



MULTIMEDIA RESEARCH

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Summative Evaluation of
Stormchasers
with a Student Audience

Report for
Museum Film Network
NOVA/WGBH

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**EXECUTIVE SUMMARY OF SUMMATIVE EVALUATION OF
STORMCHASERS (STUDENT SAMPLE)**

Multimedia Research, May 24, 1996

With major funding from the National Science Foundation, the Museum Film Network and NOVA/WGBH in conjunction with MacGillivray Freeman Films have produced an IMAX/ OMNIMAX film called *Stormchasers*. *Stormchasers* follows scientists as they investigate the dramatic weather effects of monsoons, hurricanes, and tornadoes.

The summative evaluation reported here focused on the following major outcomes:

- To what extent did the program appeal to student viewers?
- To what extent did the program achieve its intended viewing goals?
- Did the implementation of school-based activities prior to viewing affect outcomes?
- What did viewers perceive that they learned from the program, if anything?

Method. Two middle schools in the Greater Boston area participated with their sixth and seventh graders. A total of 91 students explored film-related science concepts prior to viewing the film at the museum (ACTIVITY + FILM treatment) and another 74 students only viewed the film (FILM treatment). All students completed a pre-viewing questionnaire three weeks before visiting the theater and completed a post-viewing questionnaire one day after viewing the film.

The Treatment groups did not differ significantly with respect to the classifications of gender, ethnicity, reported interest in learning about severe storm systems like hurricanes, monsoons and tornadoes and reported knowledge of severe storm systems.

- **To what extent did the program appeal to student viewers?**

Three-quarters of the student audience thought the program was either "very" or "moderately" interesting. Viewers particularly liked the photography of the storms, the realistic "you are here" feeling, and the information about storms. The audience more often mentioned wanting more storm footage and more action with less of a focus on people and people talking. On the other hand, students were surprised by the novel activities of the stormchasers and the features of severe storms.

After seeing the film, respondents were asked to rate how interesting or boring *Stormchasers* was. Two-fifths of the sample rated the program as "very interesting" (38.8%); one-third (32.1%) felt the program was "moderately interesting," 23.4% rated the film as "okay" and fewer than 6% thought the program was "moderately" or "very" boring. The following categories describe what the audience liked about the film:

- 31.9% The photography of the storms
- 28.5% The special effects of the OMNI Theater with its "you are there" feeling, large screen and surround sound
- 27.2% The information about storm formation and prediction and the storms themselves
- 3.6% Seeing power of storms
- 2.4% The excitement

When asked in an open-ended question what they did not like about the film, respondents' answers focused on the following concerns:

- 21.8% Too much talking, too many people with not enough action or storm footage
- 11.4% Wanted more OMNI effects but disliked dizzy feeling
- 7.3% Wanted more information
- 6.1% Boring
- 4.2% Did not like to see death and destruction by storms
- 3.6% Too much information, too technical
- 3.0% Sailplane segment
- 2.4% Too loud
- 1.8% Problems with the theater itself in terms of seating discomfort
- 1.2% Too short

Visitors were asked to complete the sentence, "I was surprised . . . ". A small portion of the sample (7.1%) were either not surprised or wrote no answer to the question. The remaining responses were sorted into the following mutually exclusive categories:

- 27.2% Surprised by the stormchasers themselves -- that people fly into hurricanes or chase storms, by their courage, and by how close the people get to storms
- 22.9% Surprised by the positive production qualities of the film itself; they liked the realism, the image size, the photography, sound and graphics.
- 19.3% Surprised by the qualities of storms -- their destruction, their power, the lightning, and the hurricane eye
- 15.1% Surprised by the film's general information and specifics concerning prediction, tracking, monsoons and tornadoes
- 4.8% Surprised at whole film
- 3.6% Surprised by negative film qualities - too short and too little action or storm footage.

Students also completed the sentence stem: "I was most disappointed" Almost one-third (31%) of the sample were either not disappointed or wrote no answer to the question. Two-thirds of the audience were disappointed as follows:

- 35.8% Disappointed by the lack of action footage presenting more storms.
- 20.6% Disappointed by the coverage or focus of the film: the focus on death and destruction and on tornado chasers as they talked or drove, the lack of coverage of other storms and too much or too little coverage of facts
- 4.8% Disappointment at lack of OMNI-unique effects.
- 1.8% Disappointment at feeling sick.
- 1.2% Disappointment because the film was not scary
- 1.2% Disappointment with seating comfort
- 0.6% Disappointment with the sound.

• **To what extent did the program achieve its intended viewing goals?**

Viewing the film significantly increased science knowledge, as measured by a 14-point content test on the intended viewing goals. Viewers of *Stormchasers* came away knowing more about the elements responsible for our weather patterns, the methods and tools used by scientists to study, track and predict severe weather, and the relative predictability of storm systems. Viewing the film increased significantly students' reported interest in making a model tornado, viewing a museum exhibit on

severe storms and speaking to people who study severe storms. Their interest in learning the basics of weather prediction did not change after viewing the film.

There was a statistically significant difference between audience knowledge of the film's content before viewing the film ($M = 5.40$) and knowledge after viewing ($M = 6.85$). Almost 20% of the variability in the posttest was accounted for by its linear relationship with the pretest and the treatments (FILM, ACTS + FILM) did not contribute to the predictive power of the regression.

