



DragonflyTV Evaluation Report Spring 2003

ROCKMAN *ET AL*



DragonflyTV Evaluation Report Executive Summary

In the Spring of 2003, ROCKMAN *ET AL* conducted an evaluation that was designed to explore children's viewing behavior, outcomes of viewing, the impact of the program's structural features, viewers' content preferences, and factors that motivate greater participation by viewers. Nearly six hundred children and twenty-five adults in three major U.S. cities participated in this study. Evaluation activities included:

- Five sets of student surveys: one administered prior to viewing episodes of DragonflyTV, one following each of the three programs viewed as part of the evaluation, and one administered after students had seen all three episodes;
- A series of observations of students viewing DragonflyTV in which attention patterns were recorded and analyzed;
- Two rounds of student interviews including one prior to viewing episodes of DragonflyTV and a second round conducted after all three episodes had been viewed;
- Interviews with teachers in each classroom participating in our study after all three episodes had been viewed; and,
- Focus groups with extra-curricular science clubs.

All evaluation activities were designed with four themes in mind: content preferences, structural features, learning outcomes and participation. Major findings from this evaluation are presented below.

Content Preferences

There are many factors that play a role in determining audience appeal, but content clearly seems to be dominant among them. There was a unmistakable preference for the episode on propulsion (Episode 205) with 81% of students saying they were interested in the episode, and 91% stating that they'd like to do experiments like the one shown in that episode. Students found the segment on model rockets to be particularly appealing, often referring to this as one of their favorite things about DragonflyTV in the final round of student interviews.

We found some evidence that content preferences vary by grade and gender. Surveys revealed a significantly higher level of general interest in the topics on DragonflyTV among fourth graders. Fourth grade students also reported a slightly higher, but statistically significant, liking of the episode about mammals (Episode 211) and the episode about the Human Body (Episode 206). Girls reported a slightly higher, but statistically significant liking of the episodes on mammals and the human body. Interviews with students and teachers confirmed that younger children and girls seem to be generally more interested in animals.

The investigation segments, highlighting kids doing their own research, were clearly favored over other types of segments featured on DragonflyTV. It is also interesting

to note that the most favored segment from all three episodes was the ice cream scientist featured in Episode 206 (*Human Body*), suggesting that children like hearing from and learning about adult scientists, if the subject matter is of interest to them.

Structural Features

When viewing an episode of DragonflyTV, it is hard to deny the program's vibrant look and sound. The show features a contemporary production style, varied camera angles, quick pacing, and an assortment of music and audio clips. These features help DragonflyTV capture viewers' attention and stimulate engagement.

The number of students' eyes-on-screen throughout each program remained high. Even when there were disruptions in the classrooms, most children kept their eyes on the screen. Overall, 5th grade students seem to keep eyes-on-screen more than 4th graders. Fourth graders' attention was clearly higher during the episode on *Mammals* than it was during the episodes that followed. This finding, combined with what we learned through survey data (i.e. 4th graders liked the *Mammals* episode significantly more than 5th grade viewers) supports the notion that there tend to be more eyes on screen when the topics are of interest to the viewers.

Throughout each observation, children seemed to be enjoying the music. There were many cases where the children would sing along (or mouth the words) with songs that they knew. In other instances we saw feet tapping and what might be described as dancing in their seats. We noticed that certain songs have the ability to pull in children's attention in cases where it had wandered away from the television. The music-video-like montages of photos held their attention well and seemed to add to their overall enjoyment of the program. Survey data supported the notion that the music had a favorable impact on viewers.

We noted that students were most attentive during points in the programs where data was being collected and recorded. Children appeared interested in following along with the kid-researchers shown on the program as they were gathering data, and were attentive to the charts and graphs they created to display their findings.

Learning Outcomes

Generally speaking, teachers reported that their students wanted to do more research and more investigations as a result of viewing DragonflyTV. Furthermore, most teachers felt their students were better prepared to do science projects after viewing several episodes of DragonflyTV. Student survey data also supports the finding that students are more interested in doing science projects and focus group participants said that the show gave them ideas for doing their own science projects (and information on how to do them better).

It seemed clear to many teachers that children understood more about the scientific process and scientific inquiry as a result of watching DragonflyTV. Over 90% of

students surveyed indicated that DragonflyTV helped them to understand how to do a science experiment. The children we spoke with in interviews and focus group sessions also emphasized the value of learning different ways to graph data for analysis and presentation purposes. In student surveys we also saw a jump in the number of students indicating that it was very important to write down whatever happens in an experiment.

Participation in DragonflyTV

Nearly 70% of students surveyed indicated a desire to be on DragonflyTV. In terms of incentives for applying to be on DragonflyTV, only a few additional students indicated that they'd like tangible incentives (e.g. money or prizes) than those indicating that the intrinsic educational value—to learn new things, or to share what they've learned with others—was incentive enough. Students indicated that they'd also be motivated by competition, by being on television, and by having peers doing it as well.

Children seemed to realize the important role that adults must play behind the scenes in many of the investigations shown on DragonflyTV. They believed that adults likely served not only as supervisors, but also motivators. Teachers and extra-curricular group leaders echoed children's statements about the importance of adults' involvement in helping to guide successful investigations and subsequent applications to be on DragonflyTV. The general sentiment among teachers was that greater awareness about the show and the application process was necessary to generate more idea submission. While children's ability to participate on DragonflyTV seems to be hindered most by the lack of adult motivators and mentors, adults seem to be hindered by lack of program awareness and time.

