

# MIDDLE SCHOOL STUDENTS AND CLIMATE CHANGE: ASSESSING ATTITUDES AND EMOTIONS

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## DEDICATION

Dedicated to my family, and all the families of the Earth (organic and inorganic)

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# ABSTRACT

## MIDDLE SCHOOL STUDENTS AND CLIMATE CHANGE: ASSESSING ATTITUDES AND EMOTIONS

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While it is common knowledge that the majority of American adults hold a variety of strong and polarized beliefs and attitudes about climate change, much less is known about how American youth are thinking and feeling about this topic. This information gap is significant, because attitudes and beliefs formed in childhood (particularly during early adolescence) have a profound impact on future behaviors. Feelings, emotional responses, matter for two reasons. One, emotions significantly influence the openness and ability to learn about the science of climate change. Two, once learned, the science of climate change itself can evoke strong and often distressing emotions. The more parents and teachers understand children's emotions and attitudes about climate change, the more effectively they will teach and guide them. This study assessed middle school students' reactions to watching an informational video about climate change via two pre and post video assessment tools, the Climate Change Attitude Survey (CCAS) and the Positive and Negative Affects Scale for Children (PANAS-C). On the PANAS-C, there was a significant increase in negative emotions after viewing the video ( $p < .001$ ). Similarly, on the CCAS, student's belief that climate change has a negative impact on humans was significantly greater after watching the video ( $p < .001$ ). Our remaining findings relied on qualitative data; we describe our observations of how a skilled adult (the classroom teacher) helped the students process their emotional reactions to exposure to information about the current climate crisis. Conclusions from this study can be used to develop and refine climate change curricula and teaching practices, as well as inform mental health professionals who work with middle school students.

## Introduction

“Kids fear global warming more than terrorism, car crashes, and cancer” (“Kids fear”, 2007). Despite this captivating sentence from an informal survey done by an education website for students K-12, the fact of the matter is that while it is widely known that the topic of climate change elicits strong and often polarized responses in American adults (Hornsey & Fielding, 2017), less rigorous attention has been paid to the reaction of American youth (Christensen & Knezek, 2015). This relative dearth of research is particularly significant since it is widely agreed that attitudes formed in early adolescence, a critical developmental period, shape future attitudes and behavior (Alwin & Krosnick, 1991). Closely related to the interest in attitude formation, there have been recent calls for more attention to emotion in the science classroom (Fortus, 2014). There is a growing body of literature that suggests that emotions, as well as beliefs and attitudes, rather than knowledge alone, are major factors not only in how students learn, but also in promoting students’ pro-environmental behavioral change (Pooley & O’Connor, 2000). This study a) assesses middle school students’ beliefs and attitudes about climate change, and whether viewing a relatively brief video regarding climate change might alter these beliefs and attitudes and b) assesses whether this video might evoke strong negative feelings in the students.

## Background

The image of science as a bastion of objectivity and an area of linear progress has undergone a huge transformation ever since the groundbreaking work of Thomas Kuhn (1962). Science, once thought to be the realm of pure intellect, is now appreciated as an aspect of human knowledge that can stir intense affect; once thought to be the product of unwavering objectivity, it is now regarded as a discipline pervaded by values and attitudes. We now know that scientists themselves are deeply affected by what they study. Indeed, scientists studying climate change have often been distraught over what they have concluded (Clayton, 2018, Head & Harado, 2017). However much the case that scientists, who are committed to the scientific method, are affected by what they find, it is even more the case for the general public, the consumers of science information, that they are disturbed by the findings on climate change (Hornsey & Fielding, 2017).

This altered view of science and scientists, in which the field and its practitioners are seen as saturated with affective and ideological commitments, has begun to seep into the realm of science education. Recently, there have been calls for more attention to emotion in the science classroom (Fortus, 2014). Typically, “academic emotions” discussed in educational literature have focused on such things as test taking anxiety and school phobias (Goetz, Frenzel, Hall, & Pekrun, 2008). Broughton, Sinatra and Nussbaum (2013) proposed that “academic emotions” should

also include “topic emotions”. For example, they examined the emotional reactions of elementary school students to learning about the reclassification of Pluto to a dwarf planet. Adults might be surprised to find that these elementary school students were very distressed to learn that Pluto had lost its planetary status. It would seem wise to take this distress into account when teaching about our solar system.

One would expect that climate change, more than most areas of science, would evoke strong “topic emotions.” Indeed, that would appear to be the case. Strife (2012), in his interviews with 10 to 12-year-old American children, found that 82% of them expressed negative emotion, significant feelings of fear, sadness, and anger, about the environment and climate change. In a recent 2019 poll conducted by the Washington Post and the Kaiser Family Foundation, 13 to 17-year-old teenagers expressed as much “fear” and “anger” around the scientific topic of climate change as they did about gun control (Kaplan & Guskin, 2019).

Children are exposed to the topic of climate change, whether or not it is taught in schools. In fact, students educated in the United States get more of their information about climate change from social media than from the classroom (Roberson & Barbosa, 2015). Either way, in the classroom or online, climate change evokes strong affect, i.e., climate change is powerful “topic emotion”. One would think that schools should have an important role to play in helping children process their negative “topic emotions” with respect to climate change. Yet, our educational system has been

something of a vacuum around these issues (Branch, et al. 2016, Cordero, 2008, Wise, 2010).

To clarify the distinction that we will rely on in this study, “topic emotions”, as previously stated, refers to the various emotions potentially elicited by a particular scientific topic (e.g., human reproduction, climate change, the planetary status of Pluto); whereas, the various emotions actually elicited in the classroom (whether or not one is teaching a scientific concept) are “in the moment” feelings. These “in the moment” feelings will be assessed in this study by the PANAS-C (see Instruments/Materials section). Importantly, the kind of emotion that one is being urged to pay attention to in the science classroom (e.g., by Fortus, 2014) is not necessarily the same as a “topic emotion”. Therefore, a student could have a very strong “topic emotion” to a subject but have very little emotion while learning about it. Consider sex. This “topic” would ordinarily elicit strong emotions, particularly among high school students. But if learning about sex in the classroom confines itself to matters of biology, then the process of learning about sex will likely elicit very little emotion (Tomas & Rigano, 2018)

Furthermore, there is a temporal difference between topic emotions and emotions generated in the classroom. Emotions generated in the classroom are more transient, whereas topic emotions are more extended in time. They might well be thought of as a component of an attitude. Attitudes are often regarded as having three



components, an affective, cognitive, and behavioral component. For example, Vaughan and Hogg (2005), in a standard social psychology textbook, define an attitude as a “*relatively enduring* organization of beliefs, feelings, and behavioral tendencies toward socially significant objects...[and] events...” [italics mine] (p. 150). In contrast with the more *relatively enduring* feeling (topic emotions) that are part of an attitude, this study was interested in whether, and to what extent, strong feeling might be created *in the moment* while learning about climate change in the classroom setting.

