Dinosaurs Alive Film Summative Report

.

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RMC RESEARCH

Dinosaurs Alive Film Summative Report

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Introduction

In June 2006, RMC Research began evaluation work on the *Dinosaurs Alive* large format film project on behalf of project principals at the Maryland Science Center. A series of formative evaluation studies were conducted in 2006, providing quick-turnaround feedback from audiences and educator reviewers to inform the development of film and outreach materials. This report presents findings from the summative evaluation of the *Dinosaurs Alive* film which was released in 2D and 3D versions in March 2007. Summative evaluation studies of the educational outreach materials and traveling trunk are ongoing and will be presented in separate documents.

The *Dinosaurs Alive* film explores the work of paleontologists at the American Museum of Natural History including fieldwork conducted both past and present in New Mexico and the Gobi desert in China. The stories of these scientists provide an entre into an understanding of current scientific knowledge and study of dinosaurs. The historical component is presented through selections of footage from a 1920s expedition to the Gobi Desert led by Roy Chapman Andrews. Woven into this narrative about the history and current practices of paleontologists, the film profiles representative species, stories of fossil finds, evolutionary relationships between dinosaurs and other species, and dinosaur interactions with other species and their environments using computer generated recreations.

The purpose of this summative evaluation is to assess the film's impact, including success in areas of appeal and learning for different audiences. Evaluation questions examined viewer learning related to knowledge about the science of paleontology, and dinosaur science through comparisons of pre-viewing and post-viewing groups, ratings of the film overall, and of particular themes, images and topics by viewers.

The film's release in both 2D and 3D provided an opportunity for initial examination of the learning impact on different film formats. Towards this end, analysis was conducted to highlight the different responses and learning of 2D and 3D audiences, and provide preliminary data for subsequent study of learning in different formats.

This report includes three sections as follows: 1) methodology and demographics; 2) findings; and 3) discussion.

Methodology

A total of 845 large format film viewers participated in the study in two national sites, the California Science Center in Los Angeles, California and Museum of Science in Boston, Massachusetts. Divided nearly equally into pre-viewing and post-viewing groups, participants completed viewer questionnaires either prior to seeing the film or immediately afterwards. Pre- and post-viewing questionnaires contained a set of identical questions about content knowledge (both self-ratings of knowledge and fact-based questions) for understanding the learning impact of the film. Post-viewing respondents also completed questions about the appeal of the film overall, and of

particular scenes, and themes, as well as a limited number of open-ended questions about the presentation of paleontology and interest in visiting the project website, among others. In addition, forty-seven participants attended focus group discussions following viewing the film. These discussions were designed to provide greater clarity into the survey results.

Appeal

The *Dinosaurs Alive* film was well-liked by viewers. Seventy-six percent (76%) of viewers rating the film as either very good or excellent and 92% said they would recommend the film to others. Viewer responses on surveys and in focus groups suggest an overall enjoyment and appreciation of the film, and especially high regard for the scientific content. While many participants noted information that was new to them, others, including those dinosaur aficionados in the groups (and their parents), praised the presentation of familiar content. Audiences overall found the film visually engaging, exciting, and entertaining. While there were only minor differences in ratings given by men and women on various components of the film, there was a pattern in the ratings given by audiences of different ages. Adults consistently provided the highest ratings, followed by children. The most critical age group—consistent with the difficulty of attracting this cohort to science centers—were the young adults (ages 18-30).

The film used the excitement created by computer generated dinosaur animation to tell a larger story about the work of paleontology. All of the science themes which viewers were asked about were rated very highly. And, it was some of these stories about dinosaur science, rather than about the dinosaurs themselves that were seen as most effective. In particular, viewers felt they had learned the most about the impact of the climate, importance of fossil collections for making new discoveries, process by which new theories are developed and the specific story of dinosaur-bird evolution. Information about the diversity of dinosaurs and dinosaur behaviors, and other dinosaur and paleontology topics were also deemed effective by viewers, but less enthusiastically so.

Overall, the animated sequences of fighting dinosaurs and the aerial views of the flaming cliffs in the Gobi desert were the most popular scene and story components of the film. Content areas in which interesting visual elements were used to explore scientific content were also very popular, including the presentation of the evolutionary relationships between birds and dinosaurs, and the visualization of the impact of flash floods on dinosaur populations and dinosaur fossils. Male viewers were more enthusiastic about the *fighting dinosaurs footage*, and females were more appreciative of the *historical footage*, but otherwise their responses were largely consistent with one another.

In some cases, the appeal of particular scenes or stories varied by the age of viewer. Adults found the stories about the impact of flash floods, historical expedition footage, and presentation of changing interpretations of fieldwork more appealing than the children or young adult viewers. At the other end of the spectrum, while adults and children were enthusiastic about the story of the graduate student who discovers a new species, this story received the lowest of all ratings by young adults, likely the peers of the student profiled. Comments in focus groups, though not confined to young adults, singled this sequence out for feeling staged.

Overall, viewers enjoyed the story of historical and contemporary paleontology, the travel to different sites, and mix of archival, live action and animation footage, though different elements held greater or lesser appeal for different viewers. The diverse components of the film were generally seen as well-integrated. However, in some cases, viewers felt there was tension between the dinosaur action footage and paleontology topics. For some of these viewers, they felt the film's title had created an expectation that the film would include a greater proportion of dinosaur action footage, and were thus disappointed that there was not more CGI and dinosaur action.

Learning

Comparison of the ratings given by viewers and non-viewers (i.e. pre-viewers) on their knowledge of film topic areas suggests that respondents felt their knowledge had increased across all the content areas investigated. These gains were modest but statistically significantly. The greatest gains were recorded in how new discoveries about dinosaurs are made, the work of paleontologists, and how climate impacts fossil preservation. These findings were similar for both male and female viewers, though females' gains in knowledge about dinosaur behavior and interactions with other animals were not statistically significant.

On factual questions, comparative data again showed positive increase in knowledge between pre-viewers and viewers across all questions. This included significant gains both overall and for all subgroups on multiple choice questions about paleontologists' tools, the first dinosaur egg finds, and identification of the time periods in which dinosaurs lived. These results suggest the effective presentation of these topics. And despite some confusion about the sequence in which the dinosaurs were presented, the strategy of including timelines for each of the dinosaurs (using screen graphics), was nevertheless successful in familiarizing audiences with the eras in which dinosaurs lived.

Significant gains in viewer knowledge were recorded as well on a series of questions about the use of fossil evidence related to understanding dinosaur nesting behavior, identification of skin color, interactions with other species, evolutionary relationships to other species, and dinosaur diet. In most cases, much of this information was presented both visually and in narration and was successfully understood by viewers. Focus group discussions suggested that viewers appreciated the presentation of science as a process in which our understanding of dinosaurs continues to develop. Viewers—particularly adults—found the historical perspective provided through the story of Andrews' expedition to be interesting, and to add an additional dimension to understanding how science has both remained constant and changed.

One of the goals of the film was to present the work of paleontologists in a positive light and inspire young audiences to pursue science careers. Across data points, viewers felt the work and the lives of the scientists had been clearly presented. One third of all viewers, and two-fifths of the children who saw the film, indicated they could see themselves doing the work of a paleontologist. Children commented that they thought the work was interesting, found dinosaurs and fossils appealing, and were interested in contributing to science. On surveys and in focus group discussions, participants comments suggest that the film depicted the work as very detail-oriented and generally

conducted in hot climates, which were either incentives or disincentives for varying individuals.

Over half of viewers indicated an interest in visiting the website. Most looked to the site as an additional educational resource, and noted interest in learning more about dinosaurs and dinosaur evolution, paleontology, and specifics about the research presented in the film.

Visualizations

Discussions suggested that among the film's greatest strengths was the use of animated sequences for visualizing new kinds of information, from dinosaur environments, behavior, and interactions, to the role of the weather in creating fossil beds, and the relationship between fossils and living creatures. Viewers cited the scenes of flash floods and transformations of fossils into live action as among the most memorable sequences. For some participants, these were considered an innovative and important use of the medium—worthy of the science center locations—and a way in which the film technology was being used to help audiences make leaps of the imagination important for understanding science and the practice of scientists.

The film's successes in this regard are suggestive of the value of this medium for taking visual evidence such as actual fossils shown in live footage, and using computer generated images to help viewers imagine the worlds investigated by science, and, as noted by a focus group participant, the very imagination necessary for scientists to develop new theories and for science to progress. The use of these, and way in which they were woven into a narrative structure looking at the paleontological study of dinosaurs, may also have contributed to the strong sense viewers had of the informational content of the film.

Preliminary Study of 2D Versus 3D

The presentation of the *Dinosaurs Alive* film in 2D and 3D formats offered an opportunity to take a preliminary look at how audiences respond to the different film experiences through comparison of survey results about a single film. Investigation of this has been limited by data collection from a single site for each format. Thus any local differences in audience type or composition may further impact the differences of these results. In particular, the 2D audience included a larger proportion of young adults—consistently the most critical audiences—compared to the 3D group. Thus, disaggregation of data by film format and analysis must be seen as suggestive of possible areas for further investigation.

Although receiving strong ratings for both 2D and 3D viewers, the film was rated more highly by 3D viewers, both overall and on particular scenes and themes. While both 2D and 3D audiences were most likely to select "informative" as a descriptor of the film, 2D audiences more frequently characterized the film as "visually engaging," possibly reflecting the visual and meditative quality of the IMAX medium, while 3D audiences described the film as "exciting" and "entertaining," likely responding to the action scenes

of dinosaurs. The greater selection of "easy to follow" by 2D audiences may reflect greater distraction from narration by the visuals for 3D audiences.

2D and 3D audiences consistently rated the appeal of scenes (e.g. which varied in the proportion of viewers who indicated they liked each scene "a lot,") in similar order, despite 3D ratings being consistently higher. These differences were significant on the scenes including *dinosaur skeletons in the museum, scenery of the flaming cliffs, fighting dinosaurs* and *dinosaur-reptile evolutionary relationships.*

In terms of assessments of the effectiveness of themes presented in the film, 2D and 3D viewers indicated different degrees of effectiveness on several of these themes. 3D viewers found themes discussing the *impact of climate on preservation of dinosaur fossils* and *the importance of teamwork between individuals and institutions in conducting research* more effective than indicated by their counterparts viewing the film in 2D. In contrast, 2D viewers indicated greater clarity regarding the *diversity of dinosaurs* and *evolutionary relationship of dinosaurs to reptiles.*

Comparison of 2D and 3D responses on self-ratings of knowledge suggest a perception among 2D audiences of greater learning across all questions. Statistically significant gains (positive) in knowledge differed for 2D and 3D audiences on the questions about *dinosaur physiology*, *dinosaur evolution,* and *dinosaur interactions with other animals.* In these three areas, 2D audiences indicated significant increases in knowledge not shown by 3D group responses.

Increase in knowledge on multiple choice and true/false questions of 2D and 3D audiences suggest similar patterns in learning, with one exception. There was a greater increase in the correct response of 2D audiences on the question about the importance of fossils for learning about dinosaur diet.

These results suggest that the two formats offer different kinds of viewing experiences. For instance, the greater "visual engagement" for 2D viewers compared to the "excitement" for 3D viewers. Interestingly, responses from 2D audiences suggest greater learning, despite the greater appeal indicated by 3D audiences. Differences in ratings of appeal and effectiveness on the various scenes, images and themes suggest areas for future investigation regarding the characteristics of scenes and images which are most effective in one or another format.

Summary

The data indicate very clearly that the film's strength was the science content, and though it is less explicitly reflected in the data, a particular strength of the film may well be the way the science content is presented in the context of *stories of scientific discovery and interpretation*. This approach sets *Dinosaurs Alive* apart from other large format films and may account for the consistently strong perceptions viewers had about learning and the film's informative nature. What was clear from the data was that the telling of these stories through directly observable visual evidence and models – images of real fossils, and animation of scientifically-informed creatures and environmental conditions - was very powerful for many viewers.

A reading between the lines of viewers' ratings and focus group comments suggests that the slightly depressed overall rating for the film may be because of a sense of disappointment – for some viewers – that there wasn't more or even continuous dinosaur action, as suggested by the title. For others, the quality of the animation, particularly the backgrounds, may have detracted from their experience. And for others, particularly for 2D viewers, there may have been a sense of the film as emotionally flat – thus the importance of the lone, but perhaps telling, comment that Michael Douglas' narration lacked a sense of mystery.

