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Abstract

Despite growing interest in helping students become agents of environmental change who can through informed decision-making and action-taking transform environmentally detrimental forms of human activity, science educators have reduced agency to rationality by overlooking sociocultural influences such as norms and values. We tackle this issue by examining how elementary teachers and students negotiate and attribute responsibility, credit, or blame for environmental events during three environmental read-alouds. Our in-depth analysis and visual representation of meta-agentive discourse revealed varied patterns of agential attribution. First, humans were simultaneously attributed negative agentive roles (agents of endangerment and imbalance) and positive agentive roles (agents of prevention, mitigation, and balance). Second, while wolves at Yellowstone were constructed as intentional (human-like) agents when they crossed over into the human world to kill livestock in nearby farms, polar bears in the Arctic were denied any form of agential responsibility when they approached people's home. Third, anthropogenic causation of global warming was constructed as distal and indirect chains of cause and effect (i.e., sophisticated sequences of ripple effects), whereas its mitigation and prevention assumed the form of simple and unidirectional causative links (direct and proximal causality). Fourth, the notion of *balance of nature* was repeatedly used as a justification for environmental conservation but its cause and dynamic nature remained unclear. And, fifth, while one teacher promoted environmental agency by encouraging students to experience positive emotions such as love of nature, freedom, and oneness with nature, the other teachers encouraged students to experience negative emotions such as self-blame and guilt. This study's main significance is that it highlights the potential of read-alouds to enhance elementary students' climate literacy and the need for environmental educators who set out to promote environmental agency to expand the focus of their instructional efforts beyond rational argumentation and reasoning.

Keywords: [agency, read-aloud, environment, nature, animals, children, elementary school, discourse, climate]

Among science educators there is growing interest in how to imbue in students the capacity to become agents of environmental change who can, through informed decision-making and action-taking, reshape and transform environmentally detrimental and irresponsible forms of human relationship with nature. Such interest is particularly evident in research on the use of socioscientific issues for teaching science, which has revealed varied patterns of student reasoning and argumentation in response to environmental dilemmas (Barab et al., 2006; Hogan, 2002; Jimenez-Aleixandre, & Pereiro-Munoz, 2002; Klosterman, Sadler, & Brown, 2011; Kortland, 1996; Patronis, Potari, & Spiliotopoulou, 1999; Pedretti, 1999; Sadler, Barab & Scott, 2007; Solomon, 1992; Zeidler, Osborne, Erduran, Simon, & Monk, 2003; Zeidler & Schafer, 1984; Zeidler, Walker, Ackett, & Simmons, 2002). Yet, none of these studies makes systematic analytical employment of the theoretical construct of “agency,” focusing instead on unpacking logical relations (e.g., claim, data, warrant, qualifier, and rebuttal) in student argumentation. This incongruity is reflective of widespread conceptions of agency as strictly a sociocultural phenomenon. As such, this literature is inconsistent with recent work in the psychology of agency supporting a cognitive perspective on human agentivity (Boroditsky, 2011; Filipovic, 2007; Morris, Menon, & Ames, 2001). As Fausey, Long, Inamori, and Boroditsky (2010) write, “agency [is] a construct of paramount importance in human cognition (p. 162).”

Science educators’ focus on environmental rationality abstracted from sociocultural context also suggests a strong reliance on a rational choice model wherein environmental agency is equated to absolute free will, and environmental activity (action and decision-making) conceived as being pursued by self-interested and rational individuals who are unaffected by societal influences (e.g., social norms, shared cultural values) (Ahearn, 2001; Burns, 1984; Wertsch, Tulviste, & Hagstrom, 1993). By favoring a model of agency that situates environmental activity in the mental processes of human actors (i.e., as solely a matter of rationality), science educators have generally overlooked sociocultural aspects of human activity and treated humans as “super-rational” and “asocial” beings. In Burns’ (1994) words,

[A rational choice approach] emphasizes the volitional nature of human action and the capability of actors to make decisions and to act on the basis of rational calculations of benefit and cost. Individuals are assumed to be more or less fully informed about their action situations and to choose the best actions or means to achieve their ends... given the information (perfect or less than perfect) that the individual has about his or her “given environment” and about his “feasible set of options”... [As a result, agency] becomes in a certain sense a simple exercise in calculus (p. 198)

The present study seeks to tackle this limitation in the science education literature by examining how classroom discussion of environmental issues is socioculturally mediated, that is, linked to linguistically constructed roles and relationships with the environment. Instead of reducing it to rationality, we define *environmental agency* more broadly as the capacity to act upon environmental issues (i.e., the capability of actively resolving environmental problems) which can be expressed or demonstrated orally by elementary teachers and students through oral language use during read-alouds. By situating environmental agency in teacher-student verbal interactions, we seek to answer the following research question: How is *environmental agency* (the capacity to act upon environmental issues) expressed and demonstrated by elementary teachers and students during read-alouds?

Theoretical Models of Agency

Despite its pervasiveness in everyday and scholarly usage, “agency” remains a term whose theoretical meaning is problematic and opaque. As used by laypeople, agency typically connotes an individual, group, or institution (e.g., the US Environmental Protection Agency) who acts on behalf of someone else (e.g., the American people). In contrast, scholarly models of agency usually refer to individuals or social groups who can act for themselves (Ahearn, 2001a). Nonetheless, across the social sciences, agency is often defined too narrowly, unclearly, and simplistically (Ahearn, 2001b). Some common theoretical models of agency include treating it as synonymous to *free will* and *resistance*; both of these theoretical models have been criticized for their failure to take into account sociocultural forces and tendency to overlook the complex and ambiguous nature of human intentionality, activity, and belief systems (Ahearn, 2012).

Several researchers have emphasized the ambiguous and problematic nature of agency attribution. Wertsch et al. (1993) question whether the computer itself or its user should bear responsibility over the completion of tasks involving computer-mediated activity such as word processing and spreadsheets (i.e., the extent to which it is more appropriate to speak of computer or human agency). Goodwin (1994) reports how, while using the same videotape as evidence during a court trial, the prosecution presents Rodney King (an African-American driver who had been stopped for speeding) as a helpless victim of a brutal beating by White police officers (agents of uncontrolled brutality), whereas the defense describes King as a dangerous giant who, despite lying on the ground, was in control of the situation and continued to act aggressively against the officers who merely reacted with escalated force to defend themselves (i.e., King was the agent of his own beating). Roth (2007) argues that human agency and passivity are inherent to all human action as people cannot act upon the world without being simultaneously affected by it; being an agent also inevitably entails being a recipient of the outside world’s influence though the former has typically featured more prominently in social scientific research. Ahearn (2001b) describes how agency is expressed differently in different languages: in some languages the subjects of intransitive verbs (e.g., *Paul* fell down) are treated as agents (Paul is treated as the agent of his own demise), whereas in others they are treated as objects (Paul is treated as a passive recipient upon whom the event of falling befalls). Generally speaking, this literature emphasizes that linguistic attribution of agency can be not only highly ambiguous but also manipulated as a means of pursuing one’s personal interests and agenda.