Survey data suggests that more-involved kids are most likely to want to be on DragonflyTV. Regression analysis showed that there is a positive, statistically significant relationship between student involvement in outside activities and how much they want to be on DragonflyTV. Our analysis also showed that students' desire to be on the show varies significantly by grade, with 4th grade students stating they want to be on the show more than 5th grade students.

Other Findings and Conclusions

One of the greatest obstacles that the program seems to be facing in the markets where we conducted our study is the early morning time slot. Teachers felt that their students would be more likely to view the program if it were on at a better time. Students also felt that a better time slot might make it more conducive for them to view DragonflyTV at home.

The “reality” of DragonflyTV seems to be one of its greatest strengths. Teachers like the fact that it shows real kids and students seem better able to relate to it as a result. One teacher remarked that she liked DragonflyTV because it didn't seem like

a canned show. "I liked the Bill Nye show, but I liked DragonflyTV better because it was a real show with real kids."

Students' general opinions about science improved as a result of viewing DragonflyTV. The extent to which students understood the content presented on DragonflyTV emerged as a better predictor of positive changes in students' attitude toward science in general than the extent to which they liked the program, perhaps indicating that DragonflyTV succeeds in reaching students who have traditionally been turned off by science programming that they've found to be confusing or difficult to understand.

In sum, results from this evaluation demonstrate that DragonflyTV not only entertains, but also educates its viewers. The program succeeds at appealing to children in the target age group (nine to twelve) and manages to promote greater awareness of the steps associated with the scientific process. Teachers were extremely excited about the program and were eager to incorporate it into their instruction and students were turned on by the fact that they could learn something from a program that they enjoyed.



DragonflyTV Evaluation Report Spring 2003

DragonflyTV is a new science program targeted at children ages nine through twelve. Funded in part by the National Science Foundation, the program uniquely features real children conducting their own inquiry-based investigations. In the Spring of 2003, ROCKMAN *ET AL* conducted an evaluation that was designed to explore children's viewing behavior, outcomes of viewing, the impact of the program's structural features, viewers' content preferences, and factors that motivate greater participation by viewers.

Methodology

Research on DragonflyTV was conducted in Boston, Chicago, and San Francisco and involved a total of twenty-four fourth and fifth grade classes. In addition to the research we conducted in the formal setting of schools, we also gathered feedback from audience members in less formal settings, such as science clubs and extra-curricular organizations. Nearly six hundred children and approximately twenty-five adults participated in our study. (See Table 1.)

Table 1: Overview of Research Design

| | Chicago | | Boston | | San Francisco | |
|----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | 4 th | 5 th | 4 th | 5 th | 4 th | 5 th |
| Non-observed | 2 classes | 2 classes | 2 classes | 2 classes | 2 classes | 2 classes |
| Observed | 2 classes | 2 classes | 2 classes | 2 classes | 2 classes | 2 classes |
| Science Clubs | 1 science clubs | | 1 science club | | 1 science club | |

In collaboration with the producers, we selected three episodes from DragonflyTV's second season for this study. *Episode 211: Mammals*, *Episode 206: Human Body* and *Episode 205: Propulsion* were shown to each of the participating classrooms in that order, followed by a short post-viewing survey after each episode. We conducted interviews with two pairs of students from each class (nearly 100 students) before the students were shown the first video, (i.e. pre-viewing), and again after they had viewed all three videos (i.e. post-viewing). Surveys were also administered to students (more than 500 total) prior to viewing the first video and following the third video. The evaluation team also interviewed teachers, conducted classroom viewing observations in half of the classrooms, and held observation/focus group sessions with science clubs and extra-curricular organizations.

Pre-Viewing Interviews with Students

Two pairs of students were selected from each class prior to viewing any DragonflyTV episodes. Researchers worked with teachers to identify a pair of higher-performing students and a pair of lower-performing students. Students were asked a series of

questions about science and their television viewing habits. They were then given a prompt to design their own scientific investigation that would study the effects of caffeinated soda on some aspect of students' school performance. They were given five minutes to work with their partner to come up with plans for their investigation, to think of as many details as possible, and to identify the different steps they would need to take in order to conduct their investigation. Students were given a DragonflyTV stopwatch as a "thank you" gift for their time and participation in the interview (except in San Francisco, where classroom sets of stopwatches were given instead).

Post-Viewing Interviews with Students

Four different students from each class were selected to participate in post-viewing interview sessions after they had seen three episodes of DragonflyTV. Again, students were paired as higher-performing or lower-performing. They were asked a series of questions about DragonflyTV and their general thoughts about science and about doing scientific investigations. They were then prompted, using the same prompt used in the pre-viewing interview, to come up with ideas and descriptions about possible scientific investigations about caffeine intake and children's school performance.

Student Surveys

Evaluators administered pre-viewing and post-viewing surveys to each participating class. At the end of each episode, a five-question, episode-specific, survey was also administered to the classes. At the conclusion of the study, all students were given a DragonflyTV pencil to thank them for their help.

Preliminary analysis of data sought to answer the following questions:

- To what extent do children understand more about the scientific process and inquiry after viewing the DragonflyTV episodes compared to before?
- Are children more interested in doing science projects after viewing DragonflyTV?
- Did a higher proportion of students like science more after viewing DragonflyTV?
- What were students' viewing habits before and during DragonflyTV?
- Were there any changes in how much students would like to do a science project on their own in the future?
- What aspects of the individual DragonflyTV episodes did students like and understand the most?
- What aspects of the individual DragonflyTV episodes did students like and understand the least?
- What were students' general thoughts/attitudes about DragonflyTV?
- In general, how much do students want to be on DragonflyTV?