Despite these weaknesses, the large number of viewers who said they would recommend the film to others again speaks to viewers' respect for the content. It is not unusual to hear recommendations for films couched in terms of age or interest, delineating to whom they might or might not recommend a film. In the case of *Dinosaurs Alive* viewers were very clear that based on the science content—and for those with an interest in that particular content—they would recommend the film enthusiastically.

Introduction

In June 2006, RMC Research began evaluation work on the *Dinosaurs Alive* large format film project on behalf of project principals at the Maryland Science Center. A series of formative evaluation studies were conducted in 2006, providing quick-turnaround feedback from audiences and educator reviewers to inform the development of film and outreach materials. This report presents findings from the summative evaluation of the *Dinosaurs Alive* film which was released in 2D and 3D versions in March 2007. Summative evaluation studies of the educational outreach materials and traveling trunk are ongoing and will be presented in separate documents.

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The purpose of this summative evaluation is to assess the film's impact, including success in areas of appeal and learning for different audiences. Evaluation questions examined viewer learning related to knowledge about the science of paleontology, and dinosaur science through comparisons of pre-viewing and post-viewing groups, ratings of the film overall, and of particular themes, images and topics by viewers.

The film's release in both 2D and 3D provided an opportunity for initial examination of the learning impact on different film formats. Towards this end, analysis was conducted to highlight the different responses and learning of 2D and 3D audiences, and provide preliminary data for subsequent study of learning in different formats.

This report includes three sections as follows: 1) methodology and demographics; 2) findings; and 3) discussion.

Methodology and Demographics

In order to understand the impact of the film on wide audiences, RMC employed a quantitative study design, augmented by limited qualitative research aimed at enhancing understanding of quantitative results. To allow for a preliminary study of the differing responses of 2D and 3D audiences, data was collected at two sites—one 2D and one 3D theater. In contrast to other films and topics, geographical diversity was considered less important given the film's content. Data was collected at the Museum of Science in Boston, Massachusetts and the California Science Center, in Los Angeles, California. Visitors in Boston saw the film in 2D on an IMAX Dome screen, while those at the California Science Center viewed the film in 3D on a flat IMAX screen.

Viewer Questionnaire

The study employed a quasi-experimental design, in which responses of viewers and pre-viewers of *Dinosaurs Alive* were compared to illuminate the learning effects of the film. The pre-viewing group included randomly selected individuals on line to see the film, and the post-viewing or viewer group included people who were leaving the theater after seeing the film. This design ensures that respondents are not pre-disposed to look for specific information by pre-viewing questions, while also ensuring that pre-viewing and viewer groups resemble one another not just in terms of demographics, but in terms of the shared interest in seeing the film.

Distinct questionnaires were developed for the pre-viewers and viewers, though there were overlapping knowledge and attitude questions for comparison purposes. These included questions in which respondents in both groups were asked to identify a correct answer from a series of options related to factual information presented in the film, or to indicate whether statements were either true or false. On other questions, respondents were asked to assess their knowledge of paleontology and dinosaur science and the responses of pre-viewing and post-viewing audiences were compared. In addition, a number of questions were designed specifically for viewers and included ratings of the film and of particular scenes and content themes.

See Appendix A for Viewer Questionnaires.

Survey Data Analysis

All survey data were entered, validated, and stored in an SPSS data file. Pre-viewing and post-viewing group equivalency tests were performed on the demographic data by using chi-square analyses. Likewise, chi-square tests were performed on the categorical data to identify differences in the level of knowledge across the groups. Responses to rating scales from the pre-viewing and viewer groups were tested for statistical significant differences by performing t-tests on the mean scores.

Questions were disaggregated by gender and age to uncover any differences within participant characteristics. Findings across groups and significant differences within groups are presented within the report.

Film ratings and learning data were also disaggregated by film medium (2D versus 3D), and significant differences between these sets of viewers are presented in the report.

Open-ended survey questions were coded and entered into the SPSS data file. The frequency of the various responses could then be calculated.

The Appendix contains all descriptive statistics on the pre-viewing and post-viewing groups in addition to break-outs by gender, age, and film medium. Only statistically significant differences are reported in the appendix.

Survey data is included in Appendix B.

Survey Respondents

A total of 391 pre-viewer surveys and 454 viewer group surveys were completed. Across all demographic dimensions the two groups were roughly equivalent.

Gender

The numbers of male and female respondents was roughly equal in the pre-viewing and post-viewing groups. See Table 1

Table 1

Gender of Respondents

	Pre-Viewing N=378	Post-Viewing N=425
Male	50%	49%
Female	50%	51%

Age

The pre-viewing and post-viewing survey groups had comparable distributions of respondents by age. See Table 2.

Table 2

Age of Respondents

Age	Pre-Viewing n=379	Post-Viewing n=428
< 18	43%	30%
18-30	28%	30%
31-50	20%	29%
50+	8%	11%

In subsequent analysis, respondents have been divided into three groups, collapsing the relatively small, older adult group (50+) into the adult group (30+ to 50 years).

Throughout the report, the three groups are defined as follows: children are defined as under eighteen years; young adults include respondents between eighteen and thirty years of age, and adults include respondents over thirty.

Education levels

Consistent with the slightly higher numbers of young respondents in the pre-viewing group, there were also a larger number of students in the pre-viewing group. See Table 3.

Table 3

Pre-viewing and Post-viewing Respondents by Education Level

	Pre-Viewing (n=372)	Post-Viewing (n=417)
Elementary/Middle School Student	21%	15%
High School Student	16%	11%
High School Graduate	25%	19%
College Graduate	27%	37%
Graduate Degree	12%	19%

Familiarity with Large Format (IMAX) and 3D

Pre-viewing and post-viewing groups were also roughly equivalent in their familiarity with the large format medium. See Table 4.

Table 4

Familiarity with IMAX and 3D Film Formats

# Imax or 3D Films Seen	Pre-Viewing n=382	Post-Viewing n=431
0	20%	12%
1-3	51%	50%
4-6	16%	20%
7+	13%	17%

2D and 3D

A total of 424 2D audience members completed surveys, and 389 3D audience members. These groups were divided between pre-viewing and viewers. See Table 5.

Table 5

Pre-viewing and Post-Viewing Respondents by Film Dimension

Film Dimension	Pre-Viewing n=391	Post-Viewing n=454
2D	54%	50%
3D	46%	50%

Focus Groups

Questions and Analysis

Focus groups were conducted to illuminate quantitative findings, and provide additional detail on the film's success. Focus group questions were designed to elicit film highlights, learning, and provide insight into any confusing or unclear aspects of the film.

See Appendix A for focus group questions.

Focus Group Participants

Three focus groups were convened at each of the two sites. Four groups included "family groups" – a mix of children and their parents – and two groups were composed of adults only. A total of 29 adults and 18 children participated in focus groups. Seventeen of the children were ages 10-16; one six year-old accompanied a parent and older sibling.

All focus group participants were recruited by museum staff and drawn from member lists.

Report

Findings are presented in the sections below, and include survey results relevant to appeal and learning of the film overall; results relevant to understanding the responses of 2D and 3D audience; and finally, focus group responses. Note that subgroup (e.g. gender and age) analysis of quantitative data is included only when results varying significantly from one group to the next.

Findings

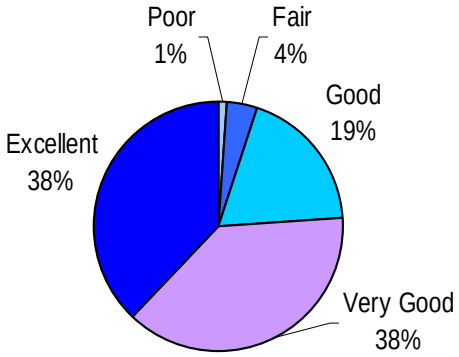
Survey Data

Appeal and Interest: Film Ratings

Respondents who had seen the film were asked to indicate their rating of the film overall on a scale from 1=poor to 5=excellent. The overall mean rating for the film was 4.1 (very good).

Equal numbers of viewers (38%) rated the film either excellent or very good. An additional 19% rated the film good, and the remaining 5% rated the film as either poor or fair. See Chart 1a.

Chart 1a - Film Ratings



Subgroup Differences

Age

Adults over 30 gave the highest ratings (4.2), followed by children (4.1). The most critical group was the young adults who rated the film between good and very good (3.8).

Differences between these groups can be seen in the distribution of ratings of good, very good, and excellent. See Table 6.

Table 6

Film Ratings by Subgroup

	Children	Young Adults	Adults
1 Poor	2%	1%	0%
2 Fair	4%	4%	5%
3 Good	15%	30%	13%
4 Very Good	40%	42%	36%
5 Excellent	39%	23%	46%

Rating Comments

Viewers were asked to provide any comments about why they gave the rating that they did. Comments were sometimes multiply coded and the following represent the percent of viewers whose comments fell into a particular category (and thus the total exceeds 100%).

The most common response (35%) was that the film was interesting, informative or that they learned a lot. Some of these comments included, “It was informative and I learned many new and interesting facts,” “I very much enjoyed seeing dinosaur fossils, then seeing the recreations of what they actually looked like. Also, the scenes where the movie took place were absolutely beautiful,” and “informative, good, scientifically-based graphics.” “This film provided excellent information about the excavation of dinosaurs and how they lived their lives millions of years ago,” and “This production was more informative than previous IMAX/OMNI movies that I have seen.”

Eight percent cited the research, science facts, or other information as a positive attribute, 4% that they liked history, and 3% noted enjoying learning about paleontology, the work of paleontologists or seeing fossil discovery. “I liked the focus on research and paleontology, rather than the typical portrayal of dinosaurs as violent predators,” and “The trip to Gobi Desert and Ghost Ranch was great,” were some of these comments.

Another 13% described the film with a positive adjective such as “amazing,” and “good.” Six percent said the film was “entertaining” or that it was “engaging,” another 5% said simply that they “liked the film,” and another 6% that it was “exciting” or “inspiring,” including one child viewer who wrote, “I think it inspired me to pursue a career as a paleontologist.”

Twelve percent mentioned that they enjoyed the visuals or dinosaurs animation, and another 4% noted the 3D or special effects as highlights. These comments included “The dinosaurs are awesome,” “The 3D is cool,” “the visual production aspects were wonderful” and “great visuals.”

Other positive comments offered by six or fewer viewers included comments about the film being well-balanced, e.g. “great integration of science, discovery, and graphics,” easy to follow, or providing a positive OMNI experience.

Some of the negative comments, provided by both 2D and 3D viewers included 10% who noted that animation was “disappointing,” or wanted “more action,” and 3% that the film was different than they expected, citing the emphasis on paleontology rather than on dinosaurs, e.g. “I was hoping for more dinosaurs because of the title *Dinosaurs Alive*.” Another 6% said the film was “boring” and 3% cited problems with the story, or technical problems, e.g. “too wordy,” and “fuzzy.” In addition, six viewers thought the film was “scary,” though it was not clear if this was a positive or negative attribute.

Recommend Film

On an open ended question about whether they would recommend the film to others and why or why not, 92% said they would recommend the film to others.

Forty-six percent of those who said they would recommend the film explained that it was because the film was “informative,” or that they had “learned a lot.” Twenty percent

described the film as “engaging” or “entertaining,” and another 20% said it was “cool,” “great,” “awesome,” or used another similarly enthusiastic adjective. Seventeen percent said they would recommend it because it was “interesting.” Other comments given by ten viewers were that they “liked,” “loved,” or “enjoyed it,” and eight said they would recommend it because of the 3D, visuals, or animation.

The comments of those who said they would not recommend the film were varied. Three said the film was boring, two that the film needed more dinosaur action, and a variety of other unique comments, including “too much history,” “needs to be more sensory pleasing (2D viewer),” and “light on content.”

A response given by a total of 20 viewers, including those who said they would recommend it, or don’t know if they would, noted that recommendation would depend on the person’s interests, e.g. “yes for those interested in paleontology, no for those more interested in visualizations of dinosaurs and their behavior.”