Before and after viewing the film, students were asked to rate on a 5-point scale how interested they were in doing each one of four activities related to storms. After viewing the film, students reported significantly increased interest in making a model tornado, viewing a museum exhibit on severe storms and speaking to people who study severe storms. Interest in learning the basics of weather prediction was not affected.

- **Did the implementation of school-based activities prior to viewing affect outcomes?**

Treatment group (FILM, ACTIVITY + FILM) was not a significant factor in the appeal ratings nor a significant predictor of posttest scores after the pretest scores accounted for almost 20% of the posttest variance in the regression analysis. Doing the activities also did not differentially affect students' reported interest in doing film-related activities after viewing the film. Thus, three to four class periods of exploration of film-related concepts prior to seeing the film did not impact science knowledge or interests significantly beyond what the students learned from the film alone. In fact, when asked whether they connected the film to anything they had previously known or experienced only 3 students mentioned the class experience with the activity guides.

- **What did viewers perceive that they learned from the program, if anything?**

The film had the most impact on what the audience perceived they learned about how storms are studied, how storms are formed and specific details of the three types of storm systems covered. Over half of the audience felt that they learned something new about scientists from the film. Only 13% of the student audience felt that they had connected or associated the film with previous experience with storms or previous knowledge about storms.

When asked about the ideas and facts that they learned from the film, 30% learned specific facts about the types of storms (tornadoes, hurricanes, monsoons), 28% learned how storms are studied, 18% learned about the formation of storms, and 13% learned about the power and destructive nature of the storm systems. Over half of the audience (54%) felt that they had learned something about scientists that they did not know before viewing the film. These ideas included that scientists get actively involved with the storms themselves; that they fly into hurricanes; that they track and predict storms; that there are careers associated with storms; that the work is important and difficult; that they take risks; that scientists are responsible for making decisions that affect people's lives; that they use special equipment; and that scientists are human.

One-fifth of the student audience (23.2%) said that they connected or associated the film with previous knowledge or experiences, although not all explained the connection: 6.7% connected the film to personal experience with storms; 6.7% connected it to previous knowledge; 3.0% to school classes; and 2.4% to previously viewed television shows.

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INTRODUCTION

With funding from the National Science Foundation, the Museum Film Network and NOVA/WGBH in conjunction with MacGillivray Freeman Films have produced an IMAX/OMNIMAX film called *Stormchasers*. *Stormchasers* follows scientists as they investigate dramatic weather effects of monsoons, hurricanes, and tornadoes.

The summative evaluation reported here focused on the following major outcomes:

- To what extent did the program appeal to middle school viewers?
- To what extent did the program achieve its intended viewing goals?
- Did the implementation of school-based activities prior to viewing affect outcomes?
- What did viewers perceive that they learned from the program, if anything?

SUMMATIVE EVALUATION DESIGN

A quasi-experimental pre-test/post-test nonequivalent comparison group design was used with middle school students to evaluate the film and ancillary schoolroom activities. Intact school classes were assigned to one of two treatments: viewing the film only (FILM) and viewing the film after doing related activities (ACTIVITY + FILM). All students completed a pre-viewing questionnaire. Two weeks later, the teachers of half of the classes spent several class periods completing two predetermined activities in the *Stormchasers'* Activity Guide. During the subsequent week, all students viewed the OMNIMAX film *Stormchasers* at the Boston Museum of Science. The following day, all students completed a post-viewing questionnaire.

METHOD

Sample

Middle schools in the Greater Boston area who were registered to visit the OMNI theater during a one week period in March were contacted about participating in the study. One middle school, providing five sixth grade classes, is located in an urban area within four miles of Boston. The district reports that 85% of its graduates go to college and the income level of residents is at the 76th percentile. The second middle school, providing four seventh grade classes, is located in a suburban area 20 miles north of Boston. The district reports that 67% of its graduates go to college and the income level is at the 83rd percentile.

Paired pre and post-viewing questionnaires were obtained from 83 sixth graders and 82 seventh graders. Seven sixth graders and eight seventh graders were absent on one of the days during which the questionnaires were administered. Three of the five sixth grade classes and two of the four seventh grade classes did the *Stormchasers* activities in

school. Thus, there were 74 students in the FILM treatment and 91 students in the ACTIVITY + FILM treatment.

Information from demographic and background questions was used to determine whether the two treatment groups were equivalent groups. Chi-square analyses revealed that the treatment groups (FILM, ACTIVITY + FILM) did not differ significantly with respect to the classifications of gender, ethnicity, reported interest in learning about severe storm systems like hurricanes, monsoons and tornadoes and reported knowledge of severe storm systems. The distribution of the whole sample on these classification variables is presented in Table 1.

Table 1. Demographic and Background Variables of Whole Student Sample

<i>Variable</i>	<i>N</i>	<i>Categories</i>	<i>Percent</i>
Gender	165	Female	47.3%
		Male	52.7%
Ethnicity	165	White	86.1%
		Minority	13.9%
Interest in Learning about Severe Storm Systems like Hurricanes, Monsoons, and Tornadoes	165	Very interested	17.6%
		Moderately interested	29.7%
		A little interested	38.2%
		Not at all interested	14.5%
Knowledge about Severe Storm Systems like Hurricanes, Monsoons, and Tornadoes	165	I know a lot	2.4%
		I know a moderate amount	41.2%
		I know a little	50.9%
		I know nothing	5.5%

Procedure

Teachers administered the questionnaires after an instructional session by the researchers. All students completed the pre-viewing questionnaires as part of their regular classroom activity. Teachers did not mention that the questionnaire was associated with the planned field trip to the museum. Questions on the pre-viewing questionnaire focused on demographic and background classification variables as well as pre-viewing knowledge about and interest in the film's topics.