There has been much attention paid to the attitudes (and emotions) of adults in the United States in relation to environmental issues (Leiserowitz, Maybach, Roser-Renouf, Feinberg, & Howe, 2013), (Ballew et al., 2019), (Saad, 2017). However, much less has been done in this area with younger Americans (Christensen & Knezek, 2015). The Climate Change Attitude Survey (CCAS), which we will use in this study, is one of the few validated measures developed to research climate change attitudes and emotions in children (Christensen & Knezek, 2015). This relative dearth of research is particularly significant since it is widely agreed that attitudes formed in middle school, a critical developmental period, shape future attitudes and behavior (Alwin & Krosnick, 1991). This widely held view, that attitudes formed in middle school shape future attitudes and behavior, suggests that adolescent attitudes toward climate change are “relatively enduring”. Yet, adolescence is usually seen as a period of great turmoil, transition and neuroplasticity (Jensen, 2014). One of the purposes of this study was

to investigate whether adolescent attitudes toward climate change would be modified by exposure to a brief educational video in the classroom.

Hypotheses:

1. Exposure to a video about climate change will elicit strong negative emotions in middle school students
2. Exposure to a video about climate change will change student attitudes about climate change

## Methods

### **Participants/Pre-study Approvals**

The participants were eighth grade students enrolled in four sections of a Physical Science class at a suburban public middle school. An experienced science teacher was selected who was interested in the outcome of the project and who taught all four sections of Physical Science.

Given that the topic of climate change has become a highly controversial, politicized issue, we took the following steps to obtain cooperation from the school administration as well as the parents/guardians of the students. This project was reviewed and approved by the department chair, the school principal and the school district school board. The teacher sent out an email to all student parents/guardians two weeks before the study took place, explaining it in general terms and with an

invitation to contact her with any questions and concerns. Parents and guardians were also able to review the questionnaires if they wished and opt out of having their children participate. There were no requests to review the tests or discuss questions or concerns from the parents/guardians. This research project was granted an exempt status by the Institutional Review Board (IRB) of the University of Pennsylvania.

### **Instruments/Materials**

#### PANAS-C

The PANAS-C is a self-report measure containing twenty-seven items divided into “positive affects” (PA) and “negative affects” (NA). It is a well-established and validated scale and has been used in numerous studies (Hughes & Kendall, 2009). The affects designated as PA are somewhat idiosyncratic to this scale. For example, “surprised” is considered a PA. The reason for this is that the original intent of the scale was to distinguish anxiety from depression. Affects were to be differentiated on the basis of anxiety disorders having high PA and NA (Hughes & Kendall, 2009), while depression would only have high NA. When this scale has been applied in studies not involving differentiating anxiety from depression, a category of ‘neutral’ has been added (Tomkins, 1984). We will use the categorization of affects into “positive,” “negative,” and “neutral” as used by Tomkins (1984); he is arguably the foremost researcher in the area of affect theory.

For this study, eight items from the PANAS-C were selected. We limited the number of items on the advice of the teacher, who recommended making the survey-taking part of the class as brief as possible considering the attention span of youth. The items were chosen by the authors on the basis of likely relevance for the topic of climate change. The eight items selected from the PANAS-C consist of four “negative affects” (sad, frightened, mad, and disgusted), three “positive affects” (interested, excited, hopeful), and one “neutral” affect (surprised). For each of the eight items, the students were instructed to “indicate to what extent you are feeling this way right now” (see Appendix A). Each of the affects were rated on a 1 to 5 scale ranging from 1 (very slightly or not at all) to 5 (extremely).

## CCAS

The Climate Change Attitude Survey (CCAS) is a fifteen item self-report measure that is a well-established and validated measure of middle school student beliefs and intentions to enact positive environmental change (Chistensen and Knezek, 2015, p. 773). As with the PANAS-C, students rated each of the items on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). (The 15 items of the CCAS are listed in Appendix B). The items were intended to capture either a belief about, or an intention toward climate change. An example of ‘belief’ would be “human activities cause global climate change” and an example of ‘intention’ would be “things I do have no effect on the quality of the environment.” Clearly, there is

some ambiguity regarding this distinction between beliefs and intentions.

Nevertheless, the CCAS has been effectively factor analyzed into these two primary factors (Christensen and Knezek, 2015). ‘Belief’ and ‘Intention’ closely align with cognitive and behavioral components of an attitude, (Vaughan and Hogg, 2005). The CCAS may well reveal the ambiguity, if not confusion, surrounding the conceptual distinction between attitudes and affects. Attitudes are generally regarded as the more overarching term, both conceptually and temporally. The creators of the CCAS stated that they intended the survey “to fill a void in the measurement of middle school students’ *affective responses* to the environment and climate change” (Christensen and Knezek, 2015, p. 773).

Despite the stated intention of the CCAS to address all of the components of attitude, it would seem that the CCAS addresses the belief and behavioral tendency aspects of attitude well, but that the only “affect” covered in the CCAS is “interest”. Not one of the “negative” affects (sad, angry, despair, frightened) are addressed by the CCAS and these emotions are obviously possible, even likely, affective responses to confronting the reality of climate change. To address our perceived gap in assessment of affect, in this study, we assessed changes in such affective responses using the PANAS-C.

The video, “Causes and Effects of Climate Change,” was developed by National Geographic and deemed appropriate for viewing by children and people with little prior knowledge of climate change science. It is a three-minute, YouTube

video which was selected for its scientific content, engaging presentation and apolitical tone([https://www.youtube.com/watch?v=G4H1N\\_yXBiA](https://www.youtube.com/watch?v=G4H1N_yXBiA)).