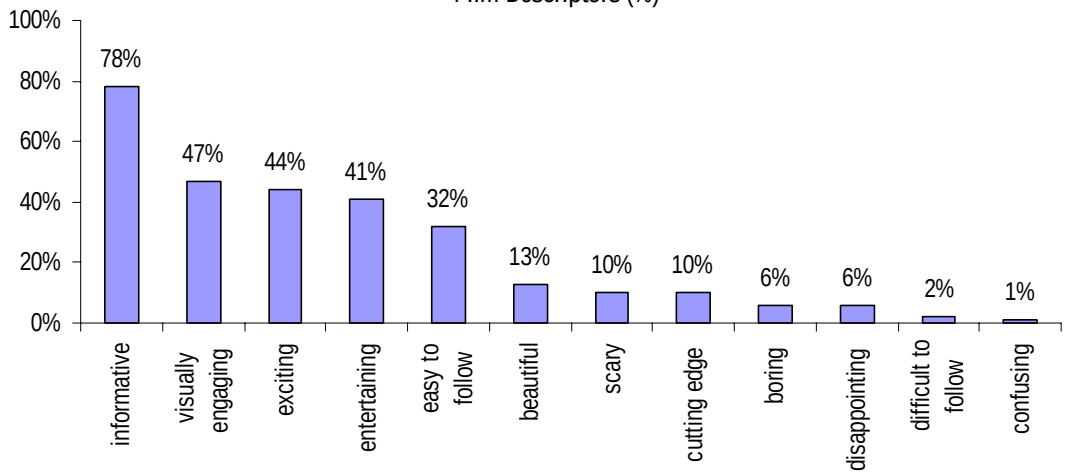
Appeal and Interest: Descriptors

Viewers were asked to select the three descriptors that best fit the film from a list of twelve words or phrases. The following were the top selections of the group overall:

- *Informative* (78%)
- *Visually engaging* (47%)
- *Exciting* (44%)
- *Entertaining* (41%)
- *Easy to follow* (32%)
- *Beautiful* (13%)
- *Scary* (10%)
- *Cutting Edge* (10%)

Each of the remaining descriptors was selected by fewer than ten percent of the viewers. Complete results are presented in Chart 2.

Chart 2
Film Descriptors (%)

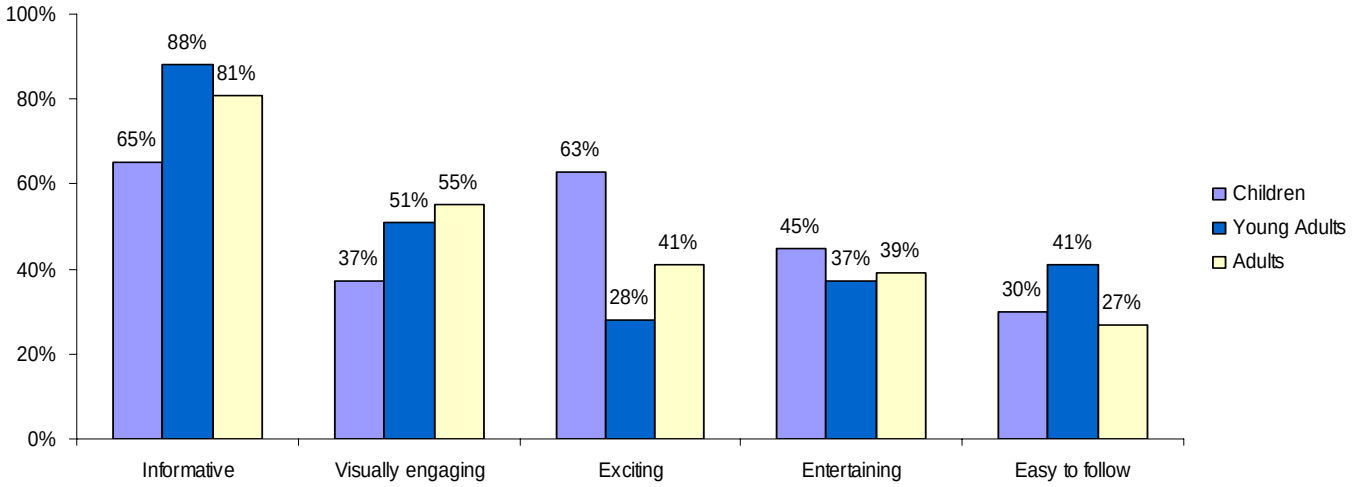


Subgroup Differences

Age

Although the top five descriptors were selected for each of the three age groups, their importance to each group differed. For instance, while adults and young adults most frequently described the film as "informative," children most frequently selected "exciting." See Chart 3 for comparative results of the top five descriptors.

Chart 3
Descriptors (top five) by Age



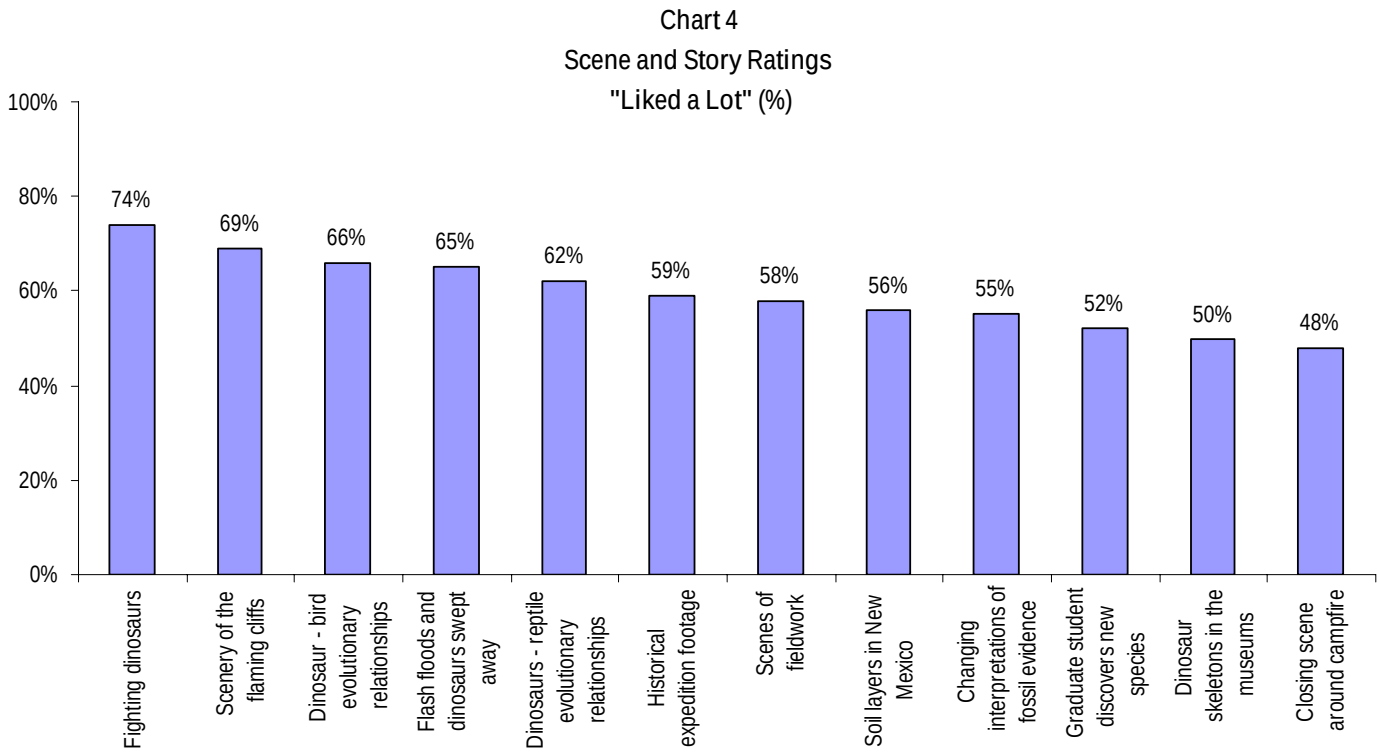
Appeal and Interest: Scene and Story Ratings

Viewers were asked to rate a list of scenes or stories from the film on a scale of 1="didn't like at all," 2= "liked a little," to 3= "liked a lot." Ratings given for all scenes and stories fell approximately halfway between "liked a little" and "liked a lot," with a low of 2.3 to a high of 2.7.

The greatest variations were in the proportion of viewers who selected either "liked a little" or "liked a lot" for each scene, with only a handful selecting "did not like." In order to differentiate between responses to these scenes and stories, the ratings are presented below in terms of the percentage of viewers who selected the highest rating, "liked a lot." This ranged from a high of 74% for the scene of fighting dinosaurs to a low of 48% for the closing scene around the campfire.

Note that the highest ratings were given to the scenes and stories using animation, full-screen images of landscape ("IMAX moments"), and strong cases of integration of these with live action and clear presentation, e.g. the dinosaur-bird story.

See Chart 4.



Subgroup Differences

Gender

The most popular scenes—*of fighting dinosaurs*—were appealing to both male and female viewers. However, these were the only scenes for which more males than females selected "liked a lot." On all other scenes, a greater percentage of female viewers selected "liked a lot" than male viewers.

Responses by males and females were significantly different only on the question about the *historical footage*. Sixty-six percent (66%) of females and 53% of males indicated they liked the historical footage "a lot."

Age

While the different age groups followed a similar pattern of ratings in terms of the order of the different scenes and stories, their responses varied by degree, with adults consistently giving the highest ratings (ranging from 51% to 79% "liked a lot"), and young adults the lowest (from 35% to 70% "liked a lot"). Children's responses generally fell between these two groups (ranging from 43% to 78% "liked a lot").

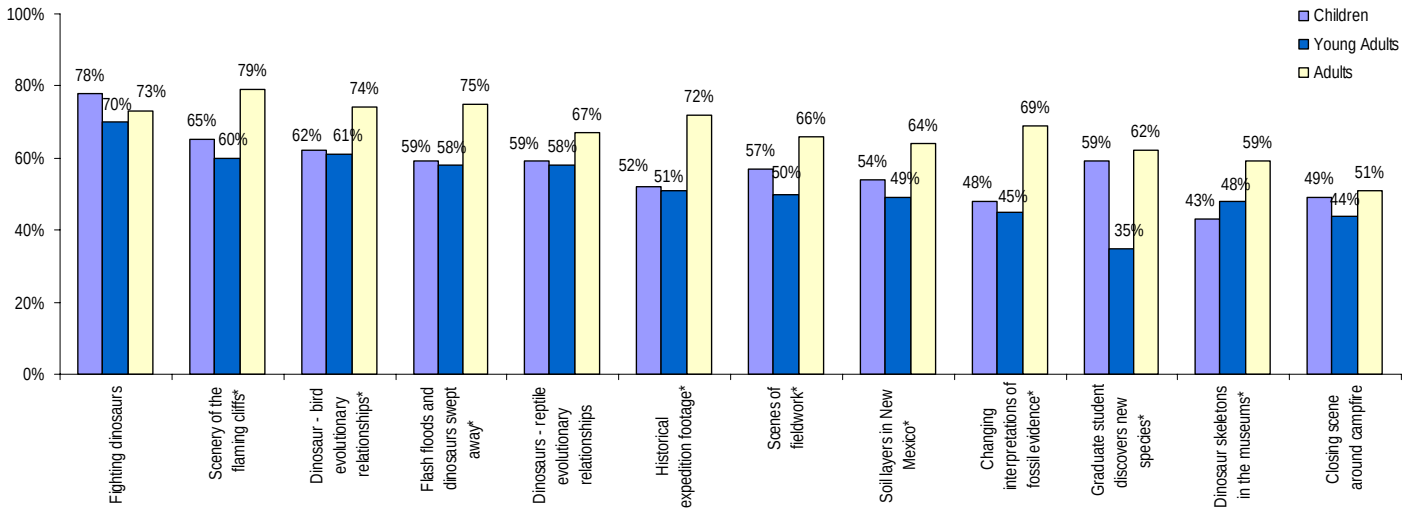
Responses by age groups varied significantly on the following questions:

- *Dinosaur skeletons*
- *Scenes of fieldwork*
- *Scenery of the flaming cliffs*

- *Historical expedition footage*
- *Graduate student discovers new species*
- *Changing interpretations of fossil evidence*
- *Flash floods and dinosaurs swept away*
- *Soil layers in New Mexico*
- *Dinosaur-bird relationships*

Complete results are presented in Chart 5 below

Chart 5
Scene and Story Ratings by Age Group
"Liked a Lot" (%)



Appeal and Interest: Science Content Themes

Participants were asked to rate the effectiveness of the themes presented in the film on a scale from 1= "not effective," 2="somewhat effective," to 3="very effective." All themes received strong ratings, with means falling mid-way between "somewhat" and "very effective" (2.4 to 2.5), and only minor variations in means from one question to the next.

Responses are presented in terms of frequencies of "very effective" and have been categorized into two groups based on the frequency with which viewers characterized the presentation as "very effective."