During the subsequent week, the film-related activities were covered by one teacher in the urban school working with three separate classes and two teachers in the suburban school working with two classes. Each student in the ACTIVITY + FILM treatment received a copy of the *Stormchasers* Activity Guide. In class, students read four pages of text and pictures that presented information about the film and fundamental background about monsoons, hurricanes and tornadoes. Over two to three class periods, students carried out two projects. The first involved a student-centered experiment with a simple sensitive breeze detector to discover why the wind goes where it goes, and the second was a simple teacher-led demonstration of how clouds form. The researchers demonstrated activities to the teachers and provided necessary materials for the experiments. In the week following the activities, all students visited the Boston Museum of Science and viewed *Stormchasers*. The day after viewing, the teachers administered the post-viewing questionnaire. Questions on the post-viewing

questionnaire included the pre-viewing film content questions and questions to assess viewers' reactions to the film (as described below). Upon completion of the questionnaire, students in the FILM group received copies of the *Stormchasers* Activity Guide.

Questionnaires

Demographic and Background Variables. The pre-viewing questionnaire established respondents' status with respect to demographic classification variables (gender and ethnicity) and background classification variables (pre-viewing interest in and pre-viewing knowledge of the film's topics).

Program Appeal. Post-viewing respondents chose one of five scaled statements to indicate how interesting or boring they found *Stormchasers*. Viewers also explained what they liked and did not like about the film and why. Finally, an attempt was made to capture unintended effects by utilizing two sentence completion items: "I was surprised . . ." and "I was disappointed"

Science Interests. Students rated their level of interest in four film-related activities both before and after viewing the film: learning the basics of weather prediction; viewing a museum exhibit on severe storms; speaking to people who study severe storms; and making a model tornado.

Science Knowledge. Both the pre-viewing and post-viewing questionnaires included a knowledge test to assess understanding of the viewing goals. Multiple-choice items and four short answer questions comprised a 14-point test about the following topics covered in the 37 minute film:

- Five major elements are responsible for the constantly changing weather patterns of our atmosphere: heat of the sun; land formations; water; wind; earth's rotation and tilt.
- Scientists use many methods and tools to study severe weather.
- The smaller storm systems are, the more difficult they are to predict.
- Prediction of severe storms begins with field study, collecting data through physical observation and measurement to form hypotheses about how storms form.
- Prediction of severe storms helps warn people so that can protect their lives and property.

After viewing the film, students responded to additional open-ended content questions: (a) describe two ideas or facts learned from the film; (b) what, if anything, was learned about scientists that was not known before the film; and (c) what, if any, connections or associations were made between the film and anything previously known or experienced.

RESULTS

Appeal of *Stormchasers*

After seeing the film, respondents were asked to rate how interesting or boring *Stormchasers* was (see Table 2). Almost two-fifths of the sample rated the program as "very interesting" (38.8%)¹; fewer than 6% thought the program was boring.

Table 2. Rating of Appeal of *Stormchasers* by Students

<i>Variable</i>	<i>N</i>	<i>Categories</i>	<i>Percent</i>
Appeal	165	Very interesting	38.8%
		Moderately interesting	32.1%
		Okay	23.4%
		Moderately boring	4.3%
		Very boring	1.2%

Expected frequencies for chi-square analyses were increased beyond 1 per cell by combining the appeal categories of "moderately boring" and "very boring." Appeal ratings were found to be independent of school, treatment, gender, ethnicity, and prior estimated knowledge about the film's topics. Prior interest in learning about the film's topics was significantly related to appeal ratings ($\chi^2(9) = 23.99, p = .004$). As students' reported pre-viewing interest in the film topics increased, so did their mean appeal ratings. Table 3 presents the mean appeal ratings for each level of interest in the film's topics.

Table 3. Mean Ratings of Appeal of *Stormchasers* by Previewing Interest in Film Topics where 1 = very interesting and 5 = very boring

<i>Categories of Interest</i>	<i>N</i>	<i>Mean Appeal Ratings of Film</i>
I am very interested	165	1.5
Moderately interested		1.8
A little interested		2.1
Not interested		2.4

¹ Of adults who viewed *Stormchasers*, 54% rated the program as "very interesting." (See Report #96-005).

What viewers liked. After viewing the film, students were asked what they liked about *Stormchasers* and why. All but two respondents provided an answer to this question, and responses were sorted into the categories presented in Table 4 below. Almost one-third of the audience (31.9%) liked *Stormchasers* because of the photography of the storms. More than one-quarter of the sample (28.5%) found the special effects of the OMNI Theater appealing with its large screen, surround sound, and "you are there" feeling. One-quarter of the audience (27.2%) liked *Stormchasers* because it was informative about storms. Another 3.6% enjoyed seeing the power of the storms and 2.4% liked the film simply because it was exciting.