## **Procedure**

The teacher began the class by introducing the researcher and explaining to the students that they have the opportunity to participate in a research study in collaboration with the University of Pennsylvania. While the teacher explained it was a research study involving science, she did not relay any information about the topic of the research, i.e. climate change. It was made clear that their participation was voluntary, and all results would be anonymous. She then instructed the students to open their laptop computer, which was provided to each student by the school and the Google form which included the surveys and video. The students completed the Google form in the following order: PANAS-C, CCAS, video viewing, CCAS, PANAS-C. The researcher was present throughout the process.

When all the students had completed the exercise, the teacher directed them into groups of four. The teacher then posed the following questions and issues, asking each group to work together on them. (a) What was their experience of taking the survey, e.g., Did they enjoy it? Did they learn something? Was it upsetting? (b) What would they want to further research about climate change? and (c) They were asked to determine at least one thing they could do today to help with the climate change problem. They were then given fifteen minutes to begin the research on that area.

While the students were engaged in small groups with these questions and issues, the teacher circulated amongst the groups. She answered questions that the students raised, and, on occasion would have all the groups stop their work while they considered particular questions that arose. For example, one student asked how he could determine whether the video was believable. The teacher then asked the entire class to consider how they might go about distinguishing fact from opinion.

The researcher observed the entirety of the activities and took anonymous, unstructured field notes. Students were not asked to identify a gender or ethnicity, however observations of class demographics were made during the study. Particular attention was paid to the social environment of the classroom (e.g., Are students isolated from each other? Are there cliques? Does the atmosphere seem relaxed or tense?). In addition to noting the quality of interactions between the students themselves, the relationship between the students and the teacher was also noted (e.g., Did the students seem relaxed around the teacher? Desire her approval? Were they cooperative with her?).

Levels of student engagement were noted (e.g., Did they seem interested? Bored?). Exact quotes of student responses were recorded by hand by the researcher with a focus on capturing comments that reflected students' emotions and attitudes about the topic of climate change. Exact quotes of the teacher's comments and questions to the class during the discussion section were recorded by hand as well. In particular, teacher responses to the student's affectively charged reactions were noted.

The researcher attempted to assess the impact her presence had on the class. Direct interaction with the researcher was limited to a few glances and smiles from students.

## Results

### Quantitative Data

The study took place on May 6th and May 9th, of 2019, prior to the COVID-19 pandemic. Ninety-one students agreed to participate and completed the questionnaires (PANAS-C and the CCAS) before and after watching the video. This was a 100% response rate. By observation, it was noted that the racial make-up was predominantly Caucasian with less than 10% Asian American and African American students.

#### PANAS-C

Before watching the video, most students, on the PANAS-C, endorsed the midpoint or higher on the scale for the most “positive” emotions (67 % for interested and 61% for hopeful); whereas on the four “negative” emotions (sad, frightened, mad, and disgusted), the majority of students chose the lowest possible rating--very slightly or not at all-- (ranging from a low of 67% for “sad” to a high of 82% for disgusted”). (See Appendix C (1). This was consistent with the researcher’s field notes, as this class of eighth grade students appeared to be a relatively happy group at the beginning of class on the day the video was to be presented. Pre-video, 20 students (22%) endorsed having little or no interest, 2 students (2%) endorsed ‘extremely or very’ for



disgusted and frightened. Whereas 4 students (4%) endorsed ‘extremely or very’ for mad.

Appendix C (2) shows the responses after the 3-minute video. Many more students were sad, frightened, mad, and disgusted, rating a 3 or above on the PANAS-C after viewing the video (See Table 1).

For example, only five students considered themselves disgusted (at 3 or above) before viewing the video, while 33 did so after seeing it. Nine students endorsed “frightened” before the video, while 37 did after the video. These gross observations are statistically significant. At the  $p < .001$  level of significance, there was a significant change after viewing the video. That is, all four negative affects as well as the neutral affect “surprised” intensified, and the positive affect, excited, significantly decreased.

**Table 1. Number of students who endorse a 3 or above on the PANAS-C in which a 1 = very slightly and a 5 = extremely**

	Pre PANAS-C	Post PANAS-C	P value
<b>Sad</b>	13	38	$p < .001$
<b>Frightened</b>	9	37	$p < .001$
<b>Mad</b>	18	32	$p < .001$
<b>Disgusted</b>	5	33	$p < .001$
<b>Excited</b>	46	27	$p < .001$
<b>Surprised</b>	26	48	$p < .001$

## CCAS

As described in the methods section, the CCAS assesses both beliefs about climate change and intentions to take positive action with regard to it. It is important to state at the outset that even before seeing the video, the majority of students “believed” in climate change. For example, 42% of the students endorsed a 5 (strongly agree) for the item “I believe our climate is changing” and approximately two thirds of the students (69%) endorsed a 4 or 5. Similarly, 54% of students endorse a 4 or 5 for the item “I am concerned about climate change”. Furthermore, two-thirds of the students believe in anthropogenic climate change (one-third endorsing 4 and one-third endorsing 5 in response to “Human activities cause global climate change”). The students were relatively interested in learning about climate change even before they were exposed to the video. Nearly 61% of the group endorsed a 4 or 5 on the item “Knowing about environmental problems and issues is important to me”. (See Appendix D (1).

Similarly, with respect to the intention factor (or the behavioral tendency component of the attitude toward climate change), the majority of students expressed interest in mitigating the causes and effects of climate change at the outset. In response to the statement “There is not much I can do that will help solve environmental problems”, 81% answered 1 or 2 (strongly disagreed). (See Appendix D (1).

Given these starting points, one would not expect that there would be much change after witnessing a three-minute video. For many of the students, there is no or little room to move in the predicted direction (i.e., toward more belief in climate change or a greater intention to do something about it). Nevertheless, despite these base rates, both the belief and intention factors on the CCAS displayed significant change at the  $p < .001$  level of significance (See Appendix D (2)).

Table 2 illustrates these findings with two paradigmatic items from the belief factor and two from the intention factor (see Appendix D (2) for results for the entire CCAS).