Most Effectively Presented (60%-61% "Very Effective")

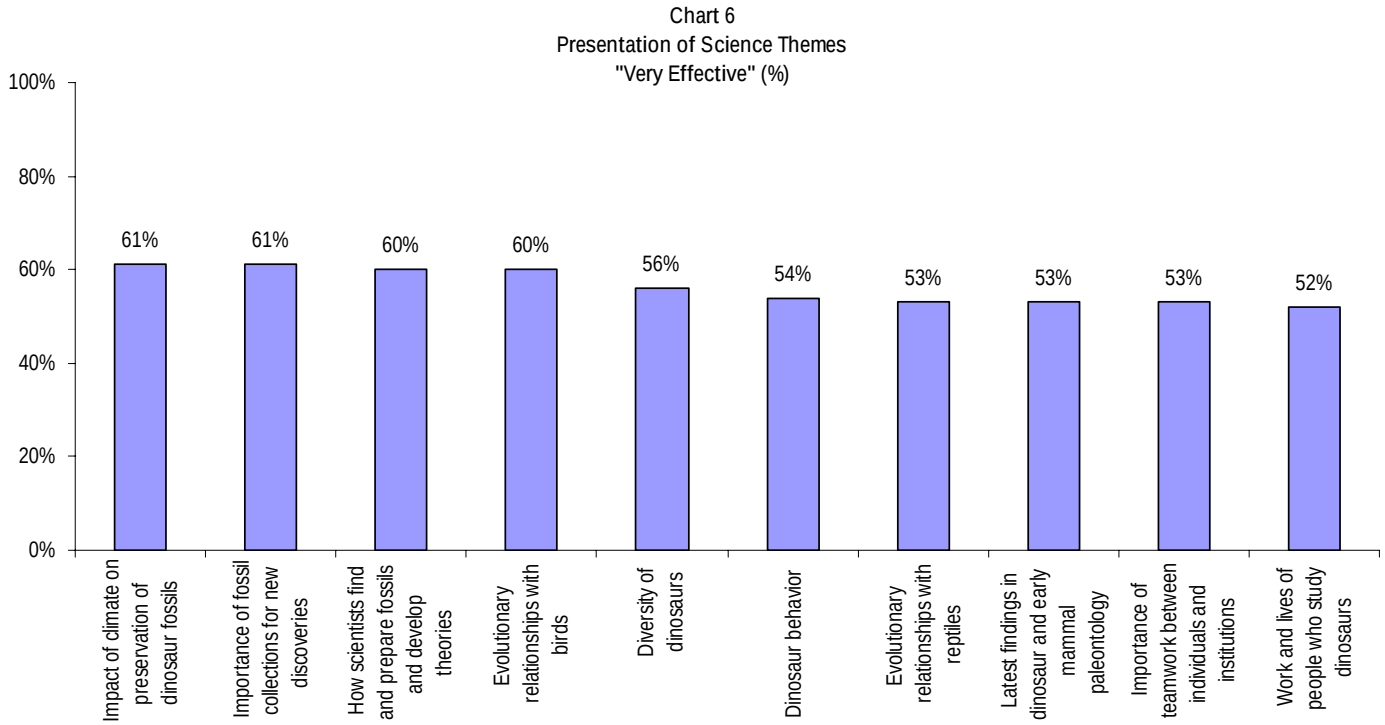
- *Impact of climate (61%)*
- *Importance of fossil collections (61%)*

- *How scientists find and prepare fossils… and arrive at theories. (60%)*
- *Evolutionary relationships with birds (60%)*

Effectively Presented (52%-56% "Very Effective")

- *Diversity of dinosaurs (56%)*
- *Dino behavior (54%)*
- *Evolutionary relationships to reptiles (53%)*
- *Latest findings (53%)*
- *Importance of teamwork (53%)*
- *Work and lives of scientists (52%)*

See Chart 6.



Subgroup Differences

Gender

Female viewers rated each of the themes slightly higher than their male counterparts, with the range for females between 53% to 65% giving a "very effective" rating, while males ratings were somewhat lower; and (50%-61% rating each theme as "very effective"). However, on individual questions, the ratings on *dinosaur behavior* only differed significantly between males and females (with females providing higher ratings).

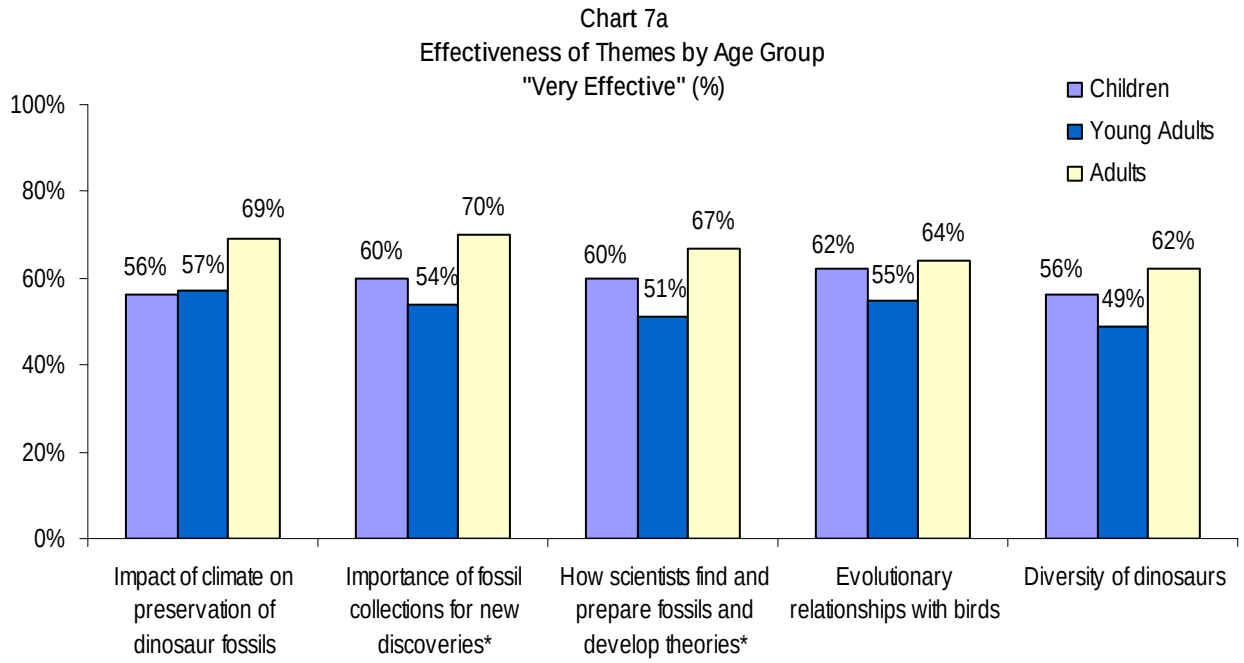
Age

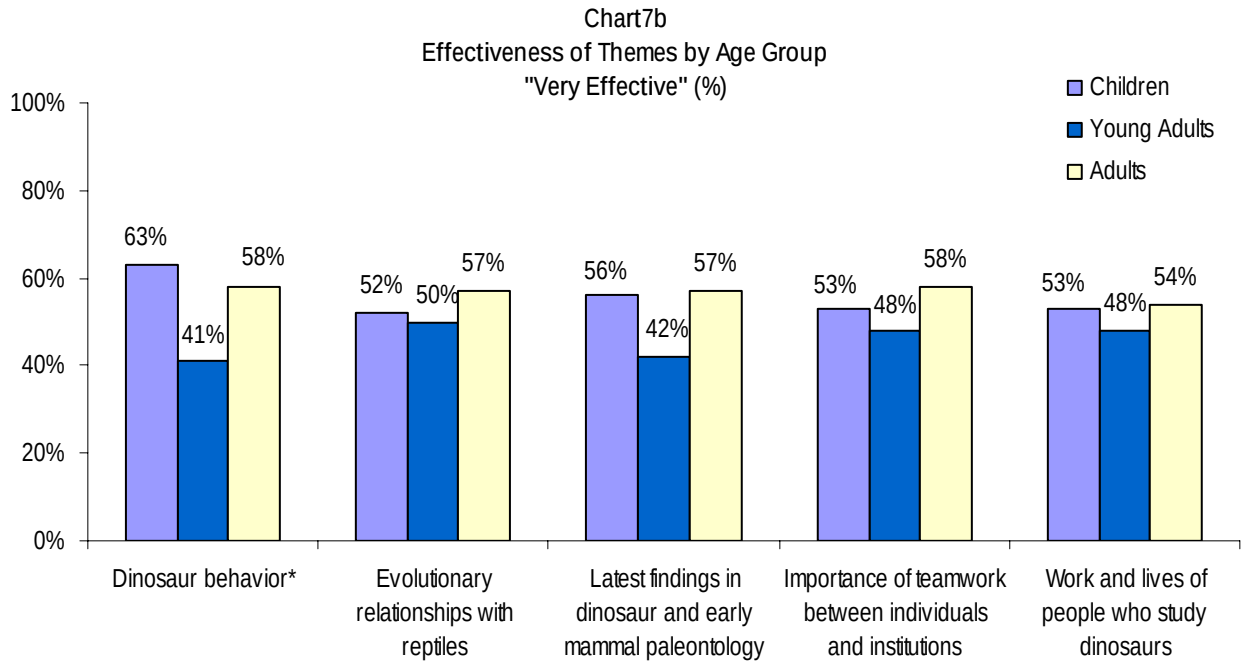
In general, children and adults again gave stronger ratings than young adults. The range of responses for adults was 54%-70% selecting "very effective," followed by 52% to 63% of children selecting "very effective" for each of the themes, and young adults at 41% to 57% selecting "very effective."

Responses by age group were significantly different on the following scenes:

- *Importance of fossil collections for new discoveries*
- *How scientists find fossils, etc.*
- *Dinosaur behavior*

See Charts 7a and 7b.





Learning: Topic Knowledge (Self-Ratings)

Pre-viewing and post-viewing respondents were asked to rate their knowledge of various topic areas addressed in the film on a scale from 1 to 3, in which 1=”don’t know anything,” 2=”know something,” and 3=”know a lot.”

Pre-viewing respondents rated their knowledge in each of the areas modestly, ranging between 22% and 38% who said they “didn’t know anything” about each of the topics. The areas in which the greatest numbers of respondents indicated they “didn’t know anything” included *dinosaur physiology* (38%) and *how new discoveries about dinosaurs are made* (37%).

Comparison with the post-viewing group suggests small, but significant gains after viewing across all topics. Pre-viewing means ranged from 1.7 to 1.9, and post-viewing from 1.8 to 2.2.

There was a decrease of between 10% and 20% in the numbers who said they “don’t know anything” on all but one question, and increases in both “know something” and “know a lot” on all questions.

The greatest increases in combined totals of “know a lot” and “know something” was seen in the questions about paleontology, with smaller gains seen in the questions about dinosaur science.

Greatest Gain in Knowledge

- *How new discoveries about dinosaurs are made* (21% increase)
- *The work of paleontologists* (20%)
- *How climate impacts fossil preservation* (19%)

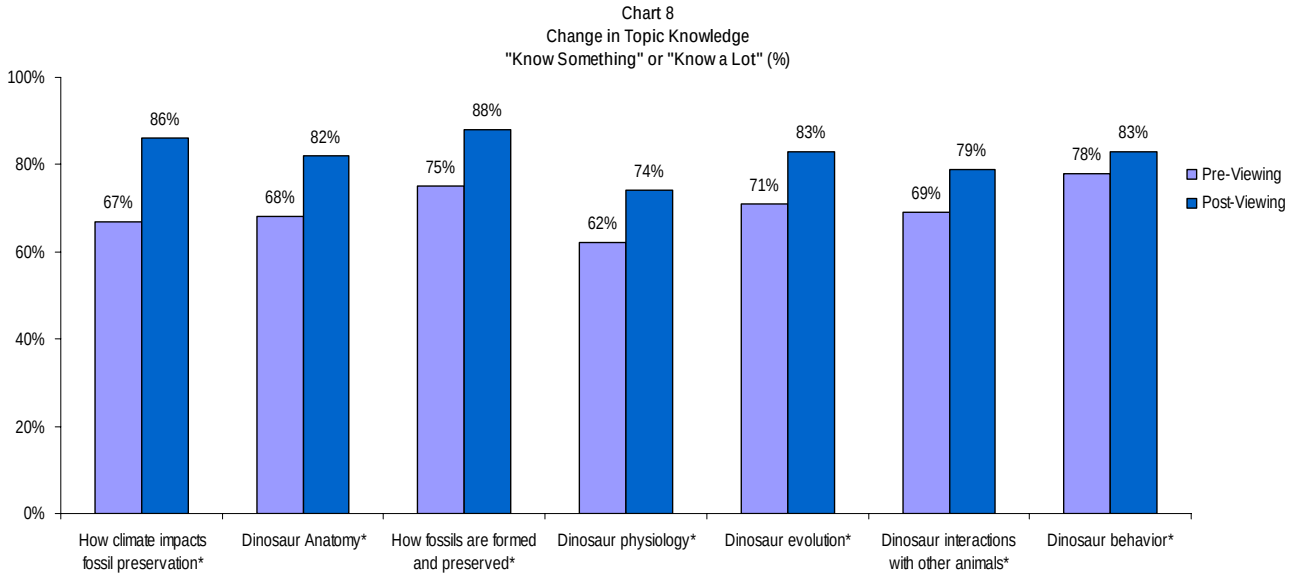
Moderate Gain in Knowledge

- *Dinosaur anatomy* (14%)
- *How fossils are formed and preserved* (13%)
- *Dinosaur physiology* (12%)
- *Dinosaur evolution* (12%)

Some Gain in Knowledge

- *Dinosaur Interactions with other animals* (10%)
- *Dinosaur behavior* (5%)

Chart 8 present results for this question. Topics have been ordered from greatest to least change in knowledge, based on the increases in the total percentages of "knows something" and "knows a lot".