Theoretical models used to understand human agency in the context of social systems or structures can be grouped into three main themes: mechanism, structuralism, and culturalism (Carspecken, 1996). In a mechanistic theme, human agency is treated in a deterministic manner as simply the result of an existing social organization that remains unaffected by human choice or free will. This theme largely precludes the possibility of cultural transformation or change by assuming that human agency is socially conditioned. Structuralist themes on the other hand view human agency as emerging from the routine activity or practice of individuals (i.e., human action) in particular social contexts or structures in a mutually constituting relationship -- human actions are not only shaped by social structures (i.e., cultural reproduction) but can also shape existing socio-structural conditions (i.e., cultural transformation). Social change or transformation is possible, despite the constraints of a self-reproducing structure, due to inherent structural tensions and contradictions which lead to the “loose structuring” of humans whose actions are not completely free nor completely socially determined (Ortner, 2001). Lastly, cultural themes embrace the notion that human agency requires volition -- a mental state characterized by intentionality, motivation, rationality, and action monitoring. As a result of emphasizing rational choice, culturalist themes tend to treat human agency as free will, a

capacity exercised by completely autonomous individuals. Although reasonable, such rational choice model of human agency has been criticized for overlooking cultural, institutional, and normative influences on human activity (Burns, 1994; Ahearn, 2001).

More recently, linguist anthropologists such as Ahearn (2001) have defined human agency as “the socioculturally mediated capacity to act (p. 112).” Such sociocultural stance on human agency cohesively combines structuralist and cultural themes and has been used to examine how social transformation is actively pursued within a particular social structure through the volition (rational and reflective choice) and activity (e.g., discursive interactions) of social agents despite the existence of reproductive constraints (a culture that favors the existing social structure). Furthermore, from this theoretical perspective, agency is viewed as linguistic and emergent in nature. Put differently, agency is grammatically encoded and is constituted through the ways that speakers and writers use language. As emphasized by Ahearn (2001), “linguistic resources can be used to exercise, attribute, or deny agency (p.120).” Evidence of such is provided by Graham (2003) who points out that Xavante Indians in Brazil demonstrate agency by portraying themselves as controllers or masters of history rather than victims or recipients of oppression. Similarly, Ahearn (2003) describes how the language used by writers of love letters in Nepal express individual agency over their romantic relationships (i.e., communicate love as product of their own agency rather than something that simply happened to them). McCollum (2002) reports that middle-class couples in the US present their professional careers as the result of agentive pursuit while romantic relations are presented as simply a matter of fate or chance. Influenced by this research, we conceive of read-alouds as social events wherein elementary teachers and students can demonstrate environmental agency (i.e., express an ability to transform their personal relations with the natural environment) through the provision of agentive verbal representations (utterances) concerning nature protection issues.

Such sociocultural model can provide science educators with a more sophisticated and clearer understanding of *environmental agency* -- as a socioculturally mediated capacity to transformatively interact with environmental social structures -- which can help us better understand the micro-processes of social reproduction and social transformation that can either enable or constrain teachers’ efforts at promoting student environmental awareness. Moreover, it highlights that environmental agency, like other forms of human agency, “extends beyond the skin” (Wertsch, Tulviste, & Hagstrom, 1993), that is, environmental agency is not located inside the mental processes of individuals. Environmentally protective behavior is not simply a matter of rational choice but rather it emerges in students’ sociocultural interactions with existing environmental social structures (i.e., prevailing human-environment relations), being mediated by semiotic tools such as *meta-agentive discourse* which Ahearn (2012) defines as
how people *talk about agency* – how they talk about their own actions and others’ actions, how they attribute responsibility for events, how they describe their own and others’ decision-making processes (p. 284).

Put differently, we consider environmental agency as potentially emerging from complex meaning-making activities (e.g., how teachers and students negotiate and attribute responsibility, credit, or blame for environmental events) that take place during read-alouds (see Figure 1 below). Environmental read-alouds, we believe, can provide elementary teachers with a pedagogical means to cope with societal reproductive loops as well as multiple and often conflicting motivations, beliefs, sociocultural norms, and sociopolitical factors that often underlie environmental issues.

[Insert Figure 1 here]

Dimensions of Agency

Our perspective takes into account multiple dimensions revealed by previous empirical and theoretical work on agency. The first dimension (*Agency--Passivity*) is concerned with the social positioning of environmental stakeholders, including the teacher, students, and absent others (e.g., humans, animals). In other words, it seeks to clarify the specific experiential roles (e.g., Agent, Recipient) intentionally or unintentionally played by the different parties involved in a particular environmental issue. Like Roth (2007), we make a theoretical distinction between agency and passivity. The former denotes a type of experiential role in which acting beings are said to have the capacity to act upon their surrounding environment. For instance, students have been shown to demonstrate *epistemic agency* (i.e., control and responsibility over ideas and knowledge-building processes) in computer-supported learning environments (Scardamalia, 2000; Scardamalia & Bereiter, 2006) as well as in inquiry-based science classrooms (Oliveira, Sadler & Suslak, 2007). Because beings in agentive roles are guided by intentions or goals, they are considered responsible for their actions. Passivity, on the other hand, refers to an experiential role of receptiveness, that is, beings who are simply susceptible to or affected by others' actions and to whom experiences or events simply happen. Passive recipients are simply objects of others' actions or impacted by the world (i.e., their experience is unplanned or unintentional), and for this reason have no responsibility over the experienced events.

The second dimension of agency is *Individuality—Collectivism* which is focused on the specific level of authorship and responsibility attributed to environmental activity (i.e., whether an individual person or social group is to be granted credit, blame, or responsibility over environmental action under consideration). Evidence of such dimension of agency has been provided by scholars of bureaucratic social activities in government organizations who have described how collective agency is constructed through bureaucratic processes that promote diffusion of individual authorship (i.e., prevent precise specification of authorship or attribution of responsibility) (Hull, 2003). Likewise, given the involvement of multiple stakeholders in environmental issues, authorship and responsibility over environmental damage or protection can remain attributed to an individual or it can evolve into a collective problem or effort during read-alouds. Put differently, the meaning-making processes that take place during read-alouds have the potential to diffuse individual environmental agency, thus leading to the emergence of collective or distributed environmental action.

The third and last dimension of agency is *Human--Nonhuman*. This dimension deals with the identities of agents which can vary from humans (real or fictitious) to a variety of nonhuman entities. As shown by a growing number of studies across several fields, attribution of agentive capacity is not limited to humans. Animals such as pets (Kortenkamp & Moore, 2009) and invasive exotic species (Hogan, 2002) are often attributed the capacity to act as agents of environmental destruction. And, as reported by Basso (1996), even the landscape itself has been shown to exercise agency by shaping the social conduct of Western Apache Indians. Such diversity of agents underscores the possibility of nonhuman environmental agency attribution.

Agency across School Subjects

In this section we review research that has examined agency across school subjects as varied as science, environmental studies, mathematics, and English as a Second Language.

Agency in Science and Environmental Education

Although the literature on environmental agency is remarkably limited, a few educational researchers have identified specific ways science teachers can encourage students to see themselves as agents of change. A salient theme in this literature is that providing students with opportunities to conduct their own inquiries into environmental issues and use their findings to take action is central to the creation of agents of change (Prain, 2011). Educators like Barratt Hacking, Barratt and Scott (2007) recommend engaging young people in local environmental research, while others emphasize the importance of youth environmental action to engender active forms of citizenship (Schusler, Krasny, Peters & Decker, 2009). Similarly, Aduriz-Bravo (2011) emphasizes that science teachers can empower students and foster a sense of agency by engaging them in argumentation and authentic acts of scientific inquiry wherein students are allowed to co-construct and apply their knowledge of the natural world.