Table 4. What Viewers Liked about *Stormchasers*

<i>Categories</i>	<i>%</i>	<i>Examples of Responses</i>
Plane footage, mostly going into eye	21.8%	"I liked it when the airplane went into the hurricane's eye, because it had a lot of action." "I liked the part when the pilots entered the eye of the hurricane because it was beautiful."
Footage of storms/ hurricanes/ tornadoes	4.1%	"I liked the tornado part. I liked the pictures it showed." "I liked how they showed one storm on tape." "I liked the up-close footage of storms because I like to see storms."
Footage of clouds	4.2%	"I liked the clouds, because they were so real looking and fluffy and bright."
Photography, generally	1.8%	"I liked the spectacular pictures in the film."
Photography, Total	31.9%	
Realistic "you were there" feeling	18.2%	"I like it because it made it like you were right there." "I liked how they made it seem as if you were really in a rainstorm or flying through the clouds."
OMNIMAX screen effect	7.9%	"I liked the screen and how you felt like you were moving." "I liked the size of the screen because it was very big."
Sound effects	2.4%	"I liked the sound effects because they were really cool."
Effects, Total	28.5%	
Informative about storm formation and prediction	10.3%	"I liked the way they explained how the scientist tracked down the storms and how they predict them." "I liked the information it gave about different storms. It helped me to understand where and why certain storms came to be."
Informative about storms/ hurricanes/ tornadoes/ monsoons	9.1%	"I liked it because I got to learn about the different storms." "It told me about different storms." "I liked when they talked about the monsoon in India because I like rain." "I liked what they showed about hurricanes, because they gave a lot of information about it."
Informative, generally	3.6%	"It had alot of interesting facts."
Informative <u>and</u> fun	2.4%	"It was interesting how I learned some things and had fun at the same time."
Info about people	1.2%	"I liked that the stormchaser people had courage and they were brave."
Info about methods	0.6%	"I like the radars. They were interesting."
Informative, Total	27.2%	
Power of storms	3.6%	"I liked it when they showed the tornado forming over the barn, because it looked so powerful and destructive."
Exciting	2.4%	"It was exciting."

What viewers did not like. After the film, students were asked also what they did not like about *Stormchasers* and why. Almost all of the sample (92%) responded to this question. A small group of students (3.6%) said that they disliked all of the film, but 24.8% said that they liked all of the film. The remaining responses of those who specified what they disliked were sorted into categories presented in Table 5. One-fifth (21.8%) of the audience wanted more storm footage and more action with less focus on talking and the people. Some (4.8%) wanted more OMNI effects typical of other OMNI films but others (6.6%) disliked of the dizzying camera effects of the OMNI style film. Another 7.3% wanted more information, but 3.6% said the information was too much. Small groups of viewers simply felt the show was "boring" (6.1%), or they disliked the death and destruction of the storms (4.2%) or the opening sailplane segment (3.0%). A few students complained that the film "too loud" (2.4%), or "too short" (1.2%) or complained about the theater itself in terms of viewing discomfort (1.8%).

Table 5. What Viewers Did Not Like about *Stormchasers*

<i>Categories</i>	<i>%</i>	<i>Examples of Responses</i>
Too much talking	9.1%	"I didn't like all the people talking a lot." "When the guy was just sitting there talking about things I didn't understand."
Too many people shown	7.3%	"There were too many pictures of people." "How they showed pictures about the stormchasers getting set."
Not enough action	3.6%	"I don't think it had enough action in it." "Not much action." "Could have had more action."
Not enough storm footage	1.8%	"How they showed little about the storm."
Balance, Total	21.8%	
Not much use of OMNI's unique features	4.8%	"It didn't make you feel like you were really there." "I didn't like the fact that it was really like a regular show, at the Omni theater. You weren't really feeling like you were in it."
Disliked feeling dizzy	4.8%	"It made me dizzy."
Disliked camera rotating around people	1.8%	"Too much spinning around the people."
OMNI Techniques, Total	11.4%	
Need more science information	5.5%	"It didn't give enough information." "Didn't talk about tornadoes that much." "They didn't tell us how a monsoon starts because I didn't know how." "They didn't say a lot about hurricanes, because I like learning about them."
Need more info on other storms	1.8%	"I didn't think that two storms were good enough. They should make <i>Stormchasers 2</i> with blizzards and irregular storms."
Need more info, Total	7.3%	
Boring	6.1%	"I thought that it was boring. I didn't really care about people chasing storms."
Death and Destruction by Storms	4.2%	"I did not like when they said people died in the storms." "I did not like when they showed the houses of people all broke."
Too much info	3.6%	"It was too educational."

Sailplane segment	3.0%	"The scenery of the clouds where you feel like you're flying." "When they went into the sky at the beginning of the film." "They kept showing the guy in a plane." "There was no point when it showed the guy at the beginning and at the end."
Too loud	2.4%	"Very loud. It gave me a headache."
Complaints of theater itself	1.8%	"I didn't like the seats because you hardly have anywhere to put your feet." "I didn't like finding a seat, because it made me dizzy."
Too short	1.2%	"I thought it should be longer."