Additional inferential statistical analyses were conducted using two basic statistical procedures. First, t-tests were used to examine differences between means. Second, regression analysis was used to fit models to examine a variety of additional relationships based on students' reports. All analyses included tests to examine whether or not statistically significant differences exist based on grade, gender, ethnicity, or

academic performance level. Specifically, additional analysis addressed the following questions:

- Is there a statistically significant relationship between students' reports of the extent to which they liked science prior to viewing DragonflyTV and how much they liked each video and understood the content?
- Is there a statistically significant difference in how much low, average, and high academic performing kids want to be on the show?
- Is there a statistically significant relationship between students' reports of the extent to which they liked each video and understood the content and the extent to which they reported liking science after viewing the three episodes of DragonflyTV?
- Is there a statistically significant relationship between the extent to which students liked the DragonflyTV episodes and their interest in doing experiments?
- Is there a statistically significant difference in the liking of one episode versus another?
- Is there a statistically significant difference in the comprehension of one episode versus another?
- Is there a statistically significant pre-post change in students' understanding of the importance of experimental methods?
- Are there significant differences among groups of viewers based on academic performance (low v/s average v/s high) or involvement in extracurricular programs (no involvement v/s low or high involvement)?
- Which students (low, average, or high academic performers) are more likely to be involved in extracurricular activities?
- Which students (low, average, or high academic performers) are more likely to do investigations/apply to be on the show?
- Are kids that are generally more involved in activities outside of school more or less likely to do investigations/apply to be on the show?
- Do more "involved" kids show greater liking (or understanding) of the show?
- What significant differences exist based on region, student grade level, gender, and ethnicity?

Tables 2 and 3 show the demographic breakdown of our student survey sample based on grade by city, gender, ethnicity, and teachers' reports of student academic performance. Our final sample consisted of 242-4th, 295-5th, and 7-combined grade students. Students were drawn from a total of eight schools and 23 teachers in three cities (Boston, Chicago, and San Francisco). Please note that data in the tables throughout the report may not total 100% due to rounding and to occasional missing data for a category.

Table 2: Demographic Data by Grade

| | | 4 th Grade Students (n=242) | 5 th Grade Students (n=295) |
|-----------------------------|------------------|---|---|
| City | Boston | 25% (n=61) | 32% (n=94) |
| | Chicago | 42% (n=101) | 37% (n=109) |
| | San Francisco | 33% (n=80) | 31% (n=91) |
| Gender | Male | 55% (n=132) | 47% (n=137) |
| | Female | 45% (n=108) | 53% (n=153) |
| Ethnic Background | Asian | 10% (n=23) | 21% (n=56) |
| | African American | 55% (n=131) | 43% (n=116) |
| | Caucasian | 17% (n=40) | 18% (n=49) |
| | Hispanic | 13% (n=14) | 13% (n=34) |
| | Other | 6% (14) | 7% (n=18) |
| Academic Performance | Low | 25% (59) | 25% (69) |
| | Average | 50% (118) | 46% (127) |
| | High | 26% (61) | 29% (80) |

Table 3: Demographic Data by Locale

| | | Boston | Chicago | San Francisco |
|-----------------------------|------------------|-------------|-------------|---------------|
| Grade | 4 th | 41% (n=68) | 46% (n=107) | 47% (n=82) |
| | 5 th | 59% (n=98) | 54% (n=126) | 53% (n=92) |
| Gender | Male | 52% (n=80) | 51% (n=109) | 49% (n=88) |
| | Female | 48% (n=75) | 49% (n=104) | 51% (n=90) |
| Ethnic Background | Asian | 12% (n=19) | 18% (n=34) | 16% (n=27) |
| | African American | 65% (n=101) | 56% (n=106) | 27% (n=47) |
| | Caucasian | 4% (n=6) | 20% (n=38) | 26% (n=45) |
| | Hispanic | 12% (n=19) | 6% (=12) | 19% (n=33) |
| | Other | 7% (n=10) | ----- | 13% (n=22) |
| Academic Performance | Low | 33% (n=51) | 21% (n=40) | 21% (n=37) |
| | Average | 48% (n=74) | 55% (n=105) | 40% (n=71) |
| | High | 19% (n=30) | 24% (n=45) | 39% (n=68) |

Teacher Interviews

At the conclusion of our study, we spoke at length with each teacher to better understand the impact that the program had on students. We also sought to discover any impacts that DragonflyTV had or might have on their instructional practices. Teachers were given a fifty-dollar gift certificate as compensation for their assistance. In all, we worked with 23 teachers during this study.

Viewing Observations

Half of the classrooms in this study were observed as they viewed the three episodes of DragonflyTV. Two observers recorded at ten second intervals whether or not a subset of students had their eyes on the television screen and jotted down notes about what types of behavior were occurring during various points of each program. A more detailed overview of the methodology for the viewing observations that were conducted for this evaluation is presented in the section on Structural Features.

Focus Group Sessions

In addition to working with students in formal educational settings, we also obtained feedback from children outside of the school-day. In Boston and San Francisco, we conducted focus groups with participants in after-school science programs. As the children in these groups had elected to be involved in an academic program outside of the school day, we anticipated, and found (for the most part), that they were slightly more engaged in the program and tuned in to its educational value. In Chicago, we worked with a 4-H club. Even though the 4-H group was not directly affiliated with a particular school (in fact, many of the participants had to travel from a great distance in order to participate) we still found the children to be academically oriented in addition to wanting to have a good time.