It is also argued that helping students shift from being conversationally motivated to becoming agents of environmental change requires quality opportunities for dialoguing with stakeholders about their findings, and time to renegotiate their own understandings and actions. The importance of allowing young children to take a stance is emphasized by Blanchet-Cohen (2009) who emphasizes that students need to move beyond being able to talk about environmental issues to actually act. Similarly, Bigger, and Web (2010) argue that teachers should promote “engaged resisters” in the classroom by encouraging young people to overcome peer pressure and cultures that marginalize environmental activism.

Environmental educators have also emphasized the important role of reading in the promotion of student environmental agency. Reading environmental literature is seen as an effective means to promote intersubjectivity (McKenzie, 2008), help students politically understand the world, create dialogue about values and ethics, introduce different perspectives, consider alternative courses of action, and encourage students to reconsider their attitudes and concepts (Bigger, 2009). Likewise, Gruenewald (2008) argues that fictional literature can help increase the sophistication of students’ stances on the environment. By connecting with characters, plots, relationships, dilemmas and places, and being provided with time to re-evaluate and re-negotiate their own opinions, students can begin to question their stance on the environment and ultimately (re)position themselves.

Agency in Mathematics Education

Mathematics educators have also recognized the importance of agency. For instance, Boaler and Greeno (2000) argue that “the application of thought and development of agency should be an intrinsic part of any learning environment. Yet there is evidence that such practices are dismally represented for students in many mathematics classrooms (p. 171)”. Such state of affairs is underscored by Wagner (2007) who observes that students expect mathematical discourse to be devoid of human agency. When this view is challenged, students exercise their agency by rejecting the notion of human agency in mathematical language. Drawing upon the notion of *the dance of agency*, that is, the inter-play between human agency and the “agency of the discipline” (procedures of the discipline that dictate the practices of the individual causing the individual to surrender human agency), Wagner (2007) argues that “if we expect students to exercise their personal agency in mathematics, they will need to grow accustomed to expressing agency in their utterances (p. 48).” Similarly, Boaler (2003) reports that classroom practices that help students negotiate the dance of agency develops students’ personal agency.

Other studies have also examined practices in the mathematics classroom that foster student agency. Drawing upon Pickering’s (1995) work on agency, Boaler and Greeno (2003) report that, while didactic teaching practices position the discipline as the authority (i.e., gives it

all agency), discussion-based teaching practices position students as active agents who are responsible for constructing their own learning and accountable for the learning of their classmates. Brown (2009) point out that, when classroom practices lead to a shift from agency of the discipline to conceptual agency, students begin to develop a sense of agency in the classroom and view themselves as acting mathematicians. In a similar study, Cobb, Gresalfi, and Hodge (2009) describe how students see mathematics as a tool and feel obligated to themselves for leaning in classroom where they are afforded the opportunity to express agency. By contrast, in classrooms where students are restricted to exercising disciplinary agency, they see the teacher as the only authority and feel obligated to produce correct answers.

Mathematics educators with an interest in social justice have also focused on issues related to agency. Employing a post-structural definition of agency as “a subject’s power to negotiate the very sociocultural discourses that attempt to construct or constitute its identity (p. 10),” Stinson (2010) reports that, to be successful in mathematics, African American males, need to exercise agency by developing opposing discourses that enabled them to reject the notion that, by being successful in mathematics, they were “acting white.” Using a Freirean perspective, Gutstein (2007) discusses how mathematics instruction can help to develop social agency by structuring instruction in a way that students learn how to use mathematics as a tool to understand social injustices and enact change. He also suggests using problems students are familiar with and linking them to larger social issues to create opportunities for students to develop agency in mathematics. These researchers point out that helping students view themselves as agents of social change leads to the development of a sense of empowerment.

Agency in Language Education

In her study of the language learning afforded by asynchronous international computer-mediated communication, Basharina (2009) finds that student agency is revealed through the use of deep, strategic, or surface approaches to learning. Drawing upon Entwistle’s (2001) work on learning styles, she reports that *deep communicators* (intrinsically motivated individuals driven by an intention to understand) make use of multiple learning strategies such as consulting additional sources, self-correction, and writing their best. By contrast, students who use a *strategic approach* (driven by an intention to simply excel on assessment) invest just as much effort as it is necessary to satisfy the instructors. However, Norton & Toohey (2001) argue that such use of Entwistle’s classification may unjustly ascribe learners’ failure to achieve entirely to their low aptitude, lack of motivation, or inappropriate learning strategies, at the same time overlooking contextual factors such as possible marginalization from a community of practice, insufficient mentoring from an expert, or scant access to a learning community. To avoid this, researchers need to consider two aspects: the affordances and constraints of a learning environment as well as students’ agency.

Several studies highlight that developing a sense of agency is a very important part of learning to communicate in a second language. Wassel, Hawrylak, and LaVan’s (2010) study of English Language Learners (ELL’s) in urban high schools reveals that specific classroom structures can affect students’ agency, that is, their ability to access relevant resources necessary for meeting their learning and social needs. Such structures include various resources such as space and time, and a schema of caring. Poor instructional practices, lack of empathy for students’ experiences, diminished access to the curriculum constitute roadblocks that can hinder students’ learning. Pinnow (2011) discuss the role of multimodal fluency in establishing agency in the second language classroom. Adopting a concept of *investment* (Pierce, 1995), McKay and Wong (1996) relate Mandarin-speaking students’ discourses and identities to their exercise of

agency in terms of their positioning in relations of power both in the school and American society. Chang and Strauss (2010) underscore the need for academic supervisors to foster ELL students' agency during their thesis writing. Using the notion of agency, these authors provide evidence that, through the adoption of specific practices, teachers create social structures in their classrooms that can either empower or inhibit ELL students' sense of agency.

Methodological Design

In this study, we adopt a case study methodology to thoroughly examine the phenomenon of *environmental agency* in the context of read-alouds. Our methodological choice was informed by Yin (2009) who posits that a case study design should be utilized when one needs to understand a real-life phenomenon in depth (in the present case *agency*) and when such understanding encompasses important contextual conditions highly relevant to the phenomenon of study. This is precisely the goal of this exploratory paper which relies mainly on descriptive data systematically collected through open-ended research methods (video-recorded observations) and analyzed inductively to build a naturalistic (Lincoln & Guba, 1985) and phenomenological (Merriam, 1998) account of elementary teachers' and students' meta-agentive discourse. To achieve this goal, we qualitatively explored each of three cases (distinct teacher read-aloud sessions) separately. Such methodological approach allowed us to dedicate a fair amount of attention to each teacher's read-aloud and her interaction with the students discussing the environmental books. As emphasized by Patton (2002), "the analyst's first and foremost responsibility consists of doing justice to each individual case. All else depends on that...[as a result] each case study in a report stands alone, allowing the reader to understand the case as a unique, holistic entity (p. 449, 450)." This approach enabled us to conduct an in-depth exploration of participants' first-hand experience of the phenomenon at hand (i.e., environmental agency) without interfering with teachers' oral literacy practices.