**Table 2.**

	Pre CCAS agree or strongly agree (4,5)	Post CCAS agree or strongly agree (4,5)	P value
<b>BELIEF:</b>			
Item 1: I believe our climate is changing	63	83	$p < .001$
Item 8: Climate change has a negative effect on our lives	53	73	$p < .001$
<b>INTENTION:</b>	Pre CCAS disagree or strongly disagree (1,2)	Post CCAS disagree or strongly disagree (1,2)	
Item 9: We cannot do anything to stop climate change	52	64	$p < .005$
Item 13: Things I do have no effect on the quality of the environment	56	74	$p < .001$

While the paired t-test results for both the PANAS-C and the CCAS were highly significant, it should be noted that many students did not change their before and after ratings at all on either measure. (See Appendix E(1) and Appendix E(2)). One would expect that student responses to the PANAS-C, which measures “in the moment” affect, would show more change at two separate times (i.e., pre-to post) than for the measure on attitudes, which are considered to be “relatively enduring.” This is, in fact, what we found. Approximately one third of the students did not change their before and after ratings on the PANAS-C. Whereas, on the CCAS, more than half the students did not change their ratings on eleven of the fifteen items (and, the other four, items approached that frequency, 44%, 47%, 47%, and 48%).

Of note, for the statement “most of the concerns about environmental problems have been exaggerated” 11 students endorsed this with a 4 response and 2 students with a 5 response before the video. After the video, 7 students endorsed this with a 4, and students with a 5. This suggests that not all students had a move in their attitudes in the same direction.

### **Qualitative Data**

With respect to the impact of the researcher on the students, the researcher had the sense that her presence, along with the novel project itself, infused the class with energy and excitement. In addition, the teacher struck this observer as exceptionally skilled and engaging.

In all four classes, the students entered the classroom noisily and with much conversation among each other and the teacher. It was obvious to the researcher that the students liked and respected the teacher and wanted her approval. There was a positive, upbeat quality to the atmosphere at the beginning of the class.

During the classroom discussion that followed viewing the video, the students' anxiety, fear and alarm were palpable. A sample of the students' comments follow, all of which demonstrate that the three-minute video was very stirring.

“Time’s running out!”

“We only have twenty years left.”

“Wait, we only have 5 years left?”

“That’s so scary”

“What about our kids?”

“Think about the polar bears dying.”

“When people are talking about the end of the world, I’m thinking about how will it actually happen. Like, will we literally implode? That just makes me trip!”

“I don’t have any feelings about it [global warming] ...well, I’m not sure...it kind of touches my heart.”

“Will global warming kill the earth or just the humans and the animals?”

“I’m going to walk outside right now and suck up all of the greenhouse gasses!”

“Maybe I’ll be president and fix this”

“The president doesn’t believe in climate change!”

One student commented that she thought the entire exercise was “a waste of time.” Other students disagreed, stating that their participation in this study was “cool”, “an honor”, and “important”. After hearing her peers’ responses, the first student amended her viewpoint to “good”.

In response to the students’ affectively charged reactions, the teacher demonstrated active listening (Rogers & Farson, 1957); circulating among the discussion groups and joining in, maintaining eye contact and nodding in response to student’s comments, asking open ended questions with an interested and calm vocal tone, reflecting back and paraphrasing students comments. For example, in response to a student who commented she was sad about what she was learning, the teacher nodded and reflected back to her “finding out about that made you sad”. More often, the teacher guided the students into specific scientific areas to research, asking them how they would go about finding answers to their questions. The researcher did not overhear any comments from students suggesting denial that climate change was occurring. The teacher ended the class by inviting the students to continue to think about one thing they could do today to help out with climate change. The researcher observed several students talking amongst themselves as they exited about reusable straws and one student asked the teacher if they could see her reusable straw. The teacher complied and several students clustered around commenting favorably about it and one student stated she was going to get one.

## Discussion

Highly significant differences ( $p < .001$ ) were observed pre- to post-viewing in student affects and attitudes. These changes in affects and attitudes support the researchers' hypotheses. For example, the negative affects as well as the neutral item 'surprised' changed significantly as compared to the positive affects. With respect to the attitude survey, the observed changes were in the direction of greater concern for the environment and greater intention to try to do something about climate change.

The fact that these coherent changes were statistically significant ( $p < .001$ ) for both validated instruments, the PANAS-C and the CCAS, is especially interesting considering the following three factors:

- (1) The intervention, i.e. the video itself, was very brief (three minutes) and selected because it is neither controversial nor inflammatory.
- (2) Our particular subjects were a relatively highly climate informed group to begin with. The general belief that climate change is occurring would limit the statistical power of changes in the direction of further agreement about the causes of climate change. Despite this 'ceiling effect', a neutral and brief video nevertheless provoked significant changes in affects and attitudes. It has been noted that adolescents are more concerned about climate change than their parents (Leizerowitc et al, 2019). Our students conform to this general pattern

in that they were highly climate informed to begin with; two thirds of the students believed in climate change before seeing the video.

- (3) The third reason that these results are striking has to do with the setting in which they took place. The classroom has rarely been the setting of climate attitude and emotion study. As noted earlier, students educated in the United States get more of their information about climate change from social media than from the classroom. It might be fair to suggest that social media can be a force for both good and evil, in which both valid (Castillo et al., 2011) and wildly inaccurate (Zubiaga et al., 2018) sources of information confusingly coexist. This is particularly concerning given the apparent credibility of the medium for the adolescent (O’Keefe & Clarke-Pearson, 2011). A humorous, yet also disturbing example of this point was observed by the researcher. The teacher asked the students how they might determine if the video expressed facts or opinions. One of the students replied, “It’s got to be true. It’s on YouTube!”. The fact that we obtained significant changes in attitude toward climate change in an American classroom setting is a hopeful reminder that, even in an area of study heavily influenced by social media, classroom instruction has an impact.

In addition to the results from the PANAS-C, the qualitative data confirmed that the video generated strong affect. A certain confusion in the students’ comments, presumably from being emotionally overwhelmed, was frequently evident. Recall



student comments such as: “When people are talking about the end of the world, I’m thinking about how will it actually happen. Like, will we literally implode? That just makes me trip!” Another student said, “I don’t have any feelings about it [global warming] ...well, I’m not sure... it kind of touches my heart.” Another student asked, “Will global warming kill the earth or just the humans and the animals?”

In response to powerful, possibly difficult to integrate affect, there was evidence of typical adolescent defensiveness. Of all the defenses, none was more evident, particularly among the boys, than eighth grade grandiosity. Recall the following examples from male students in the class: “I’m going to walk outside right now and suck up all of the greenhouse gasses!” Another said, “Maybe I’ll be president and fix this” to which yet another student retorted, “The president doesn’t believe in climate change!”