Table 4: Overview of Focus Group Sessions

| Location | Organization | Date | Number of Participants | Episode Viewed |
|-----------------|-----------------------------------|-------------|-------------------------------|-----------------------|
| San Francisco | ASA: After-school Science Program | 4/8/03 | 7 | 205 |
| Chicago | T.H.I.N.K. 4-H Club | 5/17/03 | 8 | 206 |
| Boston | Mason: After-school Science Club | 5/13/03 | 9 | 211 |

We began each focus group session by having the children complete the same pre-viewing survey that had been administered to students in classroom settings. We then showed one episode of DragonflyTV (Episode 205: *Propulsion* in San Francisco, Episode 206: *Human Body* in Chicago and Episode 211: *Mammals* in Boston). Following the program we asked a series of questions designed to gather participants' (including adult sponsors) impressions of the program and information related to participation (e.g., barriers that might keep children from applying to be on DragonflyTV, possible incentives that would stimulate their desire to be on the show, etc.).

Research Questions

Our evaluation focused on four major themes: content preferences, structural features, learning outcomes and participation. A set of research questions were identified at the onset of the evaluation and served as the foundation for the instruments and protocols that were eventually established. In the following sections we present findings in accordance with each of the four research themes. The report will conclude with an overview of related findings and suggestions made by various research participants and staff members involved with this study.

Content Preferences

- What topics interest students most?
- What content segments most appeal to them? (Topic v/s Type)
- Do viewers want to see more or learn more about the kid-researchers shown on the program?

Structural Features

- How does viewer attention flow through the show?
- How do children respond to the show's structural features (e.g. pacing, use of music, etc.)?

Learning Outcomes

- Do children understand more about the scientific process and scientific inquiry?
- Do they understand specific elements of the scientific process (e.g., defining questions, measurement, repeated trials, and reporting results)?
- Are children more interested in doing their own science projects after viewing DragonflyTV?
- Do they actually do more science projects after viewing DragonflyTV?
- What is the nature of the relationship between viewing (e.g. frequency of viewing) and doing science projects?

Participation in DragonflyTV

- What's necessary to attract more participants to be on DragonflyTV?
- What are the barriers that keep kids from sending ideas/applying to be on the show?
- Is there a difference in how much average kids want to be on the show compared to kids who are involved in extra-curricular science-related activities?
- Could prizes, recognition and other incentives motivate greater participation?
- Does adult guidance/mentoring motivate participation?
- What types of adult involvement are most beneficial to encouraging participation?

Content Preferences

Content is clearly important in determining audience appeal. Teachers noted that a great deal of the knowledge that students were taking from the program was directly tied to the content. In this section we explore children's preferences for various topics and types of segments within the program.

On the surveys administered following each episode 57% percent of students reported that the topics on DragonflyTV interest them “a lot,” followed by 27% who reported they were interested “some.” A high percentage of students reported that they were either “sort of interested” (ranging from 26% to 29%) or “very interested” (ranging from 56% to 64%) in doing experiments like those they saw on the shows and would like to see another episode of DragonflyTV. (See Table 5.)

Table 5: Students' Interests Related to DragonflyTV by Episode

| | Not at all interested | Not very interested | Sort of interested | Very interested | Positives Combined |
|--|-----------------------|---------------------|--------------------|-----------------|--------------------|
| How would you rate this program overall? | | | | | |
| Video 1: Mammals | 5% (23) | 16% (76) | 35% (164) | 43% (201) | 78% (365) |
| Video 2: Human Body | 4% (19) | 21% (94) | 32% (146) | 43% (198) | 75% (344) |
| Video 3: Propulsion | 4% (17) | 15% (67) | 29% (128) | 52% (231) | 81% (359) |
| How interested are you in doing experiments like those you saw on the show? | | | | | |
| Video 1: Mammals | 6% (28) | 9% (40) | 29% (136) | 56% (262) | 85% (398) |
| Video 2: Human Body | 7% (32) | 9% (40) | 29% (132) | 55% (250) | 84% (382) |
| Video 3: Propulsion | 5% (20) | 4% (19) | 27% (120) | 64% (283) | 91% (403) |
| How interested are you in seeing another episode of Dragonfly TV? | | | | | |
| Video 1: Mammals | 6% (28) | 8% (38) | 30% (139) | 56% (261) | 86% (400) |
| Video 2: Human Body | 5% (24) | 8% (37) | 25% (115) | 62% (281) | 87% (396) |
| Video 3: Propulsion | 5% (20) | 10% (42) | 26% (113) | 61% (268) | 87% (381) |

Overall, a slightly higher percentage of students (52% versus 43%) reported being “very interested” in the *Propulsion* episode compared to the programs on *Mammals* and the *Human Body*. Students were also more interested in doing experiments like the ones seen on the *Propulsion* episode (64% indicating “very interested”) as compared to 55% and 56% for the *Mammals* and *Human Body* episodes, respectively. Students' tendency to report being “very interested” in seeing another episode of DragonflyTV was higher after seeing the second two videos than it was after seeing only the first video, but overall interest remained consistently high, indicating that several students who may have reported being “sort of interested” at first, switched to being “very interested” after seeing more episodes.

Students' reports of how much they liked each video also showed that their liking of DragonflyTV increased slightly with each video (means of 2.14 for video 1, 2.17 for video 2, and 2.23 for video 3). The difference in means between video 1 and video 3 ($t=2.99$, $p<.01$) and video 2 and video 3 ($t=3.29$, $p<.01$) were found to be statistically significant.

Grade Difference in Episode Preferences

Statistically significant differences were found between 4th and 5th grade students on the appeal of each video overall (based on an average of "how much did you like" items on the surveys administered to students after each program). Although students in both grades were similar in their responses for video 3: *Propulsion*, paired sample t-tests of means showed that 4th grade students reported a slightly higher, and statistically significant liking of video 1: *Mammals* ($t=2.43$, $p<.05$) and video 2: *Human Body* ($t=2.52$, $p<.05$) with means of 2.22 versus 2.09 and 2.23 versus 2.08 respectively.