It should be noted that this study does not aim at making generalizations beyond the three cases that are discussed herein. Focusing on several discreet "information-rich" cases enabled our thorough analyses, not for generalizing beyond the case, but for understanding the complexity of each case (Creswell, 2007). This is in line with Yin's (2009) argument that in analytical generalization through case studies "the investigator is striving to generalize a particular set of results to some broader theory (p. 43)," not a larger sample like in the quantitative paradigm.

We embarked on this study with a view to examining the discursive practices of elementary teachers and their students in read-alouds that also encompassed discussions of environmental issues. According to Patton (2002), a unit of analysis in case studies is usually determined during the design stage and becomes the basis for purposeful sampling. Accordingly, on analyzing transcripts of all participant teachers we selected those read-alouds where teacher-student agentive discourse revealed an interesting dynamic. Such initial findings were considered during our systematic peer-checking sessions and only after unanimous agreement became a unit of thorough analyses.

Participants

Using an Albany-area listserv, a survey of science read-aloud practices was sent to elementary teachers in upstate New York. The survey was composed of a series of open-ended questions that asked for demographic information such as years of teaching experience, teacher preparation, school and classroom settings, as well as pedagogical information concerning

teachers' read-aloud practices including frequency of their science read-alouds, book selection criteria, books commonly read aloud, strategies used to incorporate read-alouds into science instruction, and strategies adopted to ensure science learning during read-alouds. From the pool of respondents, elementary teachers who regularly performed science read-alouds were recruited to be video-recorded while facilitating a science read-aloud session in their classroom. While participation in the project was voluntary, we sought to select teachers that had a wide range of teaching experiences (novices and veterans) and taught in a variety of instructional settings (urban, suburban, and rural areas) and grade levels (1 through 6).

Initial inspection of the resulting corpus of video-recorded data revealed several environmental read-alouds with high degrees of teacher-student interactivity. More specifically, these teachers repeatedly interrupted their aloud reading of the text for short periods of time to facilitate whole-class discussions about environmental issues in the children's books. This interactive reading practice is consistent with the notion of *collaborative, dialogically-oriented read-alouds* which Pappas, Varelas, Barry and Rife (2002) describe as

read-alouds [that] allow for the voices of both children and the teacher in this process. Participants relate, imagine, clarify, validate, encourage, try to make sense, turn to their own and others' experiences to understand the world and to reveal themselves within it (p. 473).

These environmental read-alouds became the central focal point of our analysis, being adopted by three teachers -- Carol, Susan, and Andrea -- from different elementary schools. All teacher names were changed for this study to ensure confidentiality. Further, the choice of the books for read-alouds was not influenced by the researchers in any manner; all the books were selected by the participating teachers on their own accord.

With seventeen years of experience, Carol taught fifth grade to seventeen students at a suburban school. Carol indicated that often read recent science trade books, newspapers, and Internet articles to improve her students' ability to decode and comprehend texts, engage students in science topics such as Earth's climate, and to inform students about current issues related to science. Carol was video-recorded while reading the book *The Wolves Are Back* (George & Minor, 2008). A description of the contents of this book can be found on Table 1.

Susan had thirteen years of experience and taught a group of twelve fourth-graders at a suburban school. For her video-recorded read-aloud she selected the book *Why the Ice Caps are Melting?: The Dangers of Global Warming* (Rockwell & Meisel, 2006). For a description of this book, see Table 1. Susan read aloud on a daily basis, a practice aimed at engaging and informing her students about current topics relevant to their lives, especially environmental issues.

Andrea had nine years of teaching experience and taught a group of second-grade students at an urban school. She read nonfictional and colorful books aloud 2-3 times a week as a means "to spark discussion and investigation" and to introduce topics to which her students could relate. For this study, Andrea chose to read aloud the book *Polar Bears in Danger* (Edwards & Johnson, 2008). For a description of this book, see Table 1.

[Insert Table 1 here]

Data Collection

Our data set comprised mainly of a digitally captured corpus of video-recordings of classroom observations of each teacher performing a science read-aloud. The video-recordings, which took place during the 2009-2010 school year, were captured with a digital camcorder

focused mainly on the teacher. All video-recordings were transcribed in full (see Appendix for transcription conventions) and their content examined to determine how teachers and students communicated agency over environmental issues under deliberation.

Data Analysis

Our analysis of elementary teachers' and students' meta-agentive discourse during environmental read-alouds was guided by a theoretical framework that we developed based on the above literature review and our previous empirical work (Oliveira, Akerson, & Oldfield, *in press*; Oliveira, Colak, & Akerson, 2009). As can be seen on Figure 2, our framework conceives of environmental meta-agentive discourse as having two important focal points (each represented as a separate and orthogonal axis). The first focal point (Agent-Action-Recipient) is concerned with identifying the beings or entities under consideration. In other words, it seeks to clarify the types of agents taking environmental actions (e.g., humans, animals) as well as the types recipients being environmentally affected (e.g., animals, inanimate elements of nature). Also pertinent to this first focal point is whether the beings or entities involved are real, imaginary, individuals, or collectives. The second focal point (Intentions-Action-Outcomes) is focused on what the beings or entities under consideration have done or will do (i.e., the specific environmental actions taken) as well as the intentions (e.g., nature protection, financial gain) and outcomes (e.g., beneficial or harmful) of their environmental actions.

[Insert Figure 2 here]

As part of the above analysis, we constructed visual representations of environmental agency in read-aloud discourse. Construction of these visual representations entailed systematic adoption of several symbolic elements which we use to represent specific aspects of agential cognition as revealed by our review of the scholarly literature. For instance, Venn diagrams are used to represent *the human relationship with nature* (Kahn, 1999) as two separate, yet overlapping worlds. Such representational choice is consistent with psychological research showing that central to human cognitive and social development is the gradual recognition of the *differentness or other-ness* of the natural world (e.g., animals) as nonhuman and hence distinct from the human self (Kellert, 2002; Myers & Saunders, 2002; Shepard, 1996; Sobel, 1993). It is also reflective of philosophical stances on modern science as based on a separation of human from nature (Orr, 2002) as well as Myers and Saunders' (2002) argument that "animals [and nature more broadly] may be social others to us with whom we [people] can form relationships (p. 154)." Clip art images are used to identify the main agents and recipients of environmental actions considered within each read-aloud discussion. Solid arrows are used to represent agentive environmental action wherein an agent (identified as the cause and the one responsible for such action) produces outcomes that directly and proximally affect others (recipients), that is, *events with a single proximal cause* (Chiu et al., 2000; Choi et al., 2003). Dotted arrows are used to represent *ripple effects* which Maddux and Yuki (2006) define as "downstream effects of actions and events, particularly those effects that are relatively indirect and distally related to the focal event... [wherein] attention is directed toward the broader context and toward the interrelationships among individuals and events (p. 671)." As such, solid and dotted arrows allow us to distinguish between *intentional action* (motivated by an intention or goal) from *accidental action* (with unintended effects or consequences) (Dorfman, 2004; Filipovic, 2007; Slobin & Bocaz, 1988).

