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Environmental Attitudes in Youth-Created Computer Games about Climate Change

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Abstract

This paper presents findings from case studies of two girls who designed games to teach other youth about climate change. Analysis of how their environmental attitudes shaped their design decisions, and on how game design changed their attitudes, offers a window on the relationship between the two. Implications for creating game design experiences aimed at learning science, particularly when the topic is as difficult and complex as climate change, are discussed.

Introduction

Initiatives that support youth to design games have increased with the advent of graphical programming environments such as Alice and Scratch. Game design can be effective in teaching about domain-specific content, e.g., systems thinking (Puttick et al., 2014; Salen, 2007), mathematics (Tucker-Raymond et al, 2012), and model-building (Repenning, Webb & Ioannidou, 2010). Games provide a unique environment within which players can interact with a dynamic system, as well as feel empowered by seeing immediate consequences of their actions in a game world.

In this paper, we focus on exploring the agentic engagement of designing games, rather than playing them, in the context of the issue of climate change. We designed a summer workshop for young people to explore the affordances of game design with respect to learning about climate change. Elsewhere, we report findings that show that game design productively supports learning (Puttick et al., 2014; Puttick & Tucker-Raymond, 2016). In the present study, we focus on how environmental attitudes are manifested in the kinds of games participants designed, and how their attitudes were changed by game design.

Theoretical Framework

Why design games about climate change? Psychological studies of people's engagement with climate change and its implications suggest that the complexity, scale, and abstractness of the concepts and issues concerned discourage people from dwelling on the meaning of climate change for themselves (Swim et al, 2009). Realizations about the reality of climate change, and the feelings of powerlessness

that result, can be overwhelming (e.g., Hicks & Holden, 2007; Threadgold, 2012), particularly for young people, in part because their sphere of influence to effect change is limited. However, research has shown that taking action can mitigate a sense of paralysis (Clayton & Brook, 2005). We conjectured that creating games designed to teach others about climate change would provide young people with an opportunity to take action (Leiserowitz, 2005; Swim et al., 2009). In addition, since climate change is an issue of ethical complexity, this has been modeled and explored with games (Harteveld & Drachen, 2015; Wu & Lee, 2015). Given this, games have a place in exploring contemporary ethical issues.

Relevant insights from psychology. Interest in identity has risen as the impacts of human pressures on the environment become more visible, and researchers seek to understand what psychological factors might be implicated in environmental preservation (Crompton & Kasser, 2009; Clayton & Brook, 2005). While defining and investigating identity broadly is expansive, the relatively new field of conservation psychology has focused on those attitudes and behaviors that constitute part of an "environmental identity" in particular (Clayton, 2003), and that support environmental sustainability (Saunders, 2003). Relevant constructs from this field include attitudes towards: a) nature and the environment, b) sustainability, c) the importance of raising awareness through education, and d) possible paths to action.

Environmental attitudes, particularly related to valuing the environment and feelings of affinity with nature (Muller, Kals & Pansa, 2009; Bang, Medin & Atran, 2007), also have a moral dimension. Britner (2002) investigated the moral reasoning of urban middle school students with respect to the environment, framing moral reasoning in terms of "care" and "justice" moral orientations. Care orientations emphasize connections among people and attempt to fulfill the needs of all concerned, and are expressed more frequently by girls (Gilligan, 1993). Britner writes, "It is this contextual and connected view of moral problems and their solutions that Gilligan described as an ethic of care" (p. 1). On the other hand, a "justice" moral orientation, more frequently expressed by boys, emphasizes abstract and formal moral reasoning (Kohlberg, 1984). Britner found that students' responses were strongly oriented toward care reasoning, with a slightly higher care orientation among African American students and among girls. Szagun & Mesenholl (1993), in an empirical study of West German adolescents' ethical concern about nature, note that their respondents all rated harm done to an ecosystem as immoral.

Researchers have also begun to investigate the ways in which young people cope with the psychological impact of global environmental problems. For example, Ojala (2013) investigated the strategies that Swedish adolescents use to cope with the facts of climate change. She found that problem-focused coping – in which people confront the problem by looking for information or talking to others about what to do – was positively related to felt efficacy and to pro-environmental behavior.

One of the primary goals of the workshop was for designers to focus on game design as a tool to learn about climate change, and embrace the task as a form of taking action. However, we also conjectured that environmental attitudes might be a formative influence in shaping the kinds of games that participants would design. Therefore, we also surveyed and coded for environmental attitudes and values, and attitudes about behavior.

Research Design and Methods

In this study, we ask: 1) In what ways are participants' environmental attitudes expressed in the games

they designed to teach others about climate change? 2) Do participants' attitudes change as a result of designing a game to teach others?