What surprised viewers. In order to capture unplanned appeal effects, students were asked to complete the sentence, "I was surprised" Again, responses were sorted with keywords and the percentages of each mutually exclusive category are presented in Table 7 on the next page. A small portion of the sample (7.1%) were either not surprised or wrote no answer to the question. About 28% of the audience were surprised by the stormchasers themselves: surprised that people fly into storms or chase storms, by how close these people get to storms and by their courage. The positive production qualities of the film itself surprised 23% of the viewers; they liked the realism, the image size, the photography of tornadoes, the sound and graphics. Another 19% of the sample were surprised by the qualities of storms: surprised by their power, their destruction, lightning and the hurricane eye. The film's information surprised 15% of the respondents; they were surprised about information concerning prediction, tracking, monsoons and tornadoes. Small groups of people were surprised by the whole film (5%), the short length (2.4%) and the lack of action (1.2%).

What most disappointed viewers. Students also completed the sentence stem: "I was most disappointed" Responses were sorted with keywords and percentages of each mutually exclusive category are shown in Table 8 on page 9. Almost one-third (31%) of the sample were either not disappointed or wrote no answer to the question. About one-third (35.8%) of those who were disappointed mentioned the lack of footage presenting more action, more storms, tornadoes and hurricanes. Another 21% of the sample were disappointed by the coverage or focus of the film: The audience was bothered by the focus on death and destruction, on the tornado chasers, the lack of focus on other storms, and too much or too little coverage of facts. Other disappointing aspects of the film experience included the lack of OMNI-unique effects (4.8%), no Boston previewing film (2.4%), feeling sick (1.8%), seating comfort (1.2%), and the sound (0.6%).

Table 7. Respondents' Completion of "I was surprised . . . "

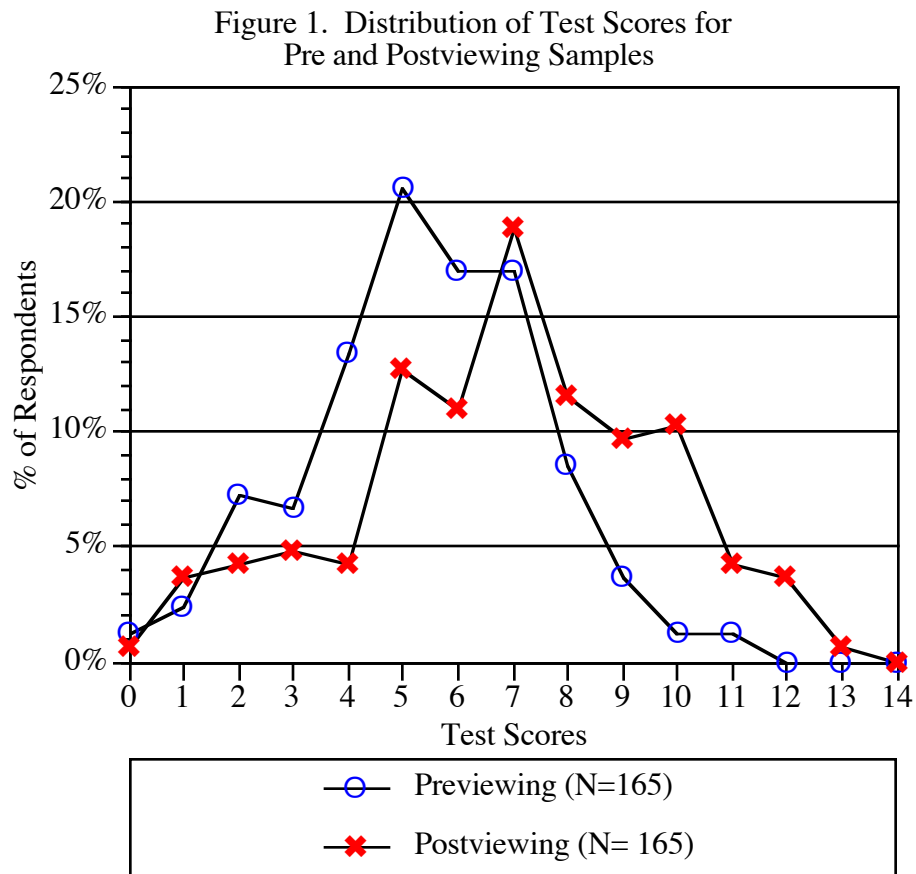
<i>Categories of Surprise</i>	<i>%</i>	<i>Examples of Responses</i>	<i>"I was surprised . . . "</i>
People/Plane Flies into Hurricane	19.4%	"that scientists actually flew into the storm."	
People Chase Storms	3.6%	"that there are real people that chase storms."	
Courage of Stormchasers	3.0%	"how brave they were."	
How Close People Get to Storms	1.2%	"how close the people were to the storm."	
Stormchasers, Total	27.2%		
Realistic	12.1%	"how realistic it was."	
Size of Images	4.2%	"at the size of the screen."	
Photography of Tornado	3.6%	"when the tornado popped out of the cloud."	
Sound	2.4%	"that they had good sound effects"	
Graphics	0.6%	"about the graphics."	
Positive Film Qualities, Total	22.9%		
Death/Destruction of Storms	10.9%	"at all the damage a hurricane can do."	
Power of Storms	3.0%	"at how powerful hurricanes are."	
Lightning at Beginning	3.0%	"when lightning hit in the beginning."	
Eye of Hurricane	2.4%	"that it was peaceful in the eye of the hurricane."	
Qualities of Storms, Total	19.3%		
General Information	7.3%	"how much I learned that I didn't know already."	
Activity of Prediction and Tracking	3.6%	"how long it takes for stormchasers to track a storm."	
Information about Monsoons	2.4%	"that a monsoon causes celebration."	
Information about Tornadoes	1.8%	"that you can only see a tornado because of dust particles that the winds pick up."	
Information, Total	15.1%		
At Whole Film	4.8%	"at the whole movie."	
Too short	2.4%	"it ended so soon."	
Lack of action or storm footage	1.2%	"that nothing happened."	
Negative Film Qualities, Total	3.6%		
Not Surprised or No Response	7.1%		