Subgroup Differences

Gender

Similar gains were seen across the responses for both male and female respondents, with two exceptions. Although there were small gains for women on *dinosaur behavior* and *interactions with other animals*, these were not statistically significant.

Age

Significant gains were seen across all three age groups on:

- *The work of paleontologists*
- *How new discoveries about dinosaurs are made*
- *How fossils are formed and preserved*
- *How climate impacts fossil preservation*

Significant gains were seen for one or two age groups on the remaining questions as follows:

- *Dinosaur anatomy* (children and young adults)
- *Dinosaur physiology* (children and young adults)
- *Dinosaur behavior* (young adults)
- *Dinosaur evolution* (children)
- *Dinosaur interaction with other animals* (children and young adults)

See Table 7.

Table 7
Change in Topic Knowledge (Significant Improvement)
by Subgroup

	Gender		Age		
	Male	Female	Children	Young Adults	Adults
The work of paleontologists	*	*	*	*	*
How new discoveries about dinosaurs are made	*	*	*	*	*
How fossils are formed and preserved	*	*	*	*	*
How climate impacts fossil preservation	*	*	*	*	*
Dinosaur anatomy	*	*	*	*	
Dinosaur physiology	*	*	*	*	
Dinosaur behavior	*			*	
Dinosaur evolution	*	*	*		
Dinosaur interaction with other animals	*		*	*	

Learning: Dinosaur and Paleontology Facts (Multiple Choice Questions)

Pre-viewing and post-viewing audiences were asked a series of questions (in either multiple choice or true/false form) about dinosaur science and paleontology.

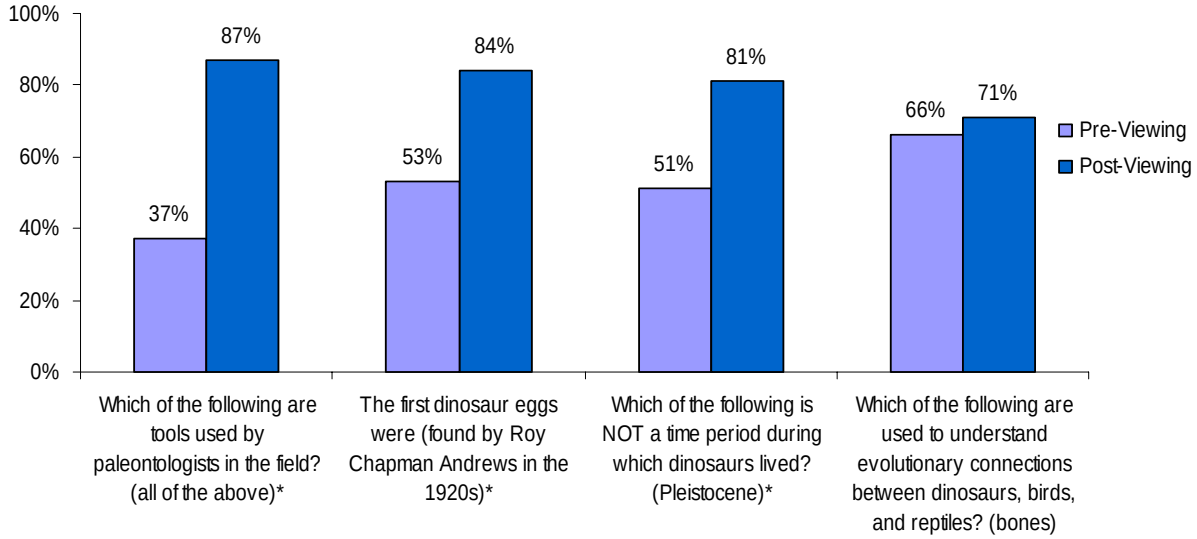
Significant improvement in correct answers on the following questions about the general film content:

- *Which of the following is NOT a time period during which dinosaurs lived? (Pleistocene)*
- *Which of the following are tools used by paleontologists in the field? (hammer, brush and toilet paper)*
- *The first dinosaur eggs were (found by Roy Chapman Andrews in the 1920s)*

Note that for the final question, pre-viewing knowledge was already quite high (66% correct).

See Chart 9

Chart 9
Content Learning (Multiple Choice)



Subgroups

Significant gains were seen across all subgroups (by gender, age, and film format) on the following questions:

- *Which of the following is NOT a time period during which dinosaurs lived?*
- *Which of the following are tools used by paleontologists in the field? (hammer, brush and toilet paper)*
- *The first dinosaur eggs were (found by Roy Chapman Andrews in the 1920s)*

Significant improvement was seen only by women on the following question:

- *Which of the following are used to understand evolutionary connections between dinosaurs, birds, and reptiles?*

Learning: Dinosaur and Paleontology Facts (True/False Questions)

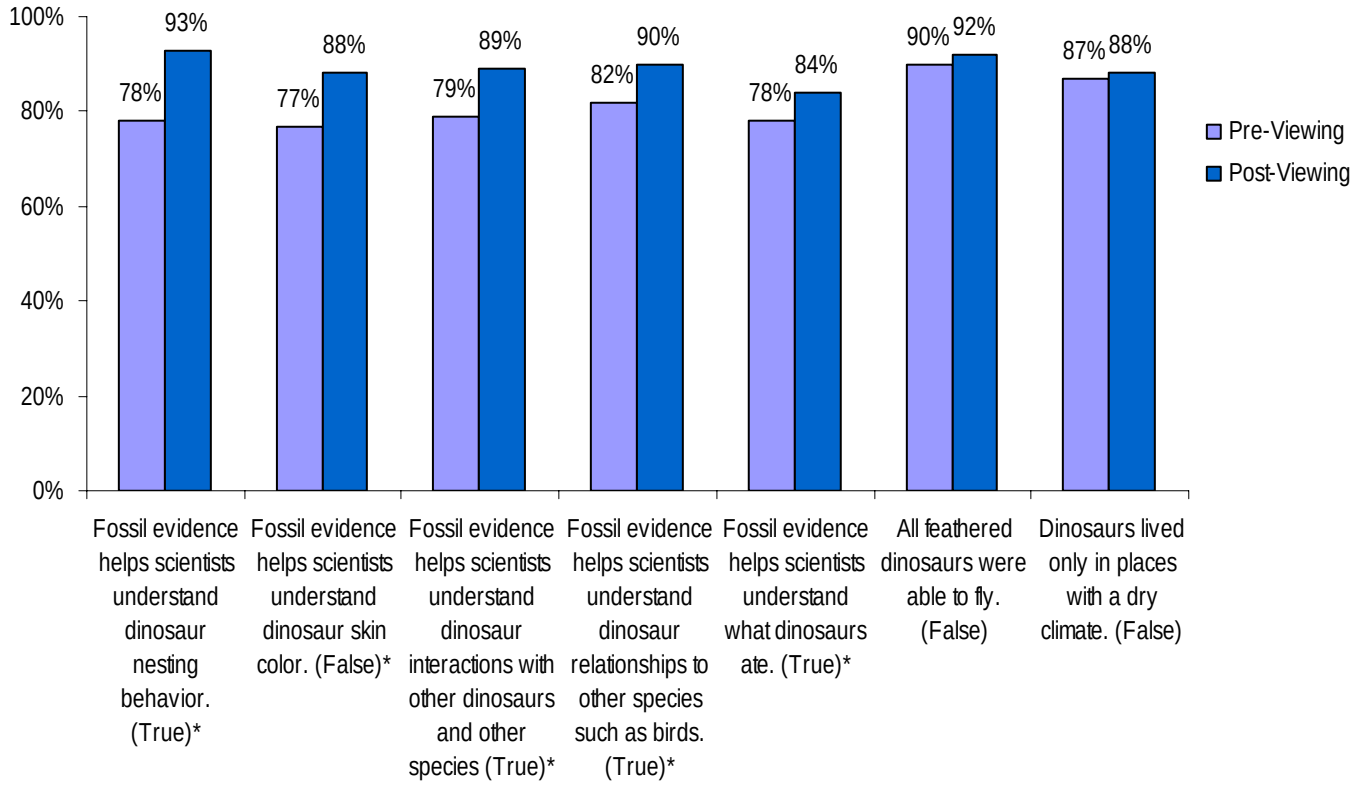
Significant improvement was seen by audiences overall on all of the questions about fossil evidence, including fossil evidence helps scientists understand…

- *dinosaur nesting behavior (true)*
- *dinosaur relationships to other species such as birds (true)*
- *dinosaur interactions with other dinosaurs and other species (true)*
- *dinosaur skin color (false)*
- *what dinosaurs ate (true)*

A very high rate of respondents correctly answered the two additional true/false questions in the pre-viewing survey, leaving little room for improvement on these questions.

See Chart 10.

Chart 10
Content Learning (True False)



Subgroups

While positive increases were seen across all of these questions, for the question about the *importance of fossil evidence*, significant improvement varied by subgroup and by question.

Gender

Female responses improved significantly on all questions, but male viewers' knowledge increased significantly only on *nesting behavior* and *interactions with other creatures*.

Age

Significant improvement in knowledge on these questions varied by age group.

- *Nesting behavior* (children, young adults, adults)
- *Relationship to other species* (children and adults)
- *Skin color* (young adults and adults)
- *Interactions with other creatures* (children)

There was no significant increase in correct responses on *dinosaur diet* when analyzed within age groups.

These results are summarized in Table 8 below.

Table 8
Content Questions (Significant Improvement)
By Subgroup

	Gender		Age		
Fossil evidence helps scientists understand…	Male	Female	Children	Young Adults	Adults
nesting behavior	*	*	*	*	*
relationships to other species		*	*		*
skin color		*		*	*
interactions with other creatures	*	*	*		
dinosaur diet		*			

Motivation

Post-viewing surveys contained two additional open-ended questions. Responses to these questions are summarized below.

Motivation: Interest in Paleontology

Thirty-four percent of viewers could see themselves doing the work of a paleontologist. There was no difference by gender on this question. Age groups differed. Forty-one percent of the children answered this affirmatively, 33% of young adults, and 29% of adults.

Since children were the primary target of the message concerning the appeal of paleontology as a career, their comments only are presented. When asked why or why not they gave this answer, the children who said they could see themselves doing the work of a paleontologist, seven said that it was interesting, six that they liked dinosaurs or fossils, five each that they would like to contribute to science or had similar career or goals in minds, four that they liked digging and three that it looked like fun. At least one each was attracted to solving puzzles, and working in the hot climate.

Of those who could not see doing this work, seventeen said they had already chosen another career, eight that the work looking painstaking or required patience, five that it was too physically demanding, another five that it looked boring, and three that the climate was unappealing. Assorted other answers offered by one or two viewers each included a lack of interest in the topic, or in dinosaurs in particular.

Motivation: Website

In an open-ended question format, viewers were asked whether they would visit the website, why or why not, and what they would hope to find there.

Fifty-six percent said they will visit the website. This included significantly more adults (68%), than children (55%), or young adults (42%).

Among those who would visit the website, 34% said simply that they are interested, 32% said they would share it with their children, and 11% said they would visit because they liked the film or liked dinosaurs.