Table 6: Students' Interests Related to Dragonfly by Episode: Compared by Grade

| | Not at all interested | | Not very interested | | Sort of interested | | Very interested | |
|--|-----------------------|-----------------|---------------------|-----------------|--------------------|-----------------|-----------------|-----------------|
| | 4 th | 5 th | 4 th | 5 th | 4 th | 5 th | 4 th | 5 th |
| How would you rate this program overall? | | | | | | | | |
| 1: Mammals (n=463) | 3.4% | 6.2% | 15.8% | 16.9% | 34.5% | 35.8% | 46.3% | 41.2% |
| 2: Human Body (n=456) | 2.4% | 5.2% | 19.3% | 21.7% | 39.1% | 26.1% | 39.1% | 47.0% |
| 3: Propulsion (n=442) | 1.6% | 5.5% | 12.8% | 16.5% | 32.6% | 26.3% | 52.9% | 51.8% |
| How interested are you in doing experiments like those you saw on the show? | | | | | | | | |
| 1: Mammals (n=465) | 3.9% | 7.7% | 6.9% | 10.0% | 27.9% | 29.9% | 61.3% | 52.5% |
| 2: Human Body (n=456) | 4.3% | 8.8% | 28.0% | 29.7% | 28.0% | 29.7% | 58.5% | 53.0% |
| 3: Propulsion (n=441) | 3.7% | 5.1% | 2.7% | 5.1% | 22.5% | 30.7% | 71.1% | 59.1% |
| How interested are you in seeing another episode of Dragonfly TV? | | | | | | | | |
| 1: Mammals (n=465) | 2.5% | 8.8% | 7.8% | 8.4% | 28.4% | 30.7% | 61.3% | 52.1% |
| 2: Human Body (n=456) | 2.4% | 7.2% | 10.1% | 6.4% | 23.7% | 26.5% | 63.8% | 59.8% |
| 3: Propulsion (n=442) | 2.7% | 5.5% | 9.1% | 9.8% | 25.1% | 25.9% | 63.1% | 58.8% |

We also found slight differences between 4th and 5th graders in the appeal of topics presented on DragonflyTV. As Table 7 shows, 4th graders are slightly more interested in the DragonflyTV topics than 5th graders. Although the difference is small (mean of 2.47 versus 2.28 on a scale from 0-3), it is statistically significant ($t=2.28$, $p<.05$). However, we are reminded that there is high interest regardless of grade.

Table 7: Students' Interest in Topics on DragonflyTV

| The topics on Dragonfly TV interest me... | Grade | | Total |
|---|-----------------|-----------------|-------------|
| | 4 th | 5 th | |
| Not at all | 2.5% (5) | 7.9% (20) | 5.6% (25) |
| Not much | 8.1% (16) | 11.9% (30) | 10.2% (46) |
| Some | 29.4% (58) | 24.5% (62) | 26.7% (120) |
| A lot | 59.5% (118) | 55.7% (141) | 57.6% (259) |
| Interest: combined | 88.9% | 80.2% | |

Gender Differences in Episode Preferences

Statistically significant differences were also found between boys and girls on the extent to which they liked each video overall (again, based on the average of “how much did you like” questions on the surveys administered to students after each episode).

Although boys and girls were similar in their preferences for video 3: *Propulsion*, paired sample t-tests of means showed that girls reported a slightly higher, and statistically significant liking of video 1: *Mammals* ($t=3.24, p<.001$) and video 2: *Human Body* ($t=3.11, p<.01$) with a mean rating for each video of 2.24 versus 2.05 on both for boys respectively.

Next, we explore students' preferences for content within each of the three episodes.

Mammals

The highest percentage of students (65%) reported that they liked the investigation of sea lions at the zoo “a lot,” slightly higher than how baby animals grow (60%), which paws cats use the most (59%), and the riddle about getting a cheetah to walk on a leash (46%). As Table 8 also shows, students reported liking the hosts, the part about the scientist who studies chimpanzees, and the music for the mammals video the least.

Table 8: Mammals Video (Video 1/Episode 211)

| How much did you like... | Not at all | Not much | Some | A lot | LIKE TOTAL |
|--|------------|-----------|-----------|-----------|------------|
| The music? | 11% (53) | 16% (75) | 36% (167) | 37% (172) | 73% (339) |
| The hosts? | 10% (47) | 24% (111) | 39% (180) | 28% (129) | 67% (309) |
| The kids that were featured? | 6% (29) | 13% (58) | 40% (181) | 41% (188) | 81% (369) |
| The investigation of how baby animals grow? | 4% (18) | 11% (50) | 25% (119) | 60% (279) | 85% (398) |
| The investigation of sea lions at the zoo? | 4% (17) | 8% (37) | 24% (109) | 65% (296) | 89% (405) |
| The investigation of which paws cats use the most? | 4% (18) | 11% (53) | 26% (121) | 59% (273) | 85% (394) |
| The riddle about getting a cheetah to walk on a leash? | 13% (61) | 16% (72) | 25% (117) | 46% (211) | 71% (328) |
| The part about the scientist who studies chimpanzees? | 13% (59) | 18% (84) | 35% (161) | 35% (160) | 70% (321) |

Note: Like Total, presented in the column on the far right, totals respondents who indicated that they liked something “some” or “a lot”.