Table 8. Respondents' Completion of "I was disappointed . . . "

<i>Categories of Disappointment</i>	<i>%</i>	<i>Examples of Responses</i>	<i>"I was disappointed . . . "</i>
Too short	17.0%	"by how short it was."	"When it ended."
Lack of Action/Destruction or Storm Footage	10.3%	"because I thought it would have more action." "nothing happened."	
Lack of Tornado Footage	8.5%	"that the camera wasn't showing how it would feel to be spinning in a tornado."	
Lack of Footage, Total	35.8%		
Focus on Death/Destruction	6.7%	"that around 6 million people died in one hurricane." "that storms can cause so much destruction."	
Focus on Tornado Chasers as they talked or drove	5.5%	"when all they showed are people driving looking for tornado."	
Lack of Information	4.2%	"that they didn't give any more information on monsoons."	
Lack of Coverage of Other Storms	2.4%	"they didn't talk about snowstorms."	
Too Much Information	1.8%	"on how they were telling us too many facts."	
Coverage/Focus, Total	20.6%		
Lack of OMNI-unique Effects	4.8%	"that it didn't make you feel like you were really there."	
Not Boston Preview	2.4%	"because in the beginning they did not have the trip around Boston."	
Feeling Sick	1.8%	"by how the motions made you sick."	
Not scary	1.8%	"that the movie was not scary."	
Seating Comfort	1.2%	"that I wasn't comfortable in the chairs."	
Sound	0.6%	"of all the loud noises."	
Not Disappointed or No Response	31%		

Science Knowledge

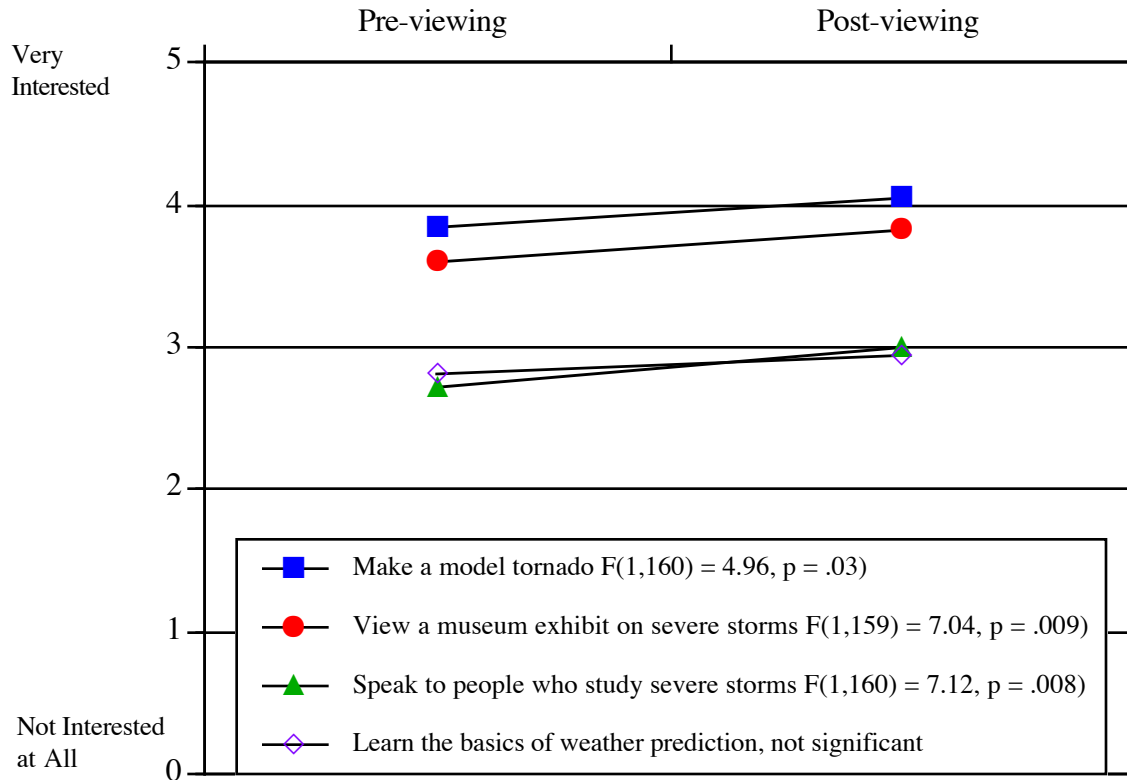
Achievement. Understanding of the intended viewing goals was assessed via a 14-point test with multiple-choice and short answer items. Figure 1 shows the distribution of the test scores before viewing and after viewing.



