to sea-level rise. *Clim. Change* 130, 411–424. <https://doi.org/10.1007/s10584-014-1171-7>.
- Graves, C.W., 1970. Levels of existence: an open system theory of values. *J. Hum. Psychol.* 10, 131–155. <https://doi.org/10.1177/002216787001000205>.
- Habermas, J., 1984. Theory of Communicative Action, Volume One: Reason and the Rationalization of Society. Beacon Press, Boston, Mass.
- Hargreaves, T., 2011. Practice-ing behaviour change: applying social practice theory to pro-environmental behaviour change. *J. Consum. Cult.* 11, 79–99. <https://doi.org/10.1177/1469540510390500>.
- Hine, D.W., Reser, J.P., Morrison, M., Phillips, W.J., Nunn, P., Cooksey, R., 2014. Audience segmentation and climate change communication: conceptual and methodological considerations. *Wiley Interdiscip. Rev. Clim. Change* 5, 441–459. <https://doi.org/10.1002/wcc.279>.
- Hissa, K., 2016. Using Photovoice to Understand Climate Change Adaptation in Rural Ontario.
- Hochachka, G., 2009. Developing Sustainability, Developing the Self an Integral Approach to International & Community Development. Trafford, Victoria, BC, .
- Hulme, M., 2017. Weathered: Cultures of Climate. SAGE, London.
- Hulme, M., 2009. Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity, 4th edition. Cambridge University Press, Cambridge, UK; New York.
- Ingersoll, R.E., Cook-Greuter, S.R., 2007. The self-system in integral counseling. *Couns. Values* 51, 193–208. <https://doi.org/10.1002/j.2161-007X.2007.tb00078.x>.
- Jones, C., Hine, D.W., Marks, A.D.G., 2017. The future is now: reducing psychological distance to increase public engagement with climate change. *Risk Anal.* 37, 331–341. <https://doi.org/10.1111/risa.12601>.
- Kegan, R., 1998. Over Our Heads: The Mental Demands of Modern Life. Harvard University Press, Boston, MA.

- Kegan, R., 1983. *The Evolving Self — Robert Kegan |.* Harvard University Press.
- Kegan, R., 1980. Making meaning: the constructive-developmental approach to persons and practice. *J. Couns. Dev.* 58, 373–380.
- Kegan, R., Lahey, L.L., 2009. *Reconceiving the challenge of change. Immunity to Change: How to Overcome It and Unlock Potential in Yourself and Your Organization.* Harvard Business Press, Boston, pp. 11–30.
- Kempton, W., 1991. Public understanding of global warming. *Soc. Nat. Resour.* 4, 331–345. <https://doi.org/10.1080/08941929109380765>.
- Koestler, A., 1967. *The Ghost in the Machine.* Penguin Group.
- Kohlberg, L., 1981. *The Philosophy of Moral Development Moral Stages and the Idea of Justice.* Harper & Row.
- Leichenko, R., O'Brien, K., 2019. *Climate and Society: Transforming the Future.* Polity Press, Cambridge, UK.
- Leiserowitz, A., 2007. Communicating the risks of global warming: American risk perceptions, affective images, and interpretive communities. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change.* Cambridge University Press, Cambridge, pp. 44–63.
- Loevinger, J., 1966. The meaning and measurement of ego development. *Am. Psychol.* 21, 195–206.
- Maibach, E.W., Leiserowitz, A., Roser-Renouf, C., Mertz, C.K., 2011. Identifying like-minded audiences for global warming public engagement campaigns: an audience segmentation analysis and tool development. *PLoS One* 6, e17571. <https://doi.org/10.1371/journal.pone.0017571>.
- McClymont Peace, D., Myers, E., 2012. Community-based participatory process – climate change and health adaptation program for northern First Nations and Inuit in Canada. *Int. J. Circumpolar Health* 71, 18412. <https://doi.org/10.3402/ijch.v71i0.18412>.
- Morton, T., 2013. *Hyperobjects: Philosophy and Ecology after the End of the World. Posthumanities.* Minneapolis.
- Moser, S.C., Dilling, L., 2011. *Communicating Climate Change: Closing the Science-Action Gap.* Oxford University Press<https://doi.org/10.1093/oxfordhb/9780199566600.003.0011>.
- Murray, T., 2017. Sentence completion assessments for ego development, meaning-making, and wisdom maturity, including STAGES. *Integral Leadersh. Rev.* (August), 1–36.
- O'Brien, K., Hochachka, G., 2010. Integral adaptation to climate change. *J. Integral Theory Pract.* 5, 89–102.
- O'Brien, K., Sygna, L., 2013. Responding to climate change: the three spheres of transformation. *Proceedings of Transformation in a Changing Climate* 16–23.
- O'Fallon, T., 2018. *The STAGES Theory: the Matrix Revealed Course Reader.*
- O'Fallon, T., 2013. *The Senses: Demystifying Awakening.*
- Pelling, M., 2011. *Adaptation to Climate Change: From Resilience to Transformation.* Routledge, London; New York.
- Pyhälä, A., Fernández-Llamazares, Á., Lehvävirta, H., Byg, A., Ruiz-Mallén, I., Salpeteur, M., Thornton, T., 2016. Global environmental change: local perceptions, understandings, and explanations. *Ecol. Soc.* 21. <https://doi.org/10.5751/ES-08482-210325>.