Clearly, climate change is an upsetting topic which can elicit strong negative affects in the classroom. Our study revealed that when such topics are taught in a graphic and relatable way, it is imperative that the teacher be someone who is skilled at helping children manage their emotions. The observer noted that the teacher did several effective things in this regard. In the first place, the teacher facilitated and encouraged the free expression of the students’ affective reactions to the video. She asked direct questions about how they felt; she remained calm and non-judgmental, further allowing students to open up; and, throughout, she expressed both verbally

and non-verbally (e.g., nodding in acknowledgment) interest in their emotional reactions.

The teacher also demonstrated a certain respect for the students, leaving room for them to respond to each other when someone became angry. For example, when the teacher asked the students what they thought of the study, one student said that she thought the video and the study was “a waste of time” (see Results section). The teacher remained calm and nonjudgmental in response to this student’s irritable and angry response (which perhaps covered over the student’s fear). Interestingly, other students disagreed, stating that their participation in this study was “cool”, “an honor”, and “important”. After hearing her peers’ responses, the first student amended her viewpoint to “good”. The teacher did not feel she had to “correct” this student. It should be noted that this example also illustrates the power of the peer group on the adolescent.

A third aspect of the teacher’s contribution was her ability to help channel the students’ negative affects (fear, sadness, anger, disgust). Lapses into nihilism were often redirected toward thinking about constructive action. It is important to note that this interest in constructive action was already latent in the students themselves as revealed by the CCAS. Indeed, as the significant difference pre- to post- indicate, the students felt significantly more inclined to take action about climate change after viewing the video. The teacher, by prompting the students, “What is one thing you could do today to help with climate change”, merely elicited those latent constructive

inclinations, thereby further moderating the students' distress and supporting their self-efficacy.

## Limitations of the Study

There were a number of limitations to this study. The subjects were suburban, almost entirely white, eighth grade students from a predominantly middle-class community. None of their parents expressed concern about the study before or after and it is unclear if this is due to the community attitude on the topic or trust of the teacher. Our findings are likely limited to this population. That is a serious limitation insofar as climate change affects poor children and children of color more than others (Lake, 2014). In addition, our teacher was particularly skilled at running the classroom, and in particular, she was able to handle students' strong emotional reactions. The outcomes might have been very different with a less skilled teacher. Finally, due to the constraints of the IRB, the researcher could not interview or ask follow-up questions, and was not permitted to audiotape. Because of these limitations, some comments were lost, while others remained unelaborated and therefore inscrutable. It would have been interesting to know where this group of students obtained their attitudes and emotions about climate change (friends, social media, family).

## Conclusion

Our study provides support for the idea that learning about climate change in the classroom setting is a highly affectively arousing event. Even a brief and politically neutral video was enough to significantly shift the affective tone in the classroom by observation and from the students' responses on the PANAS-C. It seemed clear that a skilled adult, such as the teacher of these pupils, played a vital role in helping them process their affective experience.

Furthermore, while attitudes are considered to signify relatively enduring beliefs and intentions, attitudes among middle school age adolescents may be much more malleable. These students' attitudes were significantly altered after viewing the video insofar as their belief in, and stated intention to do something about, climate change increased.

In line with recent trends in science education, our study indicates that climate science is not merely a natural science (Harker-Schuch, Bugge-Henriksen, 2013), and that education with respect to it is not merely a cognitive enterprise. The climate crisis may be a modern problem, but this basic principle of education is an ancient truth; "Educating the mind without educating the heart is no education at all" (Aristotle).

## Appendices

### Appendix A: Science Class Survey: modified from the PANAS-C (Hughes & Kendall, 2009)

This survey consists of a number of words that describe different feelings and emotions. Read each item and then choose the appropriate answer next to that word. Please indicate to what extent you are feeling this way right now.

Very slightly            1    2    3    4    5 Extremely

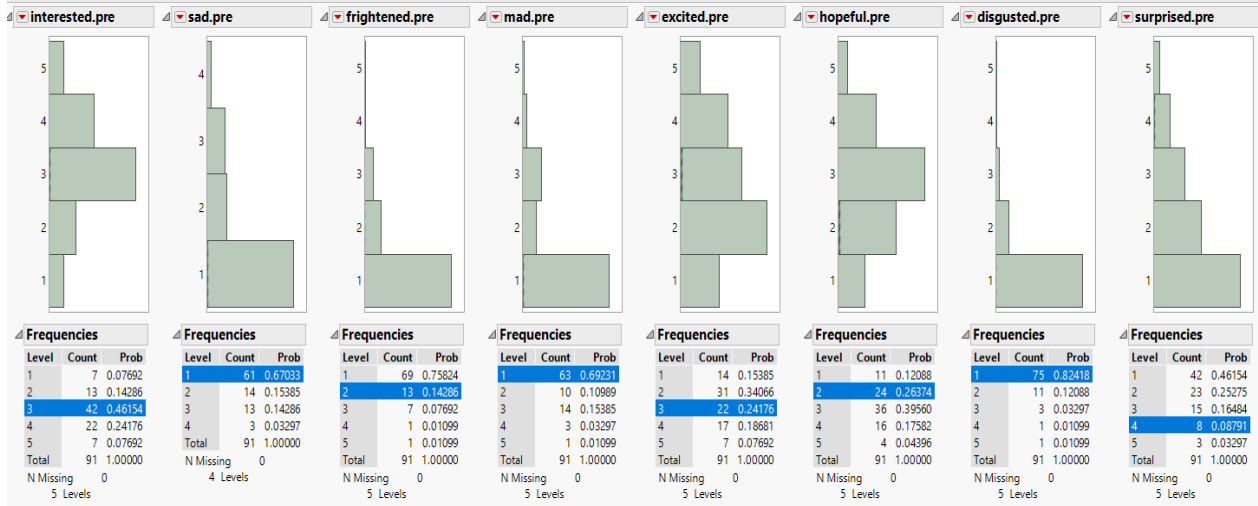
Interested  
Sad  
Frightened  
Mad  
Excited  
Hopeful  
Disgusted  
Surprised