The post-viewing mean achievement score for the whole sample was 6.85, significantly higher than the pre-viewing mean score ($M = 5.40$), as tested by a paired t test, $t(1,164) = -7.048, p \leq .0001$. A multiple regression analysis with post-test scores as the criterion variable and pre-test scores entered as the first predictor resulted in an R^2 of 19.9 and a significant coefficient ($t = 6.36, p \leq .0001$). Treatment (FILM, ACTIVITY + FILM) added as a second predictor decreased the value of the adjusted R^2 . Thus, almost 20% of the variability in the post-test was accounted for by its linear relationship with the pre-test and the treatments did not contribute to the predictive power of the regression.

Interest in Storm-related Activities. Before and after viewing the film, students were asked to rate on a 5-point scale how interested they were in doing each one of four activities related to storms. ANOVAs with repeated measures were applied to the pre/post mean interest ratings for each activity with Treatment as a factor. Treatment was not significant in any of the four analyses, but the pre/post differences were significant for three of the four activities as indicated in Figure 2 that follows.

Figure 2. Pre and Post-viewing Means for Interest Ratings in Four Storm-related Activities



Ideas or facts learned. Prior to completing the test section mentioned above, the questionnaire asked viewers to describe two ideas or facts that they learned from the film. The majority of respondents (89%) provided two ideas or facts; 95% of the sample provided at least one idea or fact. Two students did not answer at all. The facts were sorted with keywords, and percentages of each mutually exclusive category and sub-categories are shown in Table 9 on the next page. The percentages were calculated based on a possibility of 330 responses (two facts per person).

One-quarter (28%) of the viewers learned something about how storms are studied. Another 18% indicated that they learned about the formation of storms. An understanding of the power and destructive nature of storm systems was gained by 13%. Specific facts about hurricanes were provided by 13% of the sample, specific facts about monsoons by 9%, and specific facts about tornadoes by 8%. Finally, 0.6% of the students learned that no two storms are the same.

Table 9. Ideas and facts viewers learned from the film

<i>Categories of What was Learned</i>	<i>% of 330 Responses</i>	<i>Examples of Responses</i>
People/planes can fly into hurricanes/storms.	9.4%	"I learned that people really can fly into the eye of a hurricane."
People chase tornadoes	6.1%	"I learned that there were people who chased storms."
Studying storms is a career.	4.8%	"It's a dangerous job to go find storms."
The process/methods of prediction	3.6%	"I learned how people predict storms."
The process/methods of tracking	3.6%	"I learned how they track down and follow the storm."
Learned How Storms are Studied	27.5%	
How tornadoes form	5.8%	"I learned how tornadoes form." "Tornadoes form when winds from different sides collide."
Unpredictability of storms	3.6%	"Storms are very hard to predict."
How hurricanes form	3.6%	"I learned that hurricanes gather over the ocean."
How storms form	2.7%	"I learned how storms are made."
Sun/Water/Land/earth's rotation responsible for weather/storms	1.8%	"Storms can be caused by the sun's heat." "How certain storms formed - the heat of the sun, temperature of the ocean, shape of the land and the earth's rotation."
How hail forms	0.9%	"Hail is formed when the clouds can't let the rain go and it freezes."
Learned about Formation of Storms	18.4%	
Learned about Power and Destructive Nature of Storms/Hurricanes/Tornadoes	13.0%	"In 1900 there was a big storm and 6 million people died." "I learned that storms can destroy a lot of things."
Eye of a hurricane is calm or peaceful.	9.1%	"A hurricane eye is the most peaceful part."
Wall of hurricane is strong/ powerful	2.4%	"The eyewall of a hurricane is the most violent part."
Hurricanes have a wall and an eye.	0.6%	"Hurricanes have a wall and an eye."
Learned Specifics of Hurricane	12.7%	
Learned Specifics about Monsoon - importance, length, location, size, predictability	9.1%	"Monsoon is a time of rejoicing." "Monsoons can go for three months." "Monsoons occur in India." "Monsoons are the biggest." "You can predict when a monsoon is going to come."
Dust makes tornado funnel visible	3.3%	"Tornadoes are visible because they pick up dirt."
Unpredictability of tornadoes	2.7%	"Tornadoes are the hardest to predict."
Location of tornadoes	0.6%	"Tornadoes are on land."
Tornado wind speeds of 200 mph	0.6%	"The fastest tornado in the film was 200 mph."
Size of tornadoes	0.6%	"Tornadoes are small."
Timing of hurricanes	0.6%	"Hurricanes come in the month of July."
Learned Specifics of Tornadoes	7.8%	
No two storms are the same	0.6%	"No two storms are exactly the same."

Learning about scientists. Because the scientists themselves played a large role in the film, we were interested to find out if viewers felt they learned anything new about scientists. Of the 165 students, 53.9% felt that they had learned something about scien-

tists that they did not know before viewing the film. Of those who said that they had learned something new, 88% went on to describe what they had learned. Those responses were sorted with keywords, and percentages of each mutually exclusive category are shown in Table 10 below.

Viewers felt that they learned that scientists get actively involved with the storms themselves; that they fly into hurricanes; that they track and predict storms; that there are careers associated with storms; that the work is important and difficult; that they take risks and are daring or brave; that scientists are responsible for making decisions that affect people's lives; that they use special equipment and that they are human.