Participants

Participants were recruited through outreach and flyers to school districts, parent listservs and other youth organizations through which the authors had contacts. The five participants were in 6th, 7th, and 8th grades, each from a school in a different municipality. Three were African American, one was European American, and one was Nepali American. Two had no prior experience with game design, one had begun 8 months previously, and two had more than a year's familiarity. When asked what drew them to the workshop, three of the five participants listed learning or using programming; the other two attended because it was school vacation that week. Participants and their parents consented to participation in the research. Participant pseudonyms are used.

Workshop

The program was a four-day intensive game design and climate change workshop for five middle school participants, all girls, held in July 2014. Participants used Scratch (scratch.mit.edu) to create games based on a systems perspective on climate change. The program ran six hours each day for four days. There were laptop computers for each student and a room computer with a projector. The two researchers acted as facilitators – Puttick led discussions on climate change, while Tucker-Raymond provided support for game design and programming.

Participants were told that they were to think about choices people make when deciding to use certain kinds of energy sources, to connect these to climate change, and to create a game that would help other young people make these connections. On day 1, they were introduced to Scratch, completed a group concept mapping activity to see connections about climate systems, viewed an informational video about climate change, and visited a local wetlands reserve to observe and discuss possible connections from components of the reserve to climate change. On days 2-4, designers worked alone to design their games, user tested their games in pairs, elaborated the concept map as a group, and ended the workshop with presentations to family and community members.

Data Sources

Interviews: We conducted individual semi-structured interviews of 35-40 min at the end of Day 3 to capture designers' attunements to game design affordances and understand their goals in relation to their design choices. We asked them: (i) How does your game work? (ii) How is your game related to global warming? (iii) Where did the idea for your game come from?*Surveys:* Girls completed a brief pre/post survey to provide demographic data and level of Scratch experience. It also included items on attitudes, values and general knowledge of climate change, constructed on a 5-point Likert scale. Where available, items were adapted from validated instruments (e.g., Leeming & Dwyer, 1995; Leiserowitz et al., 2011). We tested the survey with a focus group of four middle schoolers, and adapted the vocabulary of some items. Content was validated by expert review. *Games:* Versions of the games were archived at the end

of each day. *Participant-observer notes:* Researcher notes provided additional data and directions for analysis.

Data Analysis

Transcripts from interviews and conversations, and logs of video data were imported into Dedoose, a web application for organizing and analyzing mixed methods research data. We generated a set of pre-determined codes based on principles in our theoretical framework (Miles and Huberman 1994) to categorize our data along dimensions prescribed by the categories shown in Table 1. At the same time, we paid attention to new patterns and ideas from the participants as they emerged and integrated them with the existing scheme (Creswell, 2009). This approach allowed us to apply both a priori and emergent coding categories to the data. For instance, we started with broad categories of analyses we had intended the survey to capture, such as socio-ecological connections as they related to values, psychology, and behavior. Reading through the transcripts allowed us to create more nuanced categories such as between behavior that mitigates or contributes to climate change.

1. Attitudes about the environment	
Positive or negative attitudes about own relationship to the environment	Example: I think that happiness is a priority but it shouldn't be one if it involves hurting the environment

2. Socio-ecological/human connections	
Ethics/morals associated with contributing to climate change	Example: We all need to help because the environment is getting worse and we have to step up and do something
Psychological impacts of climate change	Example: It's kind of nerve-wracking; The people are trading the safety of the planet for their own comfort
Human actions that contribute to climate change	Example: I don't think people realize how much pollution, from the stuff that you buy, can actually make
Human actions that can mitigate climate change	Example: Planting trees is an easy way to help decrease carbon dioxide

Table 1: Coding categories. (See Puttick & Tucker-Raymond, 2016 for details.)

Results

All of the participants chose to focus on the causes and mitigating factors of climate change. Overall, games incorporated methods to sequester carbon dioxide and methane, two important greenhouse gases. All of the participants expressed their hope that the games would have an impact on players' knowledge and potentially also on their future behavior. We discuss two cases: that of Ciara, one of the three African Americans attending the workshop, and Lane, the European American. We focus on these two cases because both girls expressed strong environmental attitudes yet produced different games

Given her 2 years' experience with Scratch, Ciara was able to create three games during the workshop. All focused on socio-ecological connections and helping players learn about actions that can be taken to mitigate greenhouse gas levels. The first game involved capture of methane ("farts") from cows (Figure 1, L), and the second was a quiz about sources and sink for carbon, which ended with an information screen that explained the connection between trash incineration and greenhouse gases. The third game asked the player to sort items into trash or recycling (Figure 1, R).