As to what they would hope to find on the website, the majority said they wanted to learn more. While a large group of those (30%) did not specify what they wanted to learn, others specified that they wanted to learn about dinosaurs (38%), paleontology (15%), research presented in the film, the sites, etc. (10%), or about dinosaur evolution (6%). Nine percent hoped to find more still or moving images of dinosaurs. A handful also said they might go to the website if their child has a report or for a homework assignment.

The most common reasons given for why they wouldn't visit the website included computer-related responses (31%), including no computer, don't use the computer, or a slow connection; 27% who were "not inspired," or "not interested," those who said they had no time (16%) and 9% each who said they wouldn't visit because other resources were preferable, or they had already seen the film.

Survey Data (2D versus 3D)

The following sections present findings from the analysis comparing survey results of 2D and 3D viewers. This section begins with a presentation of the demographics of each group, and includes pre-viewing and post-viewing data completed by 2D viewers at the Museum of Science in Boston, and 3D viewers at the California Science Center in Los Angeles.

Demographics

A total of 417 visitors completed surveys in Boston and 386 in Los Angeles. Breakdowns by gender, age, education and familiarity with the film format follow.

Gender

2D audiences included a higher proportion of males than 3D audiences. See Table 9.

Table 9

Gender of Respondents by Film Format

	2D N=417	3D N=386
Male	53%	45%
Female	47%	55%

Age

2D audience included a higher proportion of young adults compared to 3D audiences, which included high proportions of viewers in all other age groups. See Table 10

Table 10

Age of Respondents by Film Format

Age	2D N=417	3D N=386
< 18	32%	40%
18-30	37%	21%
31-50	23%	27%
50+	8%	12%

Education levels

2D respondents included slightly higher portion of respondents with graduate degrees. See Table 11.

Table 11

Education Level by Film Format

	2D N=417	3D N=386
Elementary/Middle School Student	12%	24%
High School Student	15%	11%
High School Graduate	23%	20%
College Graduate	31%	32%
Graduate Degree	18%	13%

Familiarity with Large Format (IMAX) and 3D

Respondents in both locations had similar levels of experience with the format in which they were viewing the film. See Table 12.

Table 12

Familiarity with Format

# Imax or 3D Films Seen	2D N=417	3D N=386
0	15%	16%
1-3	50%	50%
4-6	17%	19%
7+	18%	15%

Findings

Overall Ratings

3D viewers rated the film between very good and excellent (4.3), while 2D viewer ratings fell between good and very good (3.9). The greatest differences were in the proportion of ratings of good and excellent. See Table 13.

Table 13

Film Ratings by Film Format

	2D	3D
1 Poor	1%	0%
2 Fair	6%	3%
3 Good	26%	13%
4 Very Good	39%	36%
5 Excellent	28%	48%

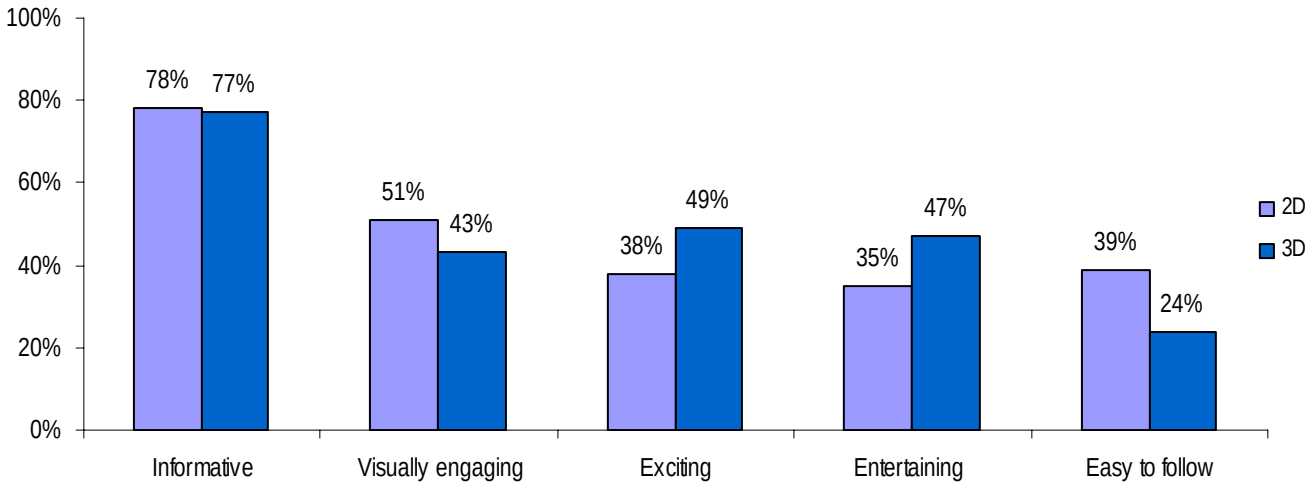
Consistent with the difference in overall ratings, significantly more 3D viewers (97%) indicated they would recommend the film than 2D viewers (88%).

Descriptors

The top five descriptors selected by 2D and 3D viewers were the same, and viewers of both versions most frequently selected "informative."

However, the degree of selection for other descriptors varied. 2D viewers were more likely to find the film "visually engaging" (51%) and "easy to follow" (39%), while 3D viewers found the film "exciting" (49%) and "entertaining" (47%). See Chart 11.

Chart 11
Top Film Descriptors by Film Format



Scene and Story Ratings

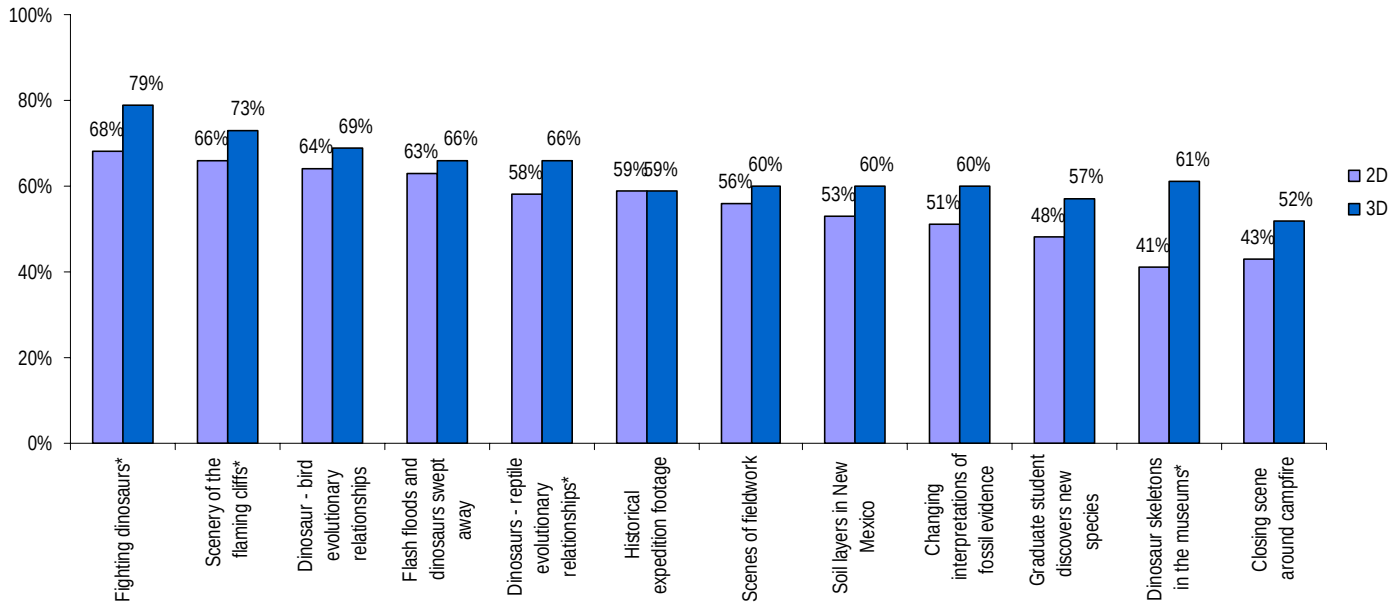
While the order of scenes and stories was similar between the two groups of viewers, 3D viewers were generally more enthusiastic about each of the scenes and stories (52%-79% "liked a lot") than the 2D viewers (41%-68%).

The greater proportion of selection of "liked a lot" by 3D viewers than 2D viewers was statistically significant on the following questions:

- *Dinosaur skeletons in the museum*
- *Scenery of the flaming cliffs*
- *Fighting dinosaurs*
- *Dinosaur-reptile evolutionary relationships*

Complete results are included in Chart 12.

Chart 12
Scene and Story Ratings by Film Format
"Liked a Lot" (%)



Science Themes

In all cases, except the *diversity of dinosaurs*, (and followed closely by *Evolution relationships between dinosaurs and birds)*, a higher proportion of 3D viewers than 2D viewers indicated the themes were "very effective."

The higher proportion of selection of "very effective" by 3D viewers than 2D viewers was statistically significant on the following questions:

- *Evolutionary relationship of dinosaurs to reptiles*
- *Importance of climate on the preservation of dinosaur fossils*

See Charts 13a and 13b.

Chart 13a
Effectiveness of Themes by Film Format
"Very Effective" (%)

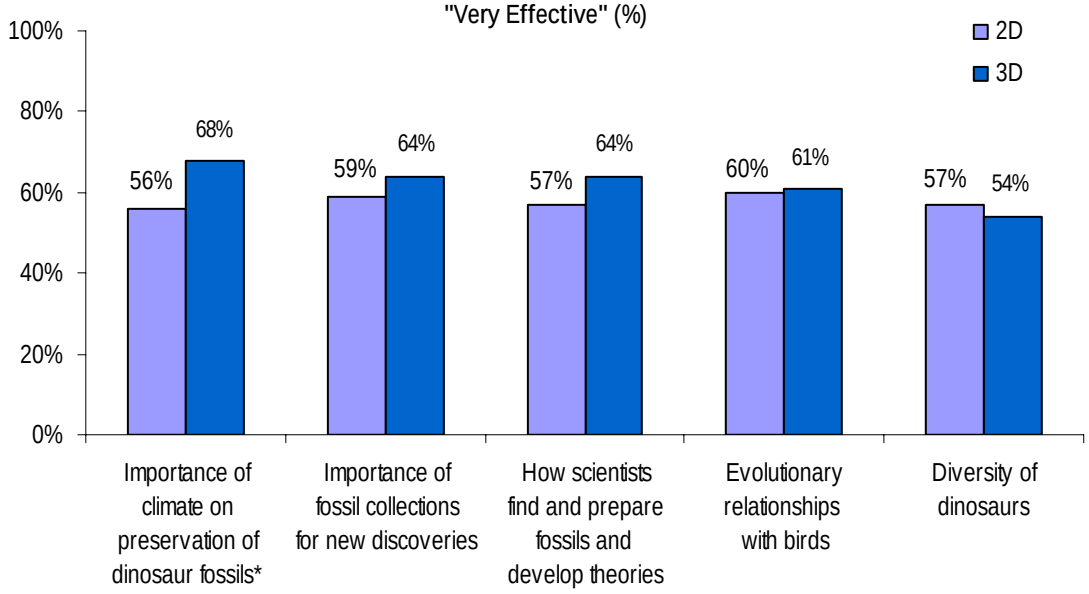
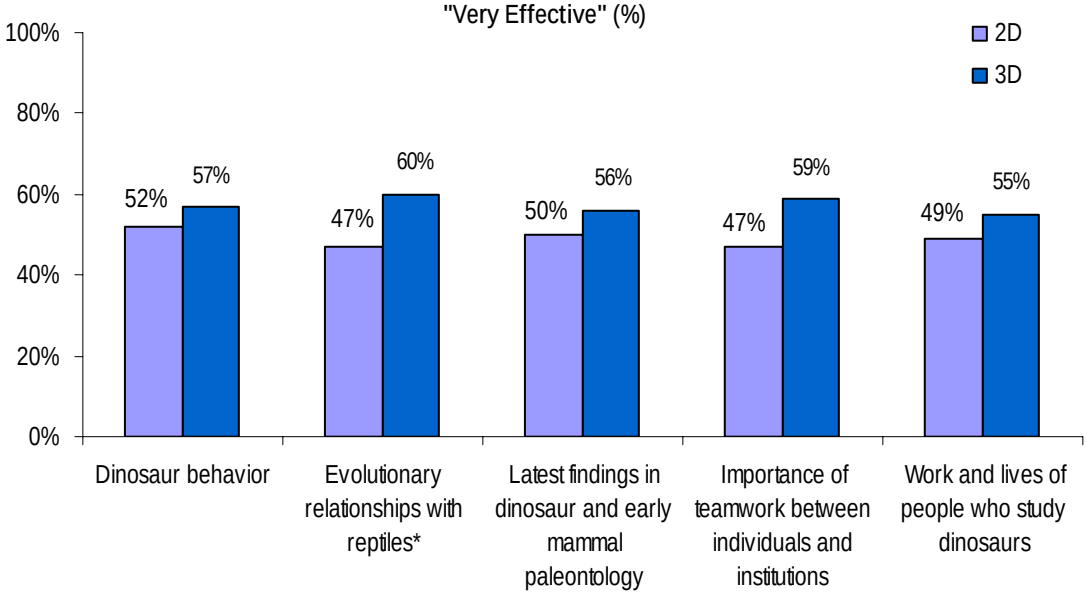


Chart 13b
Effectiveness of Themes by Film Format
"Very Effective" (%)



Topic Knowledge

On questions in which pre-viewers and viewers were asked to rate their knowledge of science topics presented in the film, significant gains were seen by 2D viewers on all questions, and on a subject of questions for 3D viewers. Questions on which significant gains were seen for 2D viewers only included the following:

- *Dinosaur physiology*
- *Dinosaur behavior*
- *Dinosaur evolution*
- *Dinosaur interaction with other animals*

Complete results of significant improvement for all question is shown on Table 14.