Children were also asked questions about how well they understood various aspects of each video. For video 1 (*Mammals*), a high percentage of students (54% to 77%=very well; 17% to 30%=sort of well) reported a good understanding of all the aspects of the video. However, students reported the greatest understanding for the investigation of which paws cats use the most (77%=very well; 17%=sort of well; 5%=not really well; 2%=not at all).

Human Body

A significantly higher percentage of students (83%=a lot; 12%=some) reported liking the part about the scientist who researches ice cream compared to other parts of the *Human Body* episode. Table 9 also shows that students liked the experiment with running water and a comb the least (18%=not at all; 20%=not much) followed by the riddle of how to get rid of warts (18%=not at all; 18%=not much).

Table 9: Human Body Video (Video 2/Episode 206)

| How much did you like..... | Not at all | Not much | Some | A lot | LIKE TOTAL |
|--|------------|----------|-----------|-----------|------------|
| The music? | 7% (33) | 11% (51) | 32% (145) | 50% (228) | 82% (373) |
| The hosts? | 12%(54) | 14% (62) | 41% (186) | 33% (150) | 74% (336) |
| The kids that were featured? | 6% (28) | 14% (63) | 38% (168) | 42% (189) | 80% (357) |
| The investigation of sunscreen? | 8% (35) | 14% (62) | 33% (149) | 46% (206) | 79% (355) |
| The investigation of dizziness and figure skating? | 11%(47) | 16% (69) | 29% (126) | 45% (200) | 74% (326) |
| The investigation of how exercise affects memory? | 7% (32) | 10% (45) | 26% (115) | 57% (257) | 83% (372) |
| The experiment with running water and a comb? | 18%(78) | 20% (91) | 29% (131) | 33% (145) | 62% (276) |
| The riddle of how to get rid of warts? | 18% (82) | 18% (81) | 26% (116) | 37% (167) | 63% (283) |
| The part about the scientist who researches ice cream? | 2% (10) | 3% (15) | 12% (54) | 83% (372) | 95% (426) |

Note: Liking Total, presented in the column on the far right, totals respondents who indicated that they liked something "some" or "a lot".

In terms of children's understanding for video 2 (*Human Body*), an equally high percentage of students reported that they understood the investigation of sunscreens, the investigation of dizziness and figure skating, the investigation of how exercise affects memory, and the riddle on how to get rid of warts "sort of well" (23% to 31%) or "very well" (55% to 62%). A lower proportion of students reported understanding the experiment with running water and a comb (12%=not at all; 11%=not really well; 29%=sort of well; 48%=very well) when compared to other aspects of the video.

Propulsion

A significantly higher percentage of students (83%=a lot; 11%=some) reported liking the investigation of model rockets at least "some" or "a lot" when compared to other aspects of the Propulsion video, followed by the investigation of kart racing (59%=a lot; 26%=some). Table 10 also shows that students liked the experiment with pepper and soap with least with a total of 44% stating they liked it either "not at all" (21%) or "not much" (23%), and only 24% reporting they liked it "a lot."

Table 10: Propulsion Video (Video 3/Episode 205)

| How much did you like..... | Not at all | Not much | Some | A lot | LIKE TOTAL |
|---|------------|-----------|-----------|-----------|------------|
| The music? | 8% (35) | 9% (42) | 29% (129) | 54% (240) | 83% (369) |
| The hosts? | 10% (43) | 16% (69) | 37% (163) | 38% (165) | 75% (328) |
| The kids that were featured? | 3% (13) | 10% (44) | 31% (138) | 56% (244) | 87% (382) |
| The investigation of model rockets? | 2% (10) | 3% (13) | 11% (50) | 83% (374) | 94% (424) |
| The investigation of kart racing? | 6% (27) | 9% (39) | 26% (116) | 59% (261) | 85% (377) |
| The experiment with pepper and soap? | 21% (90) | 23% (101) | 32% (141) | 24% (106) | 56% (247) |
| The roller coaster riddle? | 8% (33) | 15% (66) | 25% (107) | 53% (230) | 78% (337) |
| The part about the scientist with the robotic fish? | 12% (52) | 15% (67) | 30% (133) | 43% (191) | 73% (324) |

Note: Liking Total, presented in the column on the far right, totals respondents who indicated that they liked something "some" or "a lot".

For video 3 (*Propulsion*), a high proportion of students reported they also understood each aspect of the video “very well” or “sort of well,” however, a particularly high percentage of students reported that they understood the investigation of model rockets “very well” (83%), followed by an additional 14% reporting they understood it “sort of well.” A lower proportion of students reported understanding the experiment with pepper and salt (14%=not at all; 15%=not really well; 30%=sort of well; 42%=very well) when compared to other aspects of the video.

What topics interest students most?

There seems to be a general interest in animals among children in the target age group. In our pre-study interviews and surveys, many children indicated their preference for viewing programs with and about animals. Furthermore, when asked what elements they might include were they to create their own science show, many of the students that we interviewed indicated that they'd like their shows to be about animals.

The teachers with whom we spoke also suggested that the students seemed especially interested in the animal episode, as many have pets and/or are generally concerned about the care and behavior of animals. One teacher stated, "The popularity of that show makes sense. Kids love pets."

Other groups of students displayed content preferences that could be explained on a case-by-case basis. For example, one class appeared to be particularly interested in the investigation about rockets in *Episode 205: Propulsion*. We learned by talking with their teacher that they had recently finished viewing the movie *October Sky* and had subsequently become quite interested in the science of rocketry.

The episode on propulsion seemed to be students' favorite overall. However, some teachers found that their students were less interested in this segment because it was

seen as an activity that they'd be precluded from doing because they don't have access to resources or funds to purchase supplies. (See Table 11.)