### Appendix B: The Climate Change Attitude Survey. (Christianson & Knezek, 2015)

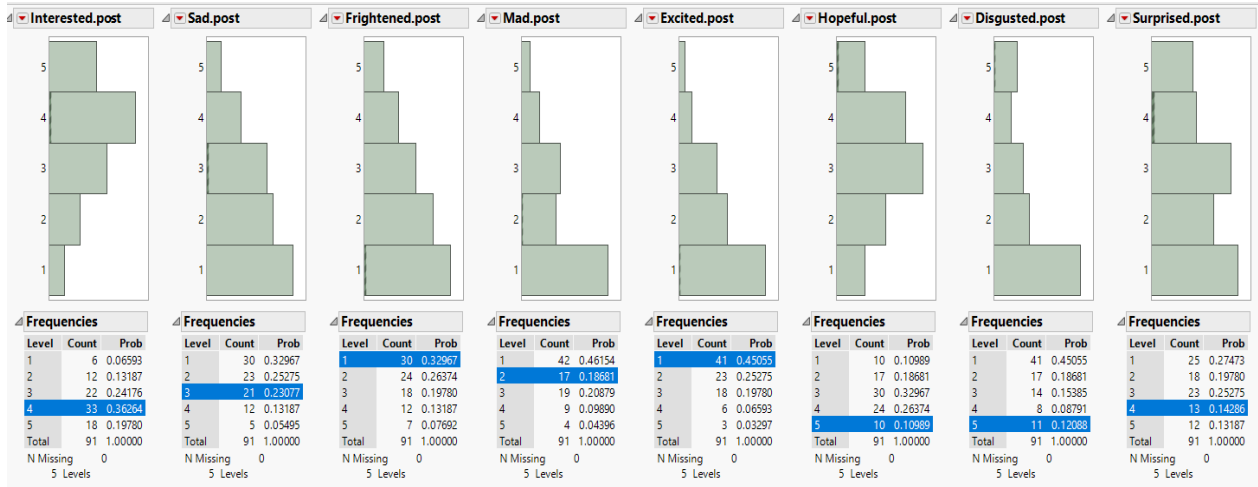
Strongly disagree    1    2    3    4    5 Strongly agree

1. I believe our climate is changing.
2. I am concerned about global climate change
3. I believe there is evidence of global climate change.
4. Global climate change will impact our environment in the next 10 years.
5. Global climate change will impact future generations.
6. The actions of individuals can make a positive difference in global climate change.
7. Human activities cause climate change.
8. Climate change has a negative effect on our lives.
9. We cannot do anything to stop climate change.
10. I can do my part to make the world a better place for future generations.
11. Knowing about environmental problems and issues is important to me.
12. I think most of the concerns about environmental problems have been exaggerated.
13. Things I do have no effect on the quality of the environment.
14. It is a waste of time to work to solve environmental problems.
15. There is not much I can do that will help solve environmental problems.

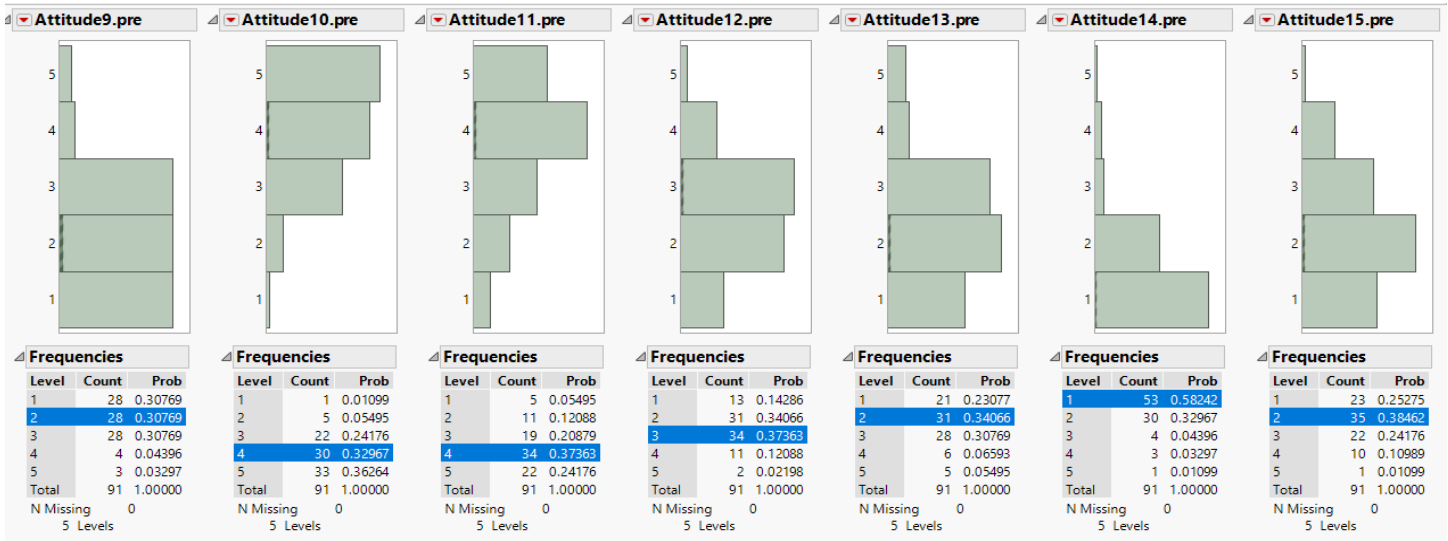
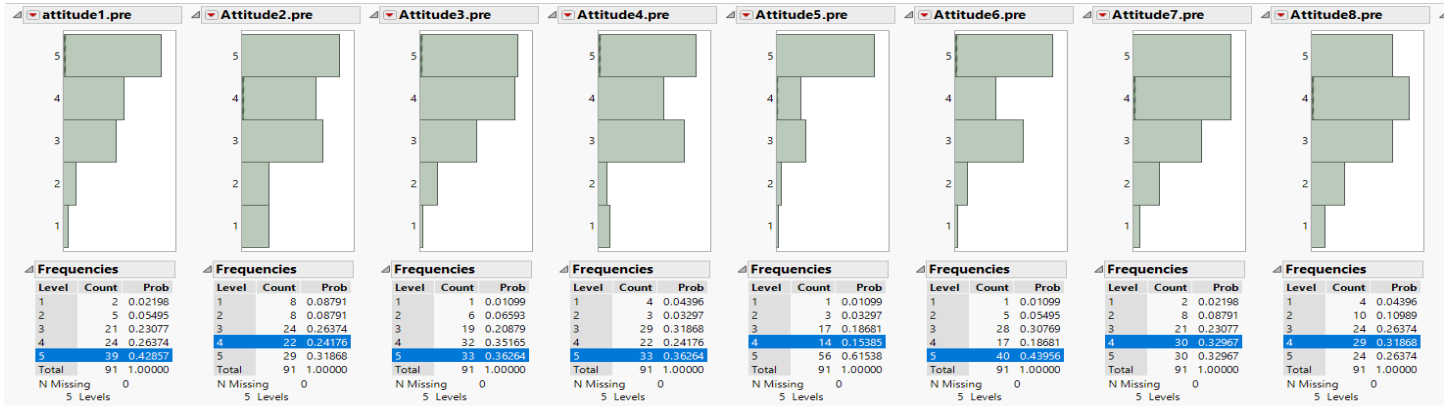
## Appendix C (1)