Table 10. What viewers learned about scientists that they did not know before the film

<i>Categories of What was Learned about Scientists</i>	<i>% of Total 165 Post-viewing</i>	<i>Examples of Responses</i>
Scientists get actively involved with storms themselves	12.7%	"They went looking for storms and the computer didn't just tell them." "They chase storms."
Scientists fly into hurricanes	12.7%	"Scientists fly into hurricanes to find out where they're going."
Scientists track and predict storms	7.3%	"They can track hurricanes." "I learned how scientists predict the weather."
There are careers associated with storms	3.6%	"I never knew that people chase storms for a living."
The work is important and difficult.	3.6%	"I learned how important it is to know where the storm is going to hit." "They have very tough jobs."
Scientists take risks, are daring or brave.	2.4%	"Scientists are daring." "To be a scientist you have to be brave, to go into a hurricane takes courage."
Scientists are responsible for making decisions that affect people	1.8%	"They made death or living decisions."
Scientists use special equipment (planes included above in 'fly')	1.8%	"They use computers to track down the storms." "Used the balloons - it was cool."
Scientists are human	1.2%	"I didn't know stormchasers were real people." "I learned that scientists study and worry more than I thought they did."

Personal associations with the film. After viewing the film, respondents were asked if they connected or associated the film with anything they previously knew or experienced. One fifth of the students (23.2%) responded positively, and half of these respondents explained what the connection or association was for them. The responses were sorted by keyword into mutually exclusive categories, which are presented in Table 11.

Although 55% of the sample had used the *Stormchasers* Activity Guide in the week prior to seeing the film, only three students connected the experience with the film! Small groups of the sample associated the film with their own personal experience with storms (6.7%), their previous knowledge (6.7%), school classes (3.0%), or a television program (2.4%).

Table 11. Viewers' connections or associations with the film

<i>Categories of Viewers' Connections or Associations with the Film</i>	<i>% of Total 165 Post-viewing</i>	<i>Examples of Responses</i>
Personally experienced hurricane	6.1%	"I experienced this with Hurricane Bob."
Personally experienced tornado	0.6%	"I lived out west and there was many tornadoes."
Connected to personal experience with storms	6.7%	
Connected to previous knowledge	6.7%	"I know a little about storms."
Connected to school classes	3.0%	"We read some things in a booklet my teacher gave us." "We watched a film on storms in 4th grade."
Connected to previously viewed TV shows	2.4%	"I saw a TV show that showed the guy who chased tornadoes."

DISCUSSION

- To what extent did the program appeal to student viewers?

Of the 165 student viewers, 71% thought *Stormchasers* was either "very" or "moderately" interesting. Those who were more interested in the film's topics prior to viewing found the film more interesting. Viewers liked both the entertainment quality of the film - the photography of the storms and the realistic "you are here" feeling, as well as the educational quality of the film - the information about storm formation and prediction. Students marveled at the realism but also felt that the film included too much talking and too many people; they expressed disappointment with the lack of action and storm footage. Many felt that the film was short.

The student audience was surprised, however, to learn about the novel activities of stormchasers and the features of storms. They were surprised that people fly into storms or chase storms, surprised by the courage of the chasers and by how close they get to storms. They were surprised by the destructive power of the storms.

- To what extent did the program achieve its intended viewing goals?

Viewing the film significantly increased science knowledge, as measured by a 14-point content test on the intended viewing goals. Viewers of *Stormchasers* came away knowing more about the elements responsible for our weather patterns, the methods and tools used by scientists to study, track and predict severe weather, and the relative predictability of storm systems.

Viewing the film increased significantly students' reported interest in making a model tornado, viewing a museum exhibit on severe storms and speaking to people who study severe storms. Their interest in learning the basics of weather prediction did not change as a consequence of viewing the film. These results encourage one to believe that *Stormchasers* provided a motivation to pursue activities that might follow the film. Exhibitory within the IMAX exit area could expand successfully on the film concepts; or the activity guide, rather than acting as an advance organizer, could provide consolidation and elaboration of information in the classroom setting after the film.

- Did the implementation of school-based activities prior to viewing affect outcomes?

Treatment group (FILM, ACTIVITY + FILM) was not a significant factor in the appeal ratings nor a significant predictor of post-test scores after the pre-test scores accounted for almost 20% of the post-test variance in the regression analysis. Doing the activities also did not differentially affect students' reported interest in doing film-related activities after viewing the film. Thus, three to four class periods of exploration of film-related concepts prior to seeing the film did not impact science knowledge or interests significantly beyond what the students learned from the film alone. In fact, when asked whether they connected the film to anything they had previously known or experienced only 3 students mentioned the class experience with the activity guides.

- What did viewers perceive that they learned from the program, if anything?

The film had the most impact on what the audience perceived they learned about how storms are studied, how storms are formed and specific details of the three types of storm systems covered. Only 13% of the student audience suggested that they had connected or associated the film with previous experience with storms (mainly Hurricane Bob) or previous knowledge about storms.

Over half of the audience felt that they learned something new about scientists from the film. Viewers said they learned that scientists get actively involved with the storms themselves; that they fly into hurricanes; that they track and predict storms; that there are careers associated with storms; that the work is important and difficult; that they take risks; that scientists are responsible for making decisions that affect people's lives; that they use special equipment; and that scientists are human. These ideas about scientists provide a broader dimensionality to the career of science that contrasts with the typical icon of scientist as a bespectacled white-coated chemist in the laboratory.

In conclusion, although the student audience wanted more action and more storm footage, *Stormchasers* was interesting to 71% of the audience and made a significant impact on the science knowledge of the viewers and their understanding of scientists.

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