Findings

In this section, we describe the observed patterns of agential attribution in each environmental read-aloud.

The Wolves Are Back

While the book focused primarily on the ecological relationships between wolves and other animals native to Yellowstone Park, classroom discussion centered on the human-wolf relation. During this discussion, Carol and her students constructed two distinct types of agential relations, namely human as agents of ecological balance (symbolized by solid arrow 1 on Figure 3) and wolves as agents of unhappiness (symbolized by solid arrow 2 on Figure 3). These are described and illustrated below.

[Insert Figure 3 here]

Humans as Agents of Balance. This particular agency emerged at the onset of the whole-class discussion that followed Carol's aloud reading of the book. Carol began this discussion by quickly summarizing the book and then prompting students to share their interpretations and to comment on the book. The following exchange ensued:

Carol: They [people] removed the wolves, and eventually... the wolves were brought back into our country from Canada... the sparrows came back once the wolves came back because they [sparrows] had the grasses that they needed for their food and for their nests, and before, they didn't because of the elk... so this page is sort of summarizing... how the balance in Yellowstone is back again and things are flourishing again. That's the end... so tell me, what do you think Jean Craighead George [author] wants you to take away from reading this book?

Student: Taking one animal away is taking many animals away.

Carol: Ok, very good. So there's a balance to be kept, isn't there? And when you [humans] take away one species, it can affect the balance of the area of all the other animals, birds, insects, and so forth.

Throughout the above discussion, humans are portrayed as the agents responsible first for the removal and later for the return of the wolves (recipients of both actions) to Yellowstone Park. As the discussion unfolds, the second environmental action is then described as having a positive environmental impact on the park's ecosystem, leading to a considerable reduction in the overgrown elk population (a direct beneficial outcome) which in turn causes "sparrows to have grasses needed for food and nests" and "things to flourish again" (indirect beneficial outcomes). As result, humans are constructed as external causal *agents of ecological (im)balance*, that is, organisms that, although not part of the park's natural ecosystem, have the power or capacity to restore the dynamic state of equilibrium that naturally exists in the population size, food supply and shelter available to a group of interdependent animals within a natural ecosystem such as Yellowstone. Such agential construction of humans does not take into account intentionality as no consideration is given to whether restoration of ecological balance was actually intended by those who decided to bring the wolves back to Yellowstone or just an accidental outcome of such environmental action, which is described in the book as simply due to visitors' yearning for the wolves' howling and public outcry in face of evidence of wolves' non-aggressive behavior toward humans.

Wolves as Agents of Unhappiness. A different type of agency emerged toward the end of the whole-class discussion when Carol encouraged students to recognize that different human groups may have different perspectives or opinions about the return of the wolves to Yellowstone Park by humans:

Carol: Do you think anybody is unhappy that the wolves are back? Do you think some people are not too happy? What people might not be too happy that the wolves are back? What kind of animals do wolves sometimes kill that people might be concerned about? How about ranchers? What kind of animals do they have that the wolves might attack?

Student: Like cows.

Carol: Like cows. Yeah, exactly.

Student: Maybe horses?

Carol: Maybe horses. Sheep.

As shown above, Carol encourages students to consider the same environmental action (returning the wolves to Yellowstone) from the perspective of “unhappy” humans. To do so, she prompts students to recognize that the wolves’ return can lead to the attack of livestock such as cows, horses, and sheep (a direct harmful outcome) which in turn can make interested humans such as ranchers unhappy (indirect harmful outcome). As a result, wolves are constructed as direct agents of attacks against domesticated animals as well as indirect agents of human unhappiness. Once again, intentionality of those involved (ranchers, visitors, rangers, park directors, and wolfs) is not addressed, that is, whether such attacks constitute accidental and unintended events is not taken up as a topic of discussion.

Why Are the Ice Caps Melting?

The aloud-reading and discussion of this book centered on the human relationship with Earth’s atmosphere. Discursively encoded in this read-aloud were two different types of agency, namely humans as agents of atmospheric imbalance (symbolized by solid arrow 1 on Figure 4) and humans as agents of environmental mitigation (symbolized by solid arrow 2 on Figure 4). These are described and illustrated below.

[Insert Figure 4 here]

Humans as Agents of Imbalance. This first type of human agency emerged throughout the read-aloud when Susan and students repeatedly interspersed aloud reading with comments and short exchanges wherein humans were invariably ascribed the role of causal agents of harmful action to the environment such as pollution and deforestation:

Susan: Are we doing good things or bad things to our Earth right now?

Students: Bad things, bad things

Susan: Some bad things...we have a lot of people living on Earth, don’t we? Yeah, lots. And we’re not all necessarily thinking about what’s best for thing for Earth, we’re thinking about what’s easier for us, I’m guilty of it, and I’m sure all of you are, we think about what’s easier for us or us to do and use, not the Earth... today these forests are being cut down to make lumber for houses and other building and wood pulp for paper...

Students: My dad cuts down trees [inaudible].

Susan: Last year [we] talked about South America, so you are well aware of the Amazon and the trees being cut down.

As underscored above, a sense of collectivistic agency pervades the above exchanges wherein the teacher herself, students and even their parents are attributed shared responsibility and blame for the “bad things” (harmful environmental outcomes) befalling upon the planet

Earth at large (recipient). While the book itself focused mainly on describing distal and indirect consequences of varied types of human action (e.g., how driving cars leads to the thickening of the greenhouse gas layer which in turn leads to warmer global temperatures which then leads to glacier melting which finally leads to flooding), Susan facilitated discussions more focused on identifying the agents causing global warming. This shift in attention toward agents who might be considered “culprits” has been shown to have important implications for how much people are inclined to blame others (Fausey et al., 2010). By admitting to her own share of responsibility over Earth’s atmospheric imbalance and encouraging students to acknowledge theirs, Susan discouraged students from simply “blaming others” and instead recognize that they also shared responsibility over the rippling effects of global warming, which are often felt halfway around the globe. As a result, agentivity over atmospheric imbalance is constructed as a morally wrong environmental outcome that can be distally and indirectly blamed on humans in general irrespective of their intentionality (not explicitly considered in the above discussions).

Humans as Agents of Mitigation. This second type of human agency emerged toward the end of the read-aloud when attention shifted away from harmful human activity causing atmospheric imbalance to environmentally responsible action that the students themselves could take to mitigate the problem of global warming:

Susan: What can you and I do to help? We can plant trees. We can stop using aerosol spray and use pump sprays instead. We can buy appliances that are designed to use less energy and tell us that by the seal pasted on them. We can walk or bicycle to places that aren’t far away. We can write letters at home and at school to representatives in Congress, telling them that we think global warming matters. So you think we can try that possibly?

Students: Say um, that you just keep planting trees, isn’t it still going to get warmer since we’re all living, isn’t it just gonna get warmer but warmer slowly?

Susan: As long as we’re maybe slowing the effect down, we’re helping. We’re just a small part of the big Earth, but any little bit will help.