Table 14
Change in Topic Knowledge (Significant Improvement) by Subgroup

	2D	3D
The work of paleontologists	*	*
How new discoveries about dinosaurs are made	*	*
How fossils are formed and preserved	*	*
How climate impacts fossil preservation	*	*
Dinosaur anatomy	*	*
Dinosaur physiology	*	
Dinosaur behavior	*	
Dinosaur evolution	*	
Dinosaur interaction with other animals	*	

Learning (Multiple Choice Questions)

Learning across age groups by film format were consistent with both the subgroups and across formats. Significant gains were seen across both 2D and 3D viewers on the following questions:

- *Which of the following is NOT a time period during which dinosaurs lived?*
- *Which of the following are tools used by paleontologists in the field? (hammer, brush and toilet paper)*
- *The first dinosaur eggs were (found by Roy Chapman Andrews in the 1920s)*

No significant improvement for either 2D or 3D indicated on the following question:

- *Which of the following are used to understand evolutionary connections between dinosaurs, birds, and reptiles?*

Learning (True/False Questions)

Responses improved significantly for all questions for both 2D and 3D audiences with the exception of the question about *dinosaur diet* which showed an increase, but not significantly, for 3D audiences.

These results are summarized in Table 15 below.

Table 15
Content Questions (Significant Improvement)
By Film Format

Fossil evidence helps scientists understand…	2D	3D
nesting behavior	*	*
relationships to other species	*	*
skin color	*	*
interactions with other creatures	*	*
dinosaur diet	*	

Motivation

There was no difference in how 2D and 3D viewers responded to questions about becoming a paleontologist or visiting the website.

Focus Group Discussions

Appeal

In opening remarks, participants were generally very enthusiastic about the *Dinosaurs Alive* film. They described the film as "entertaining" "exciting," and "complex," and that the film provided a "glimpse into the past." The attribute that consistently rose to the surface in the start of each of the groups was how informative the film was, for instance, "I enjoyed it, and thought it was informative," "it had lots of information," "It was very informative for me—showed history of paleontology in the past century and updating it." And "It was interesting—not just fighting dinosaurs, but information about how archaeologists (sic) did the dig. And my son had done a report of Roy Chapman Andrews, so that was interesting," "[it showed] how fossils were made," From the very start of discussions—even without prompting - viewers shared thoughts on content and topics that had been of interest or new to them. Details on responses to specific themes are discussed below.

Additional opening remarks often included comments on the different kinds of footage in the film—animated, live action, and archival—and in most cases viewers felt they had been woven together successfully. For instance, one participant said, "The film bounced around a lot, but pieced together the action, CGI and museum displays which all flowed together very well." There were also a number of comments that the film was well-paced.

A wide variety of scenes were mentioned as favorites or images and sequences noted as memorable both when asked directly and throughout the discussions, as people recalled additional images and sequences that they had enjoyed. A sampling of these includes, "when he reads his diary;" "when dinosaur scratches the scene;" "fighting scenes;" "where he discovers the egg…but then years later it turns out to be mother;" "the poop," "pictures from the twenties," "flying or driving to the site was exciting" and "Gobi desert views." Viewers also mentioned when the dirt is shoveled into the camera, the flaming cliffs, panoramas, and brontosaurus, among others.

Participants also often mentioned enjoying the locations in which the film had been shot, particularly the Gobi Desert footage, which people knew less about, for instance, "I was not aware of the Gobi (site), and I didn't know that finds in New Mexico are that encompassing." A few, however, found the transitions between the sites difficult to follow, e.g. it was "a little bit confusing that they were jumping from place to place," and in one group a participant asked whether they had returned to the Gobi after visiting New Mexico.

Viewers were enthusiastic about the overall production and most felt the large format or 3D experience was successful. For instance, "the production was wonderful, visually compelling, and kept my interest," and "the graphics were great." "Cool, and the 3D feels like you were there." And one viewer, although she was well-informed on much of the dinosaur science and did not find the content new, nevertheless said, "it presented everything nicely—like about the Oviraptors, and also about the bend in the river." Several viewers commented that the film felt short, and that they wanted to see more, though in one group this prompted comments that it was a good length for young audiences. Several participants commented that the liked the narration and the narrator. "I

liked narration—it was nice and I learned a lot. And it went with the background music and scenes."

Some of the concerns about the overall production included a lack of fit between the dinosaur action footage and paleontology story, which was raised by a few viewers. And at least one who felt that Michael Douglas was "not the right guy; there was nothing about his narration that coveys mystery."

Science Content

Throughout the discussions, participants commented on information they found interesting and new things they had learned, as well as areas that were confusing. By and large, they found the information was clearly presented, which was apparent as well by their ability to engage in discussions of the many things they had learned.

In many cases, their comments suggested being pleased that the film presented information or perspectives they had not previously considered. This varied for different viewers, but included "seeing all the different dinosaurs—I never would have thought about their relationship to crocodiles," "I thought the animal was a predator, and learned that it was sitting on the eggs," and although somewhat awkwardly expressed, "I was waiting for the meteoroid. This talked about more natural explanations about how the dinosaurs died."

This was true as well about the presentation of the scientific process. Participants praised the depiction of science as interpretative, "That's the interesting part of it… grad students looking at things 80 or 90 years old," "I liked the humanizing aspect of 'Hey, we were wrong.' It demonstrates that we as scientists are not as absolute as we seem," and "I liked the honesty—we learn more as we probe further, and what we know today might not be true with further discoveries." Though there was at least one dissenting voice, who felt this kind of presentation was "silly, because in twenty years we'll know something different," suggesting that she took it for granted that science progresses. Some viewers also made connections and comparisons between contemporary and earlier eras of paleontology, specifically reflecting on the continuities of "fossil hunting."

Dinosaur Evolution

Participants were very satisfied with the presentation of the evolutionary relationship between dinosaurs and birds. This was new information for a number of participants, as reflected in the following comments, "I didn't know that velociraptors had feathers, and I learned about the relationship between dinosaurs and birds," "Everybody always thinks dinosaurs are like lizards, so to learn that some have feathers, you go, 'huh,'" and "I learned how dinosaurs live on as birds." The fossil evidence of the feathered dinosaur shown in the film was particularly memorable for viewers, as well as the transition from the fossil to a flying dinosaur.

Viewers were somewhat less enthusiastic about the clarity of the presentation of the relationship between dinosaurs and reptiles. Some noted learning of the co-existence of dinosaurs and reptiles, and specifically of crocodiles, and some offered additional details about what they had learned about the relationship between crocodiles and Effigia.

Others however, felt the presentation of this in the film was difficult to follow, and that had not been "well-explained."

Climate and Preservation of Fossils

The role of flash flooding in wiping out dinosaurs and creating fossil collections—particularly the visualization of each of these—were also memorable for many viewers. And they were mentioned both in discussions of content and of specific scenes. For instance, one viewer noted "how dramatic the weather was in creating situations where the remains were so intact," and reflected on how this helps paleontologists know where to look for fossils. Another theme noted by some viewers was that the environment in which dinosaurs had lived was once tropical and is now dry, e.g. "Lush wetlands during dinosaur age –now those areas are all deserts. The movie brought that out. The visualization was nice." Responding to the questionnaire completed at the beginning of the focus group, one of the children mentioned that she hadn't picked up on the theme about "the role of the climate." In this case, at least, her lack of awareness of this "theme" appeared to reflect not having generalized the specific stories about fossil finds to thinking about the climate more broadly, rather than a lack of understanding of the particular sequences and stories in the film about fossil preservation.

Paleontology

Several distinct aspects of the depiction of paleontological study stood out for viewers. First, many were impressed by the unexamined fossil collections in museums, and how long fossil finds can be stored without being examined. They were also impressed that these collections continue to be valuable for developing new information, e.g. "It was surprising how they store what they have, and generations later find something new."

Another area which stood out was the patience and detail work required in the field, e.g. it "needs a lot of patience, and is tedious." From discussions, particularly with the children in the focus groups, some felt these were attributes that they possessed and others not. They also differentiated between different parts of the work. While one said, "it might be fun to work and dig for new bones and species," another noted that while she wasn't interested in the digging, she liked what they were doing in the lab—"that was really cool." Several participants noted enjoying hearing the banter of paleontologists in the field.

Viewers responded positively to the story of the discovery of a new species, and the profile of the young graduate student who made the find. This was a perspective shared by both children in the group, and adults who felt it was an important model for children. However, while many agreed that the story was inspiring, others did not like the story because the dialogue "felt scripted."

Participants clearly understood that they were seeing—in a cursory way—the overall process of developing new information about dinosaurs, from fossil finds to analysis. In a few cases, participants felt that parts of the process could have been shown in greater detail, such as giving a greater sense of how long digging or analysis took, or providing yet more detail of what was being seen at digs or in the laboratory. Though in one group, some of the participants noted that given the time limitations, they had been adequately portrayed.

Dinosaurs

The visualizations of the dinosaurs was another strength of the film. Participants liked being introduced to "new dinosaurs," and felt the turntables were effective in highlighting the creatures. Comments included both appreciating seeing unfamiliar species and learning new information about familiar species. For instance, an adult viewer who described himself as having been "an avid dinosaur teen," noted how differently T. rex was represented in this film compared to *Jurassic Park*.

While many viewers noted that the timeline graphic below the dinosaurs was helpful, a few viewers across the different groups were still confused about where each dinosaur fit in chronologically to the others. Viewers in one group found the dinosaur sizes were difficult to imagine, and felt that the scale could have been conveyed by including a human alongside the creatures.

Viewers were also very interested in what had been presented of dinosaur behavior. They were both interested in the details of dinosaur fighting behavior, and noted things like "dinosaurs hunt in packs like wolves do today," and other aspects of behavior, e.g. that the film showed dinosaurs are "not just all about attacking—they can be good parents too."

A piece of narration that really stood out for viewers, and came up in conversations across all of the groups, was the comment that only 2% of dinosaurs have been discovered. This was inspirational for some, and it raised questions such as "what the dinosaurs they haven't discovered look like." Others were taken aback by the figure, and felt its origins had not been clearly presented, e.g. "That was a number out of thin air." Some viewers even felt this statement lessened the credibility of the film, or had been wrongly "presented as fact, instead of projection." Another viewer noted that although she did not understand the calculations behind this figure, she recognized that it was not "made up" by Michael Douglas, and that she trusted the content because the film had been funded by the NSF.

These conversations raised additional questions about how creative decisions were made in the representation of the dinosaurs. Participants wondered about the "choice of spots" in the skin of one of the creatures, and another wondered about the kinds of sounds they were shown making.

Animation Use and Quality

Discussions of the use and quality of the animation in the film were particularly impassioned in a few of the groups. Viewers held mixed feelings about the quality of the animation, and how important that was in the context of a science film. In some cases, viewers were extremely excited not just by the visualizations of the dinosaurs themselves, which were generally seen as of a high quality, but the use of them to convey complex information about dinosaurs. Several applauded the successful use of animation in providing visualizations in ways that other media cannot. Some of these comments included, "I will remember the flood water rushing through – you don't get that from the exhibit descriptions," "I liked the flash flood recreation. That showed the imagination paleontologist uses to recreate the events – it was memorable," and another was struck by the opening scene –"It stretches the imagination as to how they could have been locked in

combat, and the fossil is still like that." These kinds of comments were made as well about the transformation of the fossil of the feathered dinosaur into a flying dinosaur, and the visualization of the fossilization of bone.