Table 11: Students' Favorite Investigations

| Rank | Episode | Topic | % |
|------|---------|------------------------------------|-----|
| 1 | 205 | "Blast Off" (Rockets) | 94% |
| 2 | 211 | "Snack Time" (Sea Lions) | 89% |
| 3 | 205 | "Gear Up" (Karts) | 85% |
| 3 | 211 | "Yeah Baby" (Animal Growth) | 85% |
| 3 | 211 | "Pick a Paw" (Cats) | 85% |
| 6 | 206 | "Total Recall" (Exercise & Memory) | 83% |
| 7 | 206 | "Crazy Eyes" (Ice Skating) | 74% |
| 8 | 206 | "Sun Burn" (Sun Tan Lotion) | 70% |

The percentage of students' "liking" for each topic/investigation was calculated by comparing students' scores on the surveys administered following viewing of each episode.

What content segments most appeal to them?

Overall, students reported liking the investigation segments best, with the rockets, sea lions and kart-racing investigations being among their most favorite (as seen in Table 11 above). "Do It, Get to It" segments were their least favorite segments overall. Table 12 highlights additional findings related to specific content segments.

Table 12: Content Preferences Compared

| Segment | Episode Rank | % | Average % |
|-------------------|--------------|-------|-----------|
| Investigation | 1: 205 | 90% | 85% |
| | 2: 211 | 86% | |
| | 3: 206 | 79% | |
| Riddle | 1:205 | 78% | 71% |
| | 2:211 | 71% | |
| | 3:206 | 63% | |
| Scientist | 1: 206 | 95% | 79% |
| | 2: 205 | 73% | |
| | 3: 211 | 70% | |
| Do It, Get to It! | 1: 206 | 62% | 59% |
| | 2: 205 | 56% | |
| | ----- | ----- | |

How children felt about the people on DragonflyTV:

Kid Researchers: Do viewers want to see more or learn more about the kid-researchers shown on the program?

On the post-study survey thirty-seven percent of students reported they agreed with the statement "I can relate to the kids shown on the program 'a lot,'" followed by an additional 38% who reported that they could relate to the kids shown on the program "some." Additional break down of this data by ethnicity is represented in Table 13 below.

Table 13: Students' Ability to Relate to Kids on DragonflyTV

| Ethnicity | Not at all | Not much | Some | A lot | Positives Combined |
|------------------|-------------------|-------------------|--------------------|--------------------|---------------------------|
| Asian | 9.9% (7) | 18.3% (13) | 38.0% (27) | 33.8% (24) | 41.8% |
| African American | 9.3% (18) | 13.0% (25) | 36.8% (71) | 40.9% (79) | 77.7% |
| Caucasian | 6.2% (5) | 24.7% (20) | 43.2% (35) | 25.9% (21) | 69.1% |
| Hispanic | 17.6% (9) | 5.9% (3) | 35.3% (18) | 41.2% (21) | 76.5% |
| Other | 10.7% (3) | 14.3% (4) | 39.3% (11) | 35.7% (10) | 75.0% |
| Total: | 9.9% (42) | 15.3% (65) | 38.2% (162) | 36.6% (155) | |

It is perhaps interesting to note that Caucasian students were among the lowest in relating "a lot" to the kid-researchers featured in this program. Additional research is necessary to better understand this finding. However, it is worth noting that most students are able to relate to the kid-researchers shown on DragonflyTV, regardless of ethnicity.

Hosts

In San Francisco the focus group participants were particularly critical of the hosts. One or two indicated that they didn't like the comic tone they took during the program, while others felt that they should be *more* funny (e.g. hosts on Cartoon Network and other shows they like). One child described them as "sarcastic" and another said that she'd prefer hosts "who talked less and did more things" (e.g. she liked it when they were racing their rockets against each other).

However, we noted in the classroom survey data that the hosts seemed to grow on children over time. Only 67% of students reported liking the hosts "some" or "a lot" after viewing the first episode (*Mammals*) but three-fourths of them indicated that they liked the hosts after viewing the second and third episodes.

Scientists

Students in the focus group sessions thought there should be more adults on the program. They suggested showing adults doing an experiment and then showing the kids doing something related to it. They liked the scientists, and liked the notion of getting different career ideas for fields that involve science.

Survey data indicates that the scientists' personality and/or research interests make a difference, with some being clear favorites among the children (e.g. the ice cream scientist in the *Human Body* episode) while others appeal far less.

Structural Features

When viewing an episode of DragonflyTV, it is hard to deny the program's vibrant look and sound. The show features a contemporary production style, varied camera angles, quick pacing, and an assortment of music and audio clips. These features help DragonflyTV to capture viewers' attention and stimulate engagement.

Our evaluation sought to better understand the impact that various structural features had on viewers. This was done, in part, through a series of viewing observations from which we were able to determine viewing patterns and attention flow over the course of each program. We were also able to gather information in a less direct fashion through our interviews with teachers and students.

Observation Data Analysis : How does viewer attention flow through the show?

Half of the 4th and 5th grade classes in our study (and an extra 5th grade classroom in Boston) were observed as they viewed three episodes of DragonflyTV, for a total of 39 observations. A team of two trained observers was present for each observation. Observers sat in the front of the classroom. Each observer was responsible for monitoring and recording the viewing behavior of five students every twenty seconds.