As underlined above, Susan identifies herself and the students as agents with the capacity of “planting trees,” an environment action meant “to help” with the problem of global warming (intended beneficial outcome). However, in their reactive comments, students appear to deny or question this agency Susan attributes to them by pointing out that the action “planting trees” will not directly and proximally cause the outcome “elimination of global warming” as implied by Susan and the book. It is important to note that, unlike the previous account of environmentally harmful action (described as broad and complex causal attributions with indirect and distal consequences to the atmospheric balance and global nature), the environmentally responsible action of planting trees is framed as a direct and proximal causality, which students appear to recognize to a certain extent as being simplistic. Instead of elaborating on the rippling effects of such beneficial action to Earth’s climatic system (e.g., contributing to the reduction of CO₂ in the greenhouse layer), Susan immediately redefines the intended outcome “helping” as “slowing down a little” (as opposed to “completely eliminating”) global warming. Put differently, while causation of global warming is problematized in terms of anthropogenic imbalance of the Earth’s atmosphere, prevention is simplified and reduced to isolated and uncoordinated acts of mitigation such as planting a few trees.

Polar Bears in Danger

This read-aloud centered on the relationship between humans and polar bears in the Arctic. In it, three different forms of collective agentive expression were verbalized by Andrea and her students: humans as indirect agents of endangerment (solid arrow 1 on Figure 5), humans agents of prevention (solid arrow 2 on Figure 5), and humans as indirect agents of endangerment (solid arrow 3 on Figure 5).

[Insert Figure 5 here]

Humans as Agents of Endangerment. Throughout this read-aloud, humans were repeatedly identified as active agents whose actions posed a threat or danger to the survival of polar bears (both directly and indirectly). Direct endangerment originated from practices such as hunting, whereas indirect endangerment was associated with anthropogenic global warming. While the book focused mainly polar bears in nature (interactions with cubs and seals in the wild), classroom discussion centered on the human-bear relationship:

Andrea: They have one enemy, who do you think that enemy is of the polar bear?

Student: A hunter.

Andrea: A hunter, man is the only danger to the polar bear [reading] people. In the past, polar bears were hunted for their meat and for their fur. In more recent times, hunters went after them for sport. People like to shoot things... perhaps the greatest danger to polar bears comes from global warming... If the world's temperature gets warmer, what's one of the dangers for polar bears?

Student: The polar bears will get too hot

Andrea: The polar bears will get too hot and die.

As can be seen above, humans are identified as the sole agent actively responsible for environmental action leading to the death of polar bears (recipients). Such harmful outcome is produced directly by means of the intentional activity of hunting, which is depicted as serving varied purposes such as providing food ("for their meat"), clothing ("for their fur"), or simply entertainment ("for sport... people like to shoot things"). Another anthropogenic source of polar bears' lethal demise is global warming which, like in the previous read-aloud, is described in the book as being distally and indirectly caused by humans through environmentally detrimental action (e.g., overconsumption of electricity, and clearing of forests) with a series of rippling effects, including the thickening of the greenhouse gas layer which produces warmer global temperatures that lead to the melting of the ice in the Arctic which then negatively impact the polar bears' ability to feed, "forcing" them to eat fish and berries and to "go near people's homes" (instead of hunting seals in the wild). Unlike the wolves in the first read-aloud, polar bears are not attributed agency over their "invasion" of the human world (as agents of endangerment to humans) which is instead depicted as simply a rippling effect of anthropogenic global warming for which humans themselves are responsible, not the polar bears.

Humans as Agents of Prevention. This third and last type of human agency was limited to the very end of the read-aloud when attention shifted away from how global warming negatively impacted polar bears to environmentally responsible action that the students themselves could take to stop or prevent the problem of global warming:

Andrea: What's one way you can help prevent that? One way?

Student: Umm, if I'm not using my TV, I turn it off

Andrea: Ok, so you shut your TV off.

Students are identified agents with the capacity of actively addressing the problem of global warming through the environmental action such as saving energy (“turning the TV off”). However, this time the intended beneficial outcome is to prevent or stop global warming (as opposed to partial mitigation). Put differently, “helping” is now defined as making a contribution toward the goal of “completely eliminating” global warming (as opposed to “slowing it down a little”) through a collective effort. Two other noticeable differences are the absence of agentic denial by students and the unemployment of the notion of “balance.” Nonetheless, the environmentally responsible action of shutting the TV off is once again reduced to a direct and proximal causality with unelaborated rippling effects (e.g., contributing to the reduction of CO₂ in the greenhouse layer). Like mitigation, prevention of global warming is simplified and reduced to a few environmental acts largely disconnected from the Earth’s climatic system.

Discussion

In this section we draw theoretical and empirical connections between our findings and the existing scholarly literature.

Human Agency

As described above, across the read-alouds, humans were simultaneously attributed negative agentic roles (agents of endangerment and imbalance) and positive agentic roles (agents of prevention, mitigation, and balance). Such seemingly contradictory patterns of agentic attribution suggest an inherent tension between morally negative and positive human agency with regard to environmental action. On one hand, human action was constructed as being driven by selfish human intentions or goals (e.g., eliminating animals to avoid financial loss, polluting for personal convenience, and killing animals for fun) that led to negative outcomes (e.g., loss of preserved wilderness, flooding, and animal attacks) affecting not only nature but also other humans. On the other hand, human acts were depicted as being altruistically motivated, that is, aimed at producing unselfish outcomes such as restoring wilderness for park visitors, avoiding flooding, and preventing animal attacks to humans.

Such tension is consistent with philosophical and theoretical arguments recently made by computer scientists who have emphasized the centrality of conflicting goals or intentions to human *moral agency*. As Wallach and Allen (2009) write,

A central feature of the human experience as moral agents is that people frequently feel poised between acting selfishly and acting altruistically. People feel the pull in both directions and this tension sets up the possibility of freedom – the equal freedom to do the wrong thing or the right thing (p. 61)

It is precisely this sort of moral agency that teachers appeared to foster by describing the ripple effects of environmentally irresponsible action back to other humans while reading-aloud. By focusing on the harm being distally and indirectly caused to other humans, students were encouraged to recognize the wrongness of such selfish environmental action. For instance, presumably unintentional acts such as leaving the TV on were portrayed as wrong for (indirectly and distally) causing polar bear attacks to humans in the Arctic. Such portrayals served to improve students’ ability to assess the moral significance of seemingly insignificant and routine acts, thus fostering their sense of moral agency as individuals capable of doing the right thing for the sake of other human beings (i.e., altruistic reasons).

The above patterns of agential attribution to humans are aligned with US educational documents underscoring the need for science learners to develop *climate literacy* which,

according to the US Global Change Research Program, includes the following essential concepts or principles: (1) Earth's climate varies over time and space driven by natural and manmade processes; (2) human activities are having an impact on the climate system; and (3) climate change will affect the Earth system and human society (USGCRP, 2009). Similarly, the current version of the benchmarks for science literacy (AAAS, 2009) emphasize the need for students to learn that "the Earth's climates have changed in the past, are currently changing, and are expected to change in the future, primarily due to changes in the amount of light reaching places on the earth and the composition of the atmosphere. The burning of fossil fuels in the last century has increased the amount of greenhouse gases in the atmosphere, which has contributed to Earth's warming" (Ch. 4: The Physical Setting, Sec. B: The Earth, Grades 9-12). Crucial for preparing learners to effectively engage in environmental decision making and take preventive, adaptive, and mitigating action against atmospheric environmental challenges, these agentic understandings were constructed during two of the examined read-alouds (*Why Are the Ice Caps Melting?* and *Polar Bears in Danger*).