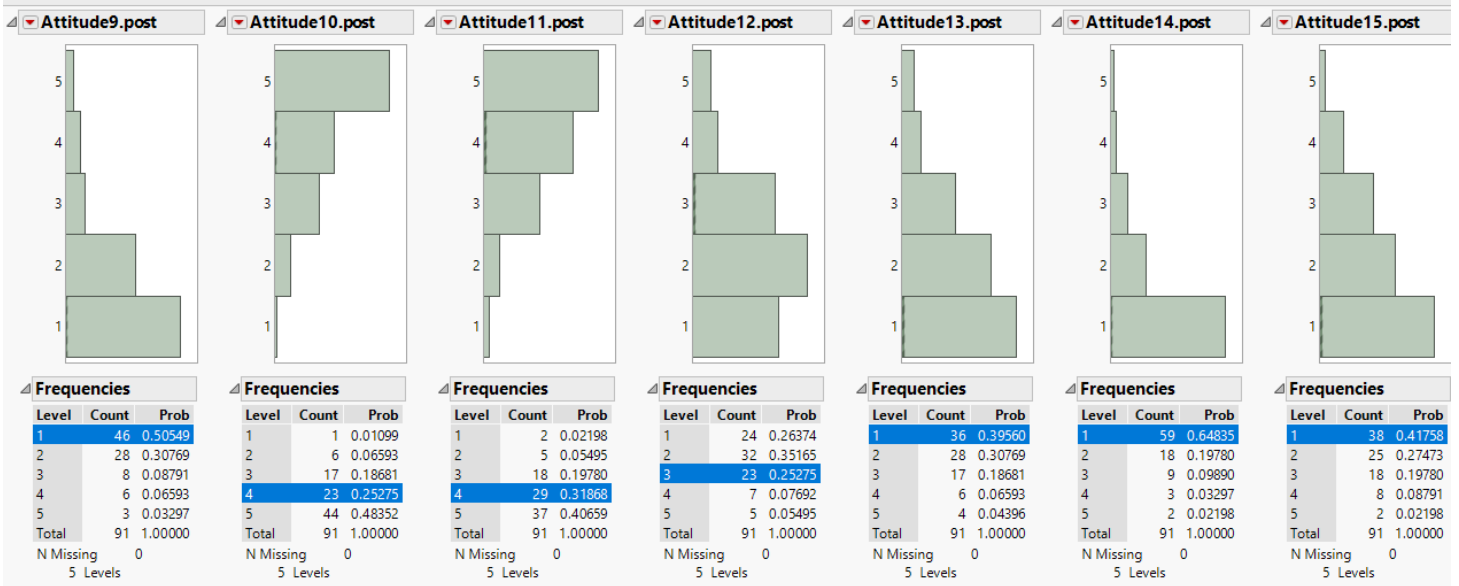
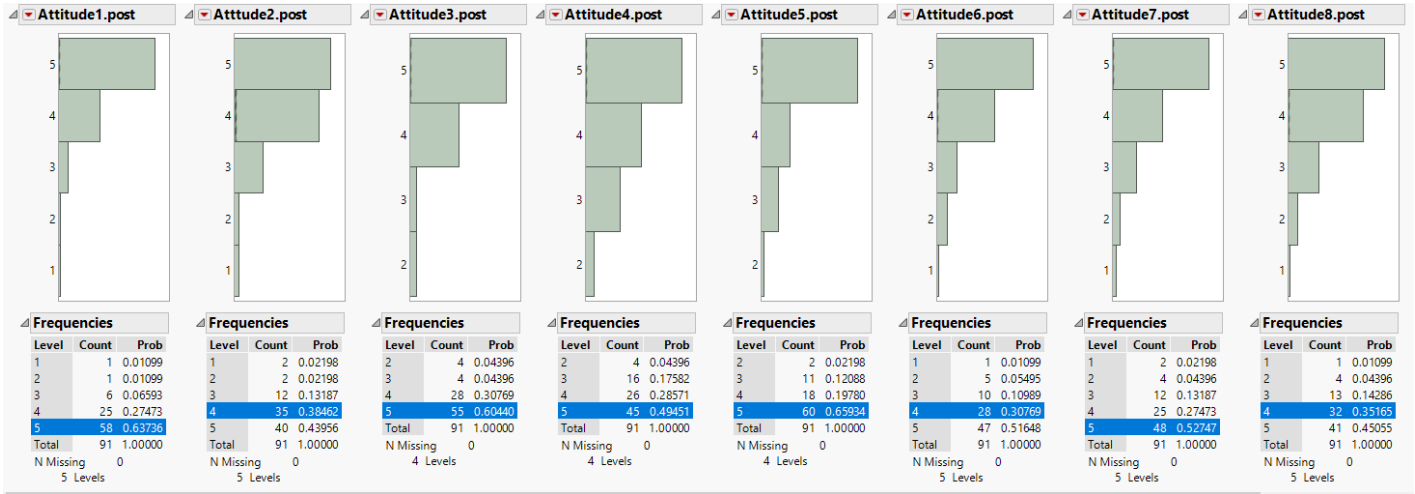
## Appendix C (2)