Despite this, some of the viewers were critical of the quality of the animation, noting in particular the background images, especially the sand, footprints and water. In two of the 2D groups in particular, participants got into detailed discussions of the relative merits of the animated sequences, and their comments suggested mixed expectations for the quality of the animation from large format films. While some felt that the animation should exceed that of feature films such as *Jurassic Park* and were resultantly somewhat disappointed, others felt that it was the scientific content which mattered most, e.g. "the animated scenes were well-placed and it didn't bother me that it was out-dated." At one extreme, a viewer felt the fighting dinosaur scenes had been "silly," and sensationalistic, and at the other, one of these participants explained that what was "extremely effective was the way the film and education can meet – when they showed the real life fossil and dissolved to animated bird." This was echoed by others, who applauded, for instance, the "cuts from reality to animation." In some cases, these viewers wished these techniques had been used more often, e.g. "when the fossil on the cliffs became an animated bird – that was so effective. I would like to see how bones map to '3D' [e.g. full-bodied creatures.]"

Discussion in the 3D groups was somewhat different. The most common criticism about the animated sequences among these groups was a desire for more of them, particularly the ones in which the animation leaps out at the audience, e.g. "I work with kids from birth to early 20s… I was looking for more of the visual effects and this was more informative," and "I anticipated more screaming dinosaurs in your face." Echoing these sentiments, a discussion by some of the children in one group included wishing for more of these 3D sequences, and liking the dinosaur recreations better than the "bones." Some viewers also noted some problems with the quality of the 3D images. One participant explained the "3D aspect wasn't as dramatic as some other 3D films. The impact of it, when dinosaurs popped up – it was too close and not realistic. The focus was lost when it got too close." Focus problems were mentioned as well in relation to a few shots by some of the 2D viewers.

Overall, both 2D and 3D viewers were happy with the film's use of the medium. To some degree, there may have been more enthusiasm by 2D viewers about the aerial and panorama views, and more concern about the dinosaur action among the 3D audiences, but viewers across the two mediums were both excited about the film.

Discussion

Appeal

The *Dinosaurs Alive* film was well-liked by viewers. Seventy-six percent (76%) of viewers rating the film as either very good or excellent and 92% said they would recommend the film to others. Viewer responses on surveys and in focus groups suggest an overall enjoyment and appreciation of the film, and especially high regard for the scientific content. While many participants noted information that was new to them, others, including those dinosaur aficionados in the groups (and their parents), praised the presentation of familiar content. Audiences overall found the film visually engaging, exciting, and entertaining. While there were only minor differences in ratings given by men and women on various components of the film, there was a pattern in the ratings given by audiences of different ages. Adults consistently provided the highest ratings, followed by children. The most critical age group—consistent with the difficulty of attracting this cohort to science centers—were the young adults (ages 18-30).

The film used the excitement created by computer generated dinosaur animation to tell a larger story about the work of paleontology. All of the science themes which viewers were asked about were rated very highly. And, it was some of these stories about dinosaur science, rather than about the dinosaurs themselves that were seen as most effective. In particular, viewers felt they had learned the most about the impact of the climate, importance of fossil collections for making new discoveries, process by which new theories are developed and the specific story of dinosaur-bird evolution. Information about the diversity of dinosaurs and dinosaur behaviors, and other dinosaur and paleontology topics were also deemed effective by viewers, but less enthusiastically so.

Overall, the animated sequences of fighting dinosaurs and the aerial views of the flaming cliffs in the Gobi desert were the most popular scene and story components of the film. Content areas in which interesting visual elements were used to explore scientific content were also very popular, including the presentation of the evolutionary relationships between birds and dinosaurs, and the visualization of the impact of flash floods on dinosaur populations and dinosaur fossils. Male viewers were more enthusiastic about the *fighting dinosaurs footage*, and females were more appreciative of the *historical footage*, but otherwise their responses were largely consistent with one another.

In some cases, the appeal of particular scenes or stories varied by the age of viewer. Adults found the stories about the impact of flash floods, historical expedition footage, and presentation of changing interpretations of fieldwork more appealing than the children or young adult viewers. At the other end of the spectrum, while adults and children were enthusiastic about the story of the graduate student who discovers a new species, this story received the lowest of all ratings by young adults, likely the peers of the student profiled. Comments in focus groups, though not confined to young adults, singled this sequence out for feeling staged.

Overall, viewers enjoyed the story of historical and contemporary paleontology, the travel to different sites, and mix of archival, live action and animation footage, though different elements held greater or lesser appeal for different viewers. The diverse

components of the film were generally seen as well-integrated. However, in some cases, viewers felt there was tension between the dinosaur action footage and paleontology topics. For some of these viewers, they felt the film's title had created an expectation that the film would include a greater proportion of dinosaur action footage, and were thus disappointed that there was not more CGI and dinosaur action.

Learning

Comparison of the ratings given by viewers and non-viewers (i.e. pre-viewers) on their knowledge of film topic areas suggests that respondents felt their knowledge had increased across all the content areas investigated. These gains were modest but statistically significantly. The greatest gains were recorded in how new discoveries about dinosaurs are made, the work of paleontologists, and how climate impacts fossil preservation. These findings were similar for both male and female viewers, though females' gains in knowledge about dinosaur behavior and interactions with other animals were not statistically significant.

On factual questions, comparative data again showed positive increase in knowledge between pre-viewers and viewers across all questions. This included significant gains both overall and for all subgroups on multiple choice questions about paleontologists' tools, the first dinosaur egg finds, and identification of the time periods in which dinosaurs lived. These results suggest the effective presentation of these topics. And despite some confusion about the sequence in which the dinosaurs were presented, the strategy of including timelines for each of the dinosaurs (using screen graphics), was nevertheless successful in familiarizing audiences with the eras in which dinosaurs lived.

Significant gains in viewer knowledge were recorded as well on a series of questions about the use of fossil evidence related to understanding dinosaur nesting behavior, identification of skin color, interactions with other species, evolutionary relationships to other species, and dinosaur diet. In most cases, much of this information was presented both visually and in narration and was successfully understood by viewers. Focus group discussions suggested that viewers appreciated the presentation of science as a process in which our understanding of dinosaurs continues to develop. Viewers—particularly adults—found the historical perspective provided through the story of Andrews' expedition to be interesting, and to add an additional dimension to understanding how science has both remained constant and changed.

One of the goals of the film was to present the work of paleontologists in a positive light and inspire young audiences to pursue science careers. Across data points, viewers felt the work and the lives of the scientists had been clearly presented. One third of all viewers, and two-fifths of the children who saw the film, indicated they could see themselves doing the work of a paleontologist. Children commented that they thought the work was interesting, found dinosaurs and fossils appealing, and were interested in contributing to science. On surveys and in focus group discussions, participants comments suggest that the film depicted the work as very detail-oriented and generally conducted in hot climates, which were either incentives or disincentives for varying individuals.

Over half of viewers indicated an interest in visiting the website. Most looked to the site as an additional educational resource, and noted interest in learning more about dinosaurs and dinosaur evolution, paleontology, and specifics about the research presented in the film.

Visualizations

Discussions suggested that among the film's greatest strengths was the use of animated sequences for visualizing new kinds of information, from dinosaur environments, behavior, and interactions, to the role of the weather in creating fossil beds, and the relationship between fossils and living creatures. Viewers cited the scenes of flash floods and transformations of fossils into live action as among the most memorable sequences. For some participants, these were considered an innovative and important use of the medium—worthy of the science center locations—and a way in which the film technology was being used to help audiences make leaps of the imagination important for understanding science and the practice of scientists.

The film's successes in this regard are suggestive of the value of this medium for taking visual evidence such as actual fossils shown in live footage, and using computer generated images to help viewers imagine the worlds investigated by science, and, as noted by a focus group participant, the very imagination necessary for scientists to develop new theories and for science to progress. The use of these, and way in which they were woven into a narrative structure looking at the paleontological study of dinosaurs, may also have contributed to the strong sense viewers had of the informational content of the film.

Preliminary Study of 2D Versus 3D

The presentation of the *Dinosaurs Alive* film in 2D and 3D formats offered an opportunity to take a preliminary look at how audiences respond to the different film experiences through comparison of survey results about a single film. Investigation of this has been limited by data collection from a single site for each format. Thus any local differences in audience type or composition may further impact the differences of these results. In particular, the 2D audience included a larger proportion of young adults—consistently the most critical audiences—compared to the 3D group. Thus, disaggregation of data by film format and analysis must be seen as suggestive of possible areas for further investigation.

Although receiving strong ratings for both 2D and 3D viewers, the film was rated more highly by 3D viewers, both overall and on particular scenes and themes. While both 2D and 3D audiences were most likely to select "informative" as a descriptor of the film, 2D audiences more frequently characterized the film as "visually engaging," possibly reflecting the visual and meditative quality of the IMAX medium, while 3D audiences described the film as "exciting" and "entertaining," likely responding to the action scenes of dinosaurs. The greater selection of "easy to follow" by 2D audiences may reflect greater distraction from narration by the visuals for 3D audiences.

2D and 3D audiences consistently rated the appeal of scenes (e.g. which varied in the proportion of viewers who indicated they liked each scene "a lot,") in similar order,

despite 3D ratings being consistently higher. These differences were significant on the scenes including *dinosaur skeletons in the museum, scenery of the flaming cliffs, fighting dinosaurs* and *dinosaur-reptile evolutionary relationships.*

In terms of assessments of the effectiveness of themes presented in the film, 2D and 3D viewers indicated different degrees of effectiveness on several of these themes. 3D viewers found themes discussing the *impact of climate on preservation of dinosaur fossils* and *the importance of teamwork between individuals and institutions in conducting research* more effective than indicated by their counterparts viewing the film in 2D. In contrast, 2D viewers indicated greater clarity regarding the *diversity of dinosaurs* and *evolutionary relationship of dinosaurs to reptiles.*

Comparison of 2D and 3D responses on self-ratings of knowledge suggest a perception among 2D audiences of greater learning across all questions. Statistically significant gains (positive) in knowledge differed for 2D and 3D audiences on the questions about *dinosaur physiology, dinosaur evolution,* and *dinosaur interactions with other animals.* In these three areas, 2D audiences indicated significant increases in knowledge not shown by 3D group responses.

Increase in knowledge on multiple choice and true/false questions of 2D and 3D audiences suggest similar patterns in learning, with one exception. There was a greater increase in the correct response of 2D audiences on the question about the importance of fossils for learning about dinosaur diet.

These results suggest that the two formats offer different kinds of viewing experiences. For instance, the greater "visual engagement" for 2D viewers compared to the "excitement" for 3D viewers. Interestingly, responses from 2D audiences suggest greater learning, despite the greater appeal indicated by 3D audiences. Differences in ratings of appeal and effectiveness on the various scenes, images and themes suggest areas for future investigation regarding the characteristics of scenes and images which are most effective in one or another format.

Summary

The data indicate very clearly that the film's strength was the science content, and though it is less explicitly reflected in the data, a particular strength of the film may well be the way the science content is presented in the context of *stories of scientific discovery and interpretation*. This approach sets *Dinosaurs Alive* apart from other large format films and may account for the consistently strong perceptions viewers had about learning and the film's informative nature. What was clear from the data was that the telling of these stories through directly observable visual evidence and models – images of real fossils, and animation of scientifically-informed creatures and environmental conditions - was very powerful for many viewers.

A reading between the lines of viewers' ratings and focus group comments suggests that the slightly depressed overall rating for the film may be because of a sense of disappointment – for some viewers – that there wasn't more or even continuous dinosaur action, as suggested by the title. For others, the quality of the animation, particularly the backgrounds, may have detracted from their experience. And for others, particularly for

2D viewers, there may have been a sense of the film as emotionally flat – thus the importance of the lone, but perhaps telling, comment that Michael Douglas' narration lacked a sense of mystery.

Despite these weaknesses, the large number of viewers who said they would recommend the film to others again speaks to viewers' respect for the content. It is not unusual to hear recommendations for films couched in terms of age or interest, delineating to whom they might or might not recommend a film. In the case of *Dinosaurs Alive* viewers were very clear that based on the science content—and for those with an interest in that particular content—they would recommend the film enthusiastically.