Global climate change is among a number of issues facing science and society that remain challenging to teach (especially to younger students) due to their interdisciplinary abstracted nature and sheer scope. Teachers have adopted a range of strategies in an attempt to make the concepts that underlie global climate change more accessible to students, including collaborations with scientists and inquiry-based investigation (Hedley, et al., 2009), scientific argumentation (Golden et al., 2012), culturally congruent place-based instruction (Roehrig et al., 2012), experiential or immersion learning (Higgins, 2009), STS approaches emphasizing interactions among Science, Technology and Society (Solomon & Aikenhead, 1994;) and socioscientific approaches emphasizing the role of an informed citizenship in public policy (Sadler, 2004; Sadler, Barab & Scott, 2007; Sadler, Chambers, & Zeidler, 2004; Zeidler, Walker, Ackett, & Simmons, 2002). Adopted mainly at the secondary level, these approaches emphasize the importance of student engagement as well as the relevance of the subject matter to students' lived experiences. The present study makes a contribution to this literature by identifying read-alouds as having a similar potential to enhance students' climate understandings at the elementary-school level, thus laying the foundation for climate literacy as defined in current educational documents.

Animal Agency

Another interesting finding was the differential patterns of agency attribution to wild animals such as wolves and polar bears. It was particularly noticeable to us that, while the returned wolves at Yellowstone Park were constructed as intentional (human-like) agents when they crossed over into the human world to kill livestock in nearby farms, polar bears in the Arctic were denied any form of agency when they approached people's home in search for food. Put differently, wolves were held responsible for their killing of livestock and the resulting unhappiness of ranchers, whereas polar bears were not attributed any sort of accountability for placing people at risk.

Such differences in agential attribution by elementary teachers and students suggest an emphasis on external aspects of agency when it comes to making sense of wild animals' behavior or action. As emphasized by several philosophers and theorists, the notion of agency presupposes the possibility of freedom of choice as well as the ability to overcome external constraints (Kant, 1949) or opposing environmental forces (Heider, 1958; Morris et al., 2001). To qualify as an agent responsible for a given course of action, a being must be able to choose

among multiple options as well as be able to counter environmental forces. A similar point is made by a number of computer scientists who emphasized the importance of taking into account degree of freedom in considerations of moral agency (Dennett, 2003; von Foerster, 1992). As Wallach and Allen (2009) write, “maximization of choice is central to moral agency (p.62)” From this perspective, it can be argued that elementary teachers and students’ attribution of agency to the wolves was likely related to an underlying perception of wolves’ freedom in making their kills – the wolves had the option of killing wild animals such as elk but instead chose to attack livestock, thus being to a certain degree morally responsible for such acts. By contrast, polar bears’ approach of human homes was conceived as a ripple effect, a distal and indirect consequence of the environmental constraints of global warming (e.g., inability to hunt seals), for which humans themselves were responsible as causal agents. Such reduced freedom of choice explains the apparent lack of agential attribution to polar bears during read-alouds.

At a cultural level, the above finding suggests differences in values toward polar bears and wolves. As emphasized by Kellert (1996; 2002), depending on their cultural background, people can develop different *values of nature* (i.e., tendencies to associate or affiliate with nature in certain ways). These values play a central role in shaping the human relationship with nature and can be shaped by social representations (Lopez-Facal & Jiménez-Aleixandre, 2009; Simonneaux & Simonneaux, 2009) and cultural images (Melson, 2001) to which children are exposed. For instance, cultural images such as the “Big Bad Wolf” (in children’s stories) and “starving polar bears” (in public service announcements) figure prominently in American culture provide people with vilified social representations of wolves and victimized social representations of polar bears. Such cultural background can affect people’s personal values and reasoning about socioscientific issues involving wolves (Jorde & Morke, 2007) and bears (Simonneaux & Simonneaux, 2009). Moreover, current psychological research (Fausey et al., 2010; Fausey & Boroditsky, 2010) shows that linguistic cues to agency in the description of events have serious consequences for people’s perception and memory of events (as accidental versus intentional) and how much people blame and punish others. Therefore, our finding underscores the need for environmental educators to carefully consider the particular values of animals being reinforced or challenged through implicit agentic communication during read-alouds as this may inadvertently shape students’ tendency to blame or punish certain animals such as wolves.

The Balance of Nature

A common theme across all three environmental read-alouds was the “balance of nature,” a notion repeatedly used as a justification for environmental conservation. In *The Wolves Are Back*, humans were portrayed as restoring ecological balance to Yellowstone through the reintroduction of wolves. Likewise, both *Why the Ice Caps are Melting?* and *Polar Bears in Danger* focused on humans’ role in altering the environment and causing global warming, as well as the need for humans to intervene to discontinue the damage being caused. However, the extent of human intervention differed in these two read-alouds. In *Why the Ice Caps are Melting?*, it was suggested that humans could only mitigate the damage being done to the environment, whereas in *Polar Bears in Danger* it was proposed that humans could prevent such damage and restore the balance of nature to its pre-human state.

Such finding is consistent with previous research revealing the popularity of the *balance of nature* in environmental conservation arguments. However, use of such metaphorical notion has been criticized by researchers such as Ladle and Gillson (2009) who argue that the *balance*

of nature metaphor is problematic because it provides a simplistic and static representation of ecological systems, which does not reflect the complexity and instability of real ecosystems. Zimmerman and Cuddington (2007) note that science students do not have a fixed definition for the balance of nature, are unable to make a distinction between the concept and its causes, and often perceive the balance of nature as a real phenomenon rather than a metaphoric or poetic description of ecological systems. Similarly, in the three read-alouds examined in this study, discussions of the balance of nature evoked a definition of balance as equilibrium. However, none of the read-alouds made a clear distinction between the notion of balance and its cause. It seemed clear from the discussions that humans could affect the balance of nature, either through absence of disturbance (*The Wolves Are Back*) or direct disturbance either positive or negative (*Why the Ice Caps are Melting?* and *Polar Bears in Danger*), but the balance of nature was treated as inherent to ecosystems (i.e., its cause remained unknown). As the above research shows, although the *balance of nature* metaphor can be helpful, this metaphor can also be problematic for teaching about the environment. Such potential, we believe, underscores the need for elementary teachers to reflect more carefully and critically about their metaphorical choices, and consider more dynamic alternatives such as the *flux of nature* (Ladle & Gibson, 2009) and the *tipping point* (Gladwell, 2000).

Agency as Rational Causality

Another important outcome of our exploratory examination of elementary teachers' and students' meta-agentive discourse was the emergence of different forms of environmental causality or *causal models* (Grotzer & Perkins, 2000) across the two read-alouds on the topic of global warming (*Why Are the Ice Caps Melting?* and *Polar Bears in Danger*). As indicated above, anthropogenic causation of global warming was constructed as distal and indirect chains of cause and effect (i.e., sophisticated sequences of ripple effects), whereas its mitigation and prevention assumed the form of simple and unidirectional causative links (direct and proximal causality). Such finding underscores the rational dimension of agency (as causality), being consistent with Lemke's (1990) semantic perspective on agency as being grammatically expressed in science talk as a logical relationship of transitivity between an *Agent* (an entity that performs, causes, or instigates an action) and a *Process* (the performed action).