- Rabinovich, A., Morton, T.A., Postmes, T., Verplanken, B., 2009. Think global, act local: the effect of goal and mindset specificity on willingness to donate to an environmental organization. *J. Environ. Psychol.* 29, 391–399. <https://doi.org/10.1016/j.jenvp.2009.09.004>.
- Raskin, J.D., 2002. Constructivism in psychology: personal construct psychology, radical constructivism, and social constructionism. *Fam. Commun. Hist.* 5, 17.
- Riddell, D., 2013. Bring on the re/evolution: integral theory and the challenges of social transformation and sustainability. *J. Integral Theory Pract.* 8, 126–145.
- Riedy, C., 2008. A developmental perspective on climate policy discourse. *Deliberative Ecological Economics.* Oxford University Press, pp. 167–193 Chapter. 7.
- Rohan, M.J., 2000. A rose by any name? The values construct. *Pers. Soc. Psychol. Rev.* 4, 255–277. https://doi.org/10.1207/S15327957PSPR0403_4.
- Rooke, D., Torbert, W.R., 2005. Seven transformations of leadership. *Harv. Bus. Rev.*
- Rosengren, D., 2016. Science, knowledge and belief. On local understandings of weather and climate change in Amazonia. *Ethnos* 1–16. <https://doi.org/10.1080/00141844.2016.1213760>.
- Roser-Renouf, C., Maibach, E., Leiserowitz, A., 2009. Global Warming's Six Americas: An Audience Segmentation Analysis (Invited). AGU Fall Meet. Abstr..
- Schwandt, T.A., Gates, E.F., 2017. Case study methodology. In: Denzin, N.K., Lincoln, Y.S. (Eds.), *The SAGE Handbook of Qualitative Research.* SAGE Publications, Inc., Thousand Oaks.
- Scoville-Simonds, M., 2018. Climate, the earth, and god – entangled narratives of cultural and climatic change in the Peruvian Andes. *World Dev.* 110, 345–359. <https://doi.org/10.1016/j.worlddev.2018.06.012>.
- Sellars, W., Rorty, R., 1997. *Empiricism and the Philosophy of Mind,* 2nd printing edition. Harvard University Press, Cambridge, Mass.
- Spence, A., Poortinga, W., Pidgeon, N., 2012. The psychological distance of climate change: psychological distance of climate change. *Risk Anal.* 32, 957–972. <https://doi.org/10.1111/j.1539-6924.2011.01695.x>.
- Suldovsky, B., 2017. The information deficit model and climate change communication. *Oxf. Res. Encycl. Clim. Sci.* <https://doi.org/10.1093/acrefore/9780190228620.013.301>.
- Swim, J., Clayton, S., Doherty, T., Gifford, R., Howard, G., Reser, J., Stern, P., Weber, E., 2009. *Psychology and Global Climate Change: Addressing a Multi-faceted Phenomenon and Set of Challenges.* (A Report of the American Psychological Association Task Force on the Interface between Psychology & Global Climate Change). American Psychological Association, Washington, DC.
- Torbert, W.R., Taylor, S.S., 2008. Action inquiry: interweaving multiple qualities of attention for timely action. *The SAGE Handbook of Action Research.* SAGE Publications, London. <https://doi.org/10.4135/9781848607934>.
- Trope, Y., Liberman, N., 2010. Construal-level theory of psychological distance. *Psychol. Rev.* 117, 440. <https://doi.org/10.1037/a0018963>.
- Vinyeta, K., Lynn, Kathy, 2013. Exploring the Role of Traditional Ecological Knowledge in Climate Change Initiatives (No. PNW-GTR-879). U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. <https://doi.org/10.2737/PNW-GTR-879>.
- Wilber, K., 2000. *Integral Psychology: Consciousness, Spirit, Psychology, Therapy,* Shambhala, Boston.
- Wilber, K., 1999. Collected Works of Ken Wilber, Vol. 4: *Integral Psychology, Transformations of Consciousness, Selected Essays,* 1st edition. Shambhala, Boston.
- Wilber, K., 1996. *A Brief History of Everything.* Shambhala Publications, Boston.
- Woiwode, C., 2016. Off the Beaten Tracks: The Neglected Significance of Interiority for Sustainable Urban Development. *Futures PA*, pp. 82–97. <https://doi.org/10.1016/j.futures.2016.10.002>.
- Woiwode, C., 2012. Exploring new horizons: the nexus of climate change, urban development and spirituality. *Int. J. Urban Sustain. Dev.* 4, 219–235. <https://doi.org/10.1080/19463138.2012.694820>.
- Wolf, J., Allice, I., Bell, T., 2013. Values, climate change, and implications for adaptation: evidence from two communities in Labrador, Canada. *Glob. Environ. Change* 23, 548–562. <https://doi.org/10.1016/j.gloenvcha.2012.11.007>.
- Wolf, J., Moser, S.C., 2011. Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world. *Wiley Interdiscip. Rev. Clim. Change* 2, 547–569. <https://doi.org/10.1002/wcc.120>.
- Yin, R.K., 2013. *Case Study Research: Design and Methods,* fifth edition. SAGE Publications, Inc, Los Angeles.
- Ziervogel, G., Cowen, A., Ziniades, J., 2016. Moving from adaptive to transformative capacity: building foundations for inclusive, thriving, and regenerative urban settlements. *Sustainability* 8, 955. <https://doi.org/10.3390/su08090955>.