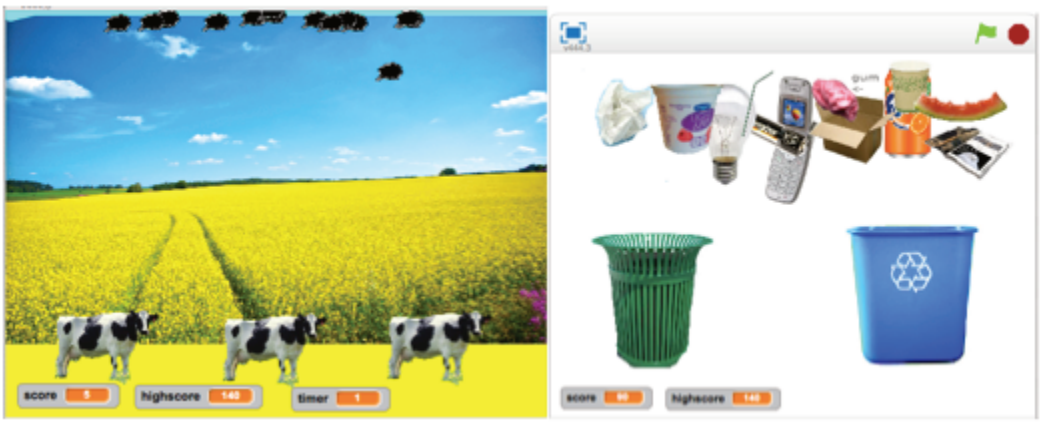

Figure 1. Screenshots of two of Ciara's three games.

Coming into the workshop, Ciara had expressed contradictory views about the reality of climate change. On the survey, she agreed with two statements, "Global warming isn't happening" and also "Humans can reduce global warming and will do so successfully." However, when asked in the interview what she had learned, she said:

Puttick: OK so you learned a bunch of new stuff. Can you just give me one example?

Ciara: I learned about carbon sinks and methane and how the environment is really in drastic need of help […] I thought we weren't as endangered as we are right now. Because it [the video] talked about these are the hottest years we've ever, in recorded history and stuff like that so I hope people learn that they need to do their part to help the environment because we all need to help because the environment is getting worse and we have to step up and do something.

She now agreed that global warming is happening, and, in light of this, she went from disagreeing to agreeing with the survey statement that she would soon talk with people other than her family about climate change. Intention to act is an important factor in determining whether or not individuals are likely to move from expressing an environmental attitude (Clayton, 2005) to actually taking action (Thogersen & Olander, 2003). For Ciara, a first step in taking action meant educating others in her game about something important she had learned – the role of carbon sinks in potentially mitigating climate change.

More important, this change in attitude directly informed the design of her second two games. Her goal became to teach others what to do to "do their part to help the environment." We conjecture that the desire to help out that she expressed in the interview was motivated in part by learning about climate change, but also in part by a positive environmental attitude. Coming in to the workshop, she had prioritized protecting the environment, disagreeing with two pre-survey statements: "Both the environment and comfort are important, but my comfort should come first," (item #3) and "The highest priority should be given to the happiness of people living right now in my area, even if it hurts the environment here or anywhere else" (item #4).

Ciara appeared to show a care orientation, like the African Americans and girls in Britner's (2002) study on moral reasoning. Evidence can be seen in the quote cited above in which Ciara framed the need for action as an imperative, "we all need to help because the environment is getting worse and

we have to step up and do something." Ciara also included others in the need for action, by positioning "people [who] learn that they need to do their part" within the collective "we," and aligns herself with this community as well. In the same study, Britner noted that interdependence and connection are both central to the ethic of care (Britner, 2002).

Ciara elaborated on her attitude towards the environment when we interviewed her about her response to survey item 3 (see above):

Ciara: I was going to say neutral on number 3, because some people actually do find comfort in the environment, and I happen to be kind of like that, like I find comfort you know, going outside.

This attitude relates to an aesthetic choice she made for the background in her first game. She selected a bright yellow field with a sunny blue sky in the background. Color theorists report that yellow can be a color associated with happiness and optimism (Elliott, Fairchild & Franklin, 2015), although the perception is culturally and contextually based, and evidence of the psychological impact of colors is still limited. Nevertheless, one could argue that such a landscape reflects one in which "comfort" could be derived. In addition, it could also be seen to reflect her optimistic attitudes for change, and to reinforce the larger mitigation theme of all her games.

Lane also came into the workshop exhibiting positive environmental attitudes. She responded "very true" to the item that asked about whether she talked with parents about environmental problems, and to the item that she would soon talk with people other than her family about climate change. In addition, she "agree(d) very much" that protecting the environment was more important than saving money, convenience or comfort. She also agreed very much that sacrificing "happiness" by foregoing an activity that used energy was important because that would protect the environment.