Researchers were asked to record whether or not each pair of students' eyes were directed toward the television set. In some cases students exhibited engaged viewing behaviors (e.g. taking notes, discussing with a peer something they'd seen/heard or laughing) even when they were not actually viewing the television set. In these cases, observers attempted to provide commentary that would later help in our efforts to decode the data. One observer began making observations immediately, while the other observer delayed onset of observation by 10 seconds. The result was a data set for each observed classroom with approximately 175 data collection points per episode representing a detailed viewing pattern for ten students (and general notes about the overall behavior of each class).

Viewing data was analyzed by grade. Average viewing scores for each data point were then plotted on a series of graphs for each program, and observation notes were then used to help explain findings. The following section presents data on attention flow within each episode.

The first program that students watched was *Episode 211: Mammals*. The program proved to be a good introduction to DragonflyTV and succeeded handily in sparking their interest in viewing subsequent episodes for our study.

Note: In the charts below times where the total "eyes-on screen" averages of 4.50 or higher are highlighted.

Episode 211: *Mammals*

| Time | 4 th Grade | 5 th Grade | Total | What's on screen | 3.0 | - | 5.0 |
|------|-----------------------|-----------------------|-------|---|-----|---|-----|
| 0:00 | 3.83 | 3.71 | 3.77 | Intro/overview | | - | |
| 0:10 | 4 | 4.29 | 4.15 | Intro | | | - |
| 0:20 | 4.67 | 4 | 4.31 | major funding is provided by... | | | - |
| 0:30 | 4 | 4.29 | 4.15 | National Science Foundation | | | - |
| 0:40 | 3.83 | 4.29 | 4.08 | NSF | | | - |
| 0:50 | 4.17 | 4.43 | 4.31 | Musical Intro/theme | | | - |
| 1:00 | 3.67 | 4 | 3.85 | Musical Intro/theme | | | - |
| 1:10 | 4.17 | 4.71 | 4.46 | Musical Intro/theme | | | - |
| 1:20 | 3.5 | 3.57 | 3.54 | Host Intro (actually starts at 1:17) | | - | |
| 1:30 | 2.83 | 4.86 | 3.92 | Michael and Mariko continue talking | | | - |
| 1:40 | 4.17 | 4 | 4.08 | Yeah Baby! Baby animal segment starts | | | - |
| 1:50 | 4.83 | 4.71 | 4.77 | Montage of animal shots | | | - |
| 2:00 | 4 | 4 | 4 | Matt intro: Likes animals/zoo | | | - |
| 2:10 | 4.67 | 4.86 | 4.77 | Danny likes animals | | | - |
| 2:20 | 4.33 | 3.86 | 4.08 | Kyndall introduced | | | - |
| 2:30 | 4.5 | 4.71 | 4.62 | Talk: speed of growth differs | | | - |
| 2:40 | 4.5 | 4 | 4.23 | We'll record the growth | | | - |
| 2:50 | 4 | 4.57 | 4.31 | Kid's guesses | | | - |
| 3:00 | 4.83 | 4.29 | 4.54 | 3 animals, 3 hypotheses | | | - |
| 3:10 | 4.17 | 4.71 | 4.46 | Explanation of adult weights | | | - |
| 3:20 | 4.33 | 4.14 | 4.23 | I beg your pardon | | | - |
| 3:30 | 4.33 | 4.86 | 4.62 | Hey Baby, Hey Baby | | | - |
| 3:40 | 4.17 | 4 | 4.08 | Pig nose | | | - |
| 3:50 | 4.33 | 4.57 | 4.46 | ...and they like me, I like cows | | | - |
| 4:00 | 4.5 | 4.14 | 4.31 | Weighing the cow | | | - |
| 4:10 | 4.83 | 4.57 | 4.69 | Time to go way the pigs | | | - |
| 4:20 | 4.5 | 4.14 | 4.31 | Grabbing pig (follows pig sound) | | | - |
| 4:30 | 5 | 4.86 | 4.92 | Weighing the pig (now to the chicken coop) | | | - |
| 4:40 | 4.17 | 4 | 4.08 | Holding/weighing the chickens | | | - |
| 4:50 | 4.67 | 5 | 4.85 | I know a chicken | | | - |
| 5:00 | 4.33 | 4.14 | 4.23 | Other animals | | | - |
| 5:10 | 4.33 | 4.71 | 4.54 | Cow gained 27 pounds | | | - |
| 5:20 | 4.17 | 4.14 | 4.15 | Weights only tell you how much they've grown | | | - |
| 5:30 | 5 | 4.86 | 4.92 | ...each animal was than when it was born | | | - |
| 5:40 | 4.67 | 4 | 4.31 | Visual: growth rate | | | - |
| 5:50 | 5 | 4.71 | 4.85 | Visual/kids making chart | | | - |
| 6:00 | 3.83 | 4 | 3.92 | Chart: cow's rate of growth | | | - |
| 6:10 | 4.83 | 4.71 | 4.77 | Wow, It shot up in a month | | | - |
| 6:20 | 4.17 | 4 | 4.08 | Putting cut outs on the chart | | | - |
| 6:30 | 5 | 4.86 | 4.92 | Cow's final growth rate | | | - |
| 6:40 | 4.67 | 4.14 | 4.38 | Chicken, 14 times bigger | | | - |
| 6:50 | 4.67 | 4.86 | 4.77 | Ladies and Gentlemen...if you look at the chart | | | - |
| 7:00 | 4.67 | 3.86 | 4.23 | Chicken wins | | | - |
| 7:10 | 4.17 | 3.86 | 4 | Does a mouse grow faster than a chicken.... | | | - |
| 7:20 | 4.33 | 4.14 | 4.23 | What's the biggest animal on earth? | | | - |

Episode 206: Human Body

| Time | 4 th Grade | 5 th Grade | Total | What's on screen | 3.0