The above finding suggests a potentially problematic pattern of asymmetric causal reasoning. Previous research has shown that simplified causal models can lead to oversimplified interpretations of complex systems and thus fostering student misconceptions (Grotzer & Mittlefehdt, 2012). As Grotzer and Perkins (2000) write, "while simplified [causal] models may work for many aspects of explanation in our lives, they can also distort the scientific information to the point where parts of the causal story are lost or misconstrued (p.3)." Moreover, students have been previously shown to commonly overlook long-term and indirect consequences of ecological actions and decisions (Hogan, 2002) and often lack the complex system thinking skills needed to infer nonlinear and indirect forms of causality (cyclic, domino, mutual, probabilistic, emergent, etc.) within ecosystems (Grotzer & Basca, 2003). More specifically, difficulty in understanding global warming has been attributed to people's *reductive biases* (Feltovich, Spiro, & Coulson, 1993) such as their tendency to overlook processes with multiple, decentralized, non-obvious, and cumulative causes that involve temporal delays, spatial gaps, and no intentional agency (Grotzer & Lincoln, 2007). Therefore, it can be argued that elementary teachers need to give more careful and critical consideration to the practice of providing students with simplified

causal models of human mitigation and prevention of global warming during environmental read-alouds

Agency as Emotionality

Our findings also illuminate sociocultural aspects of environmental agency such as emotionality. Such emotional dimension was particularly apparent in the visual and textual design of the three books selected by the teachers for their read-alouds. *The Wolves Are Back* contained naturalistic descriptions and scenes (canvas-like paintings of the landscape) meant to inspire and encourage students to reflect about the beauty and wonders of nature at Yellowstone park. In sharp contrast, both *Why Are the Ice Caps Melting?* and *Polar Bears in Danger* included mainly cartoonish representations of nature, scientific inscriptions (diagrams), and expository/factual texts designed to inform students about the destruction and suffering being caused by humans on wild animals, fellow human beings, and the planet at large.

The above differences suggest distinct emotion-based approaches to the development of student environmental agency. Aloud reading of *The Wolves Are Back* served to promote environmental agency by means of an inspirational environmental story designed to foster students' *emotional affinity to nature* (Kals, Schumacher, & Montada, 1999), that is, to encourage them to experience positive emotions such as love of nature, and freedom, safety and oneness with nature. Such positive emotional approach served to inspire students to become stewards of the delicate balance of nature (i.e., agents of environmental balance).

A remarkably different emotional approach was taken by the other two teachers during the other two read-alouds (*Why are the Ice Caps Melting?* and *Polar Bears in Danger*) which were aimed primarily at developing elementary students' environmental agency by means of instigating feelings of *emotional indignation* -- responsibility-related emotions such as self-blame due to insufficient nature protection by oneself, indignation about insufficient nature protection by others, and anger toward negatively evaluated nature-protective measures (Gigliotti, 1990; Kals et al., 1999). By promoting a sense of collective agency during whole-class discussions about ecological responsibility wherein students were positioned alongside the rest of humanity as agents of imbalance and endangerment, the teachers encouraged students to perceive themselves as part of the environmental problems under deliberation and hence experience negative emotions such as self-blame and guilt.

We began this paper by arguing that the existing scholarly literature suggests a tendency among environmental educators to analytically separate student rationality from emotion, and grant primacy to reasoning and argumentation while overlooking students' emotionality and emergent sense of environmental agency. This analytical disconnection between student reason and emotion presumes the educational preparation of "rational actors" whose environmental actions (thinking and decision-making) are treated as mostly *instrumental* rather than *expressive* (Parsons, 1951). However, such theoretical stance on the *mind* (Mead, 1938) is inconsistent with the empirical findings and theoretical arguments of a growing number of philosophers, social scientists, and computer scientists (Wallach & Allen, 2009). Neurological research shows that human rationality and decision-making are dependent on emotions, more specifically emotion centers of the brain (Damasio, 1994, 2003) and the biochemical mediation of emotions via peptides (Pert et al., 1985; Pert, 1995). Based on this neurological evidence, Capra (1996) argues that "human decisions are never completely rational but are always colored by emotions (p. 275)." A similar point is made by the sociologists Turner and Stats (2005), who state that "human rationality is [simply] not possible without emotion (p. 271)." From this perspective, the

widely accepted separation between emotionality and rationality is merely a historical artifact, and being emotional is not simply equivalent to being irrational. The present study sheds some light on this theoretical conundrum by highlighting how the construct of “agency” enables systematic analysis of both emotional and rational aspects of environmental classroom discussion, thus constituting a significant theoretical advancement in our present understanding of how the human relationship with nature is (re)shaped in instructional settings.

Limitations and Significance

It should be noted that the present study is limited in significant ways. One important limitation is that the collected data does not allow us to examine how the reported patterns of agential attribution affected students who participated in the environmental read-alouds (i.e., their ecological understandings, values, etc.). Such limitation can be easily overcome in future research through the use of environmental scale questionnaires such as the 2-MEV and NEP (Bogner & Wiseman, 2006; Dunlap, Van Liere, Mertig & Jones, 2000; Johnson & Manoli, 2003; Manoli, Johnson, & Dunlap, 2007) which can be used to systematically examine the relative degree of biocentrism and anthropocentrism in students’ relationship with nature (i.e., the extent to which students’ affiliation with nature reflect a view nature as having intrinsic value or merely serving their needs as humans) (Howe, Kahn, & Friedman, 1996; Kahn, 1999; Kahn, & Lourenco, 2002). The presented also has a fairly limited scope, focusing on aloud reading of only three environmental books by distinct teachers. Further research will be needed to determine the extent to which the reported patterns of agential attribution also occur with a larger assortment of children’s books and in different classroom settings.

Despite these limitations, we believe that the present study makes an important scholarly contribution to the science education literature. Its main significance is that it illuminates the need for environmental educators who set out to promote student agency to expand the focus of their instructional efforts beyond rational argumentation and reasoning around environmental dilemmas or socioscientific issues. Rather than simply adopting the linear process of “argumentation to action” typically assumed by predominant models of environmental education wherein agency is simply reduced to rationality (i.e., a matter of reason and logic), educators also need to take into account the complex emotional aspects of the human relationship with nature. Recent insights from the field of sociology of emotions can potentially help environmental educators to develop more sophisticated, theory-based understandings of *interpersonal emotion management* (Jasso, 1993), that is, an effective means to strategically manage or change the emotions felt by students in social situations centered on the environment. For instance, there is general consensus among sociologists that, like colors, human emotions can be classified into *primary* (the four universal emotions of happiness, fear, anger, and sadness) and *secondary* (emotions such as guilt, shame and pride which are derived from “mixing” primary ones) (Plutchik, 2002; Turner & Stets, 2005). Such new insights are likely to enable more systematic integration of rationality and emotionality, hence providing environmental educators with a powerful approach to effectively promote students’ sense of environmental agency and (re)shape their relationship with nature.

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