Lane created a game that asked the player to use plants to sequester carbon dioxide. It was designed to teach players that plants have different uptake capacities, and that their capacity had limits (Fig. 2). Lane's positive attitude towards and feelings of affinity with nature were directly evident in her depictions of plants and animals in her game. There one can see birds, a rabbit, and snails, as well as at least five types of carefully chosen or drawn plants (and one carrot).

Figure 2. Screenshot of Lane's game.

She was most concerned about the looming impacts of climate change. She responded "a moderate amount" on a survey item about how much she thought global warming would harm her personally, and "in 10 years" on an item about when global warming would begin to harm people in the U.S. Unprompted, she expressed her anxiety about societal inaction multiple times during the week. In her depiction of the humans in her game, it could be argued that these expressed fears about societal inaction are emphasized. We see a smiling couple that is literally sitting on the fence, a girl lying and relaxing in the foreground, and happy children playing in the background. The scene is predominantly one of inaction, in spite of the looming cloud of carbon dioxide above them. In addition, the little creature that is behind the "Buy Time" stand bears witness to the irony that, while the player can sacrifice points to buy time in the game, humankind has little time left to buy.

In the interview, she lamented the attitudes of people who choose to ignore the impact of their own behavior on the planet:

Lane: the people are […] living their lives not ignorant but in willing ignorance. It makes the planet worse […] they could talk about global warming a lot and someone could overhear it, someone could get a spark in their head to do something…

She also remained certain at the end of the workshop that humans would not address climate change, agreeing very much that "people aren't willing to change their behavior, so we're not going to [address climate change]." Lane's ethic of care, evident in her game and documented in this survey response, align both with the findings of Britner (2002) who found a strong ethic of care in girls, and of Szagun & Mesenholl (1993), whose respondents rated harm done to an ecosystem as immoral.

Lane's pro- environmental attitudes strengthened pre- to post-survey. From feeling neutral in the pre-survey, she expressed an intent to act in the post-survey by agreeing very much with the statement, "I will talk with people other than my family about how to help with environmental problems soon." Could

the experience of designing a game about climate change have empowered Lane to contemplate taking further action in talking to others about what to do? This finding would align with Ojala's finding (2013) that adolescents concerned about climate change can confront the problem by talking to others about what to do, and that this was positively related to felt efficacy.

Discussion

Our intent in this paper was to investigate the environmental attitudes of young people in relation to the design choices they make while creating games about climate change, and to investigate whether or not participants' attitudes changed as a result of designing a game.

The games designed by both participants show the influence of their attitudes in different ways. Ciara's positive environmental attitude was reflected in the appearance of the environment in her first game. In addition, although she was unsure about the reality of climate change at the beginning of the workshop, she appears to have left in possession of this understanding, and with the motivation to inspire environmental action in others. This change was reflected in the design of her second and third games, which were designed to teach others how to take action. On the other hand, Lane came to the workshop with a strong awareness of climate change. She expressed a strong sense of affinity with the environment, but also expressed a sense that humans were not going to address it. Her attitudes about nature and about humans appeared to be reflected in the design of her game too.

We took these values and attitudes into account as part of our theoretical framework for the workshop design in several ways. Features of the program included a connection to nature (Muller, Kals & Pansa, 2009; Bang, Medin & Atran, 2007) – we conducted a half-day field trip to a local natural area to observe nature, and to talk about possible connections of the area to climate change. By framing the design task as one in which the goal for participants was to educate others about climate change, we incorporated a path towards action (Leiserowitz, 2005; Swim et al., 2009). We also stressed those individual and societal behaviors and investments that might make a difference in mitigating climate change (Clayton, 2003; Saunders, 2003.

Implications

Limitations to the findings of our study include the small number of participants, the short time the girls had to engage with the topic, and the limited time they had in which to explain their decisions in a naturalistic setting. Therefore, our findings can only show girls' attitudes in this unique context (Erickson, 1996). However, given that the attitudes of these two girls showed a clear impact on the types of games they designed, these results suggest that it is important to take into account the values and attitudes that participants bring to any game design experience, in particular when the topic at hand is the difficult and complex one of climate change. Attitudes are important for two reasons; i) they should guide the design of the experience, and ii) they should be taken into account when seeking to understand from a research perspective, the games that have been designed.

Several studies have reported that many young people feel worry and powerlessness about global problems, including climate change (e.g., Hicks & Holden, 2007; Threadgold, 2012). We agree with Ojala (2013), who states that teachers need to encourage students to verbalize their emotions about climate change. She states, " In order to counteract the negative affect related to cognitive problem-

focused strategies, teachers can help their pupils to find concrete actions concerning climate change and let them work together on these issues" (p. 2204).

The impact of environmental identity and attitudes towards the natural world, and more specifically, towards the impact of humans on global climate, would be a productive focus for future study. This will continue to be a focus of our own research into students' learning about climate change through game design, but also bears closer scrutiny in climate change education programs more generally.

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