# Appendix D (1)

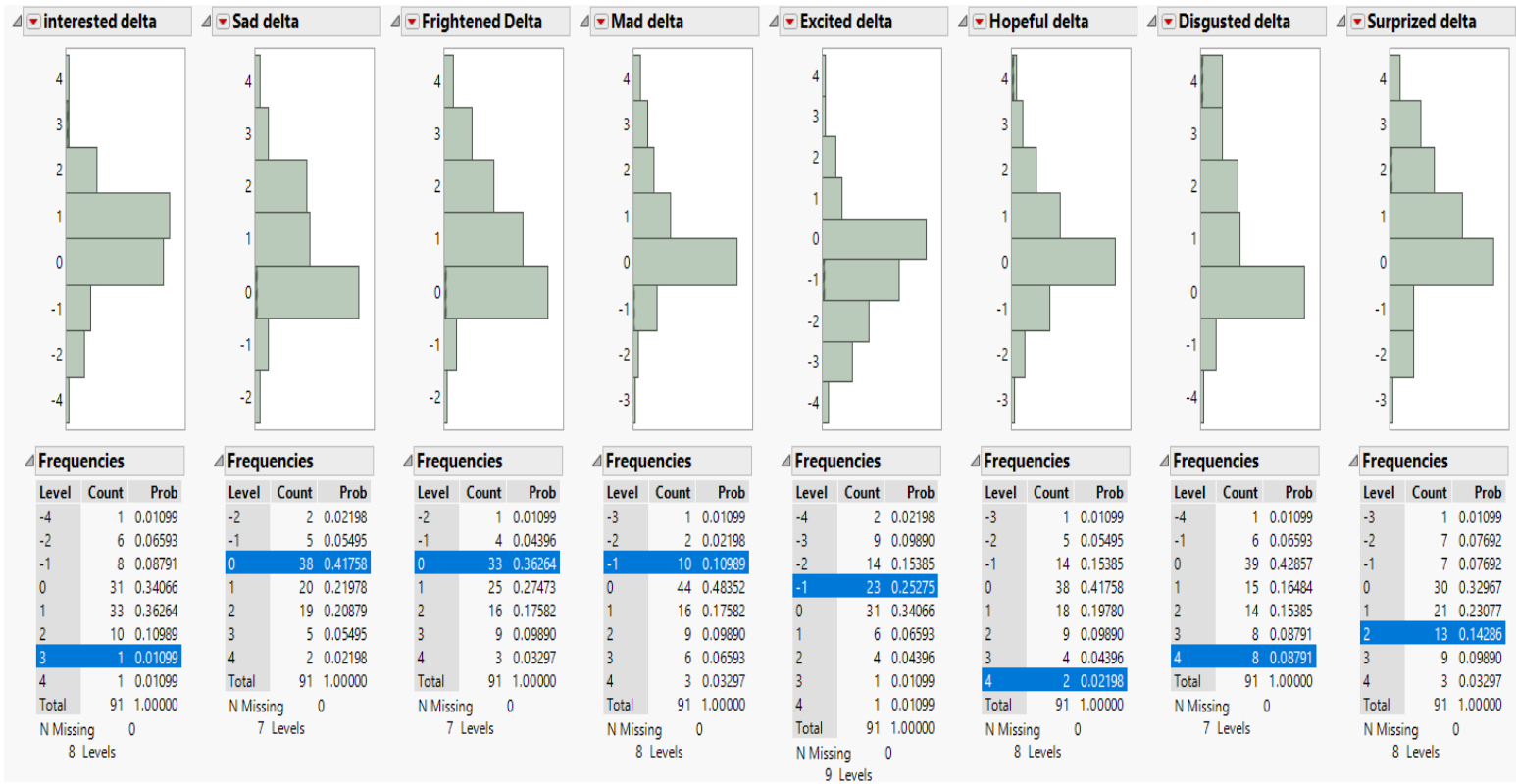


# Appendix D (2)

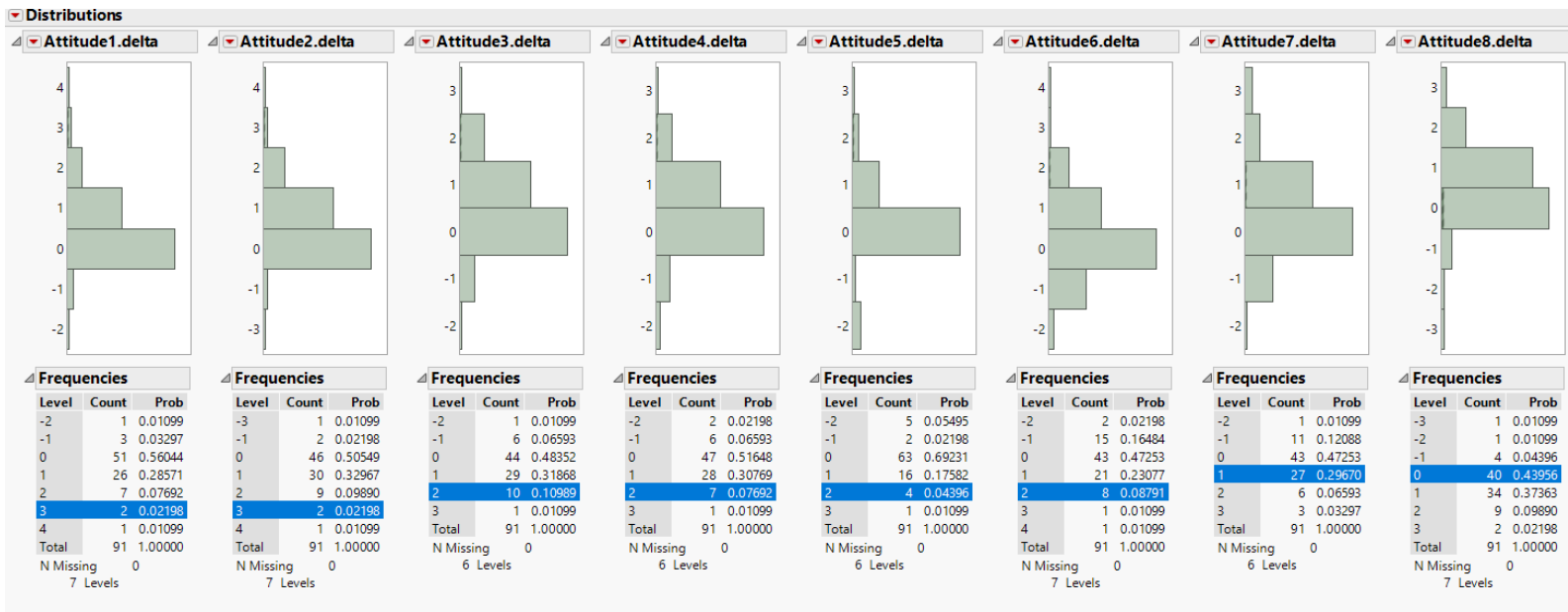




## Appendix E (1)



## Appendix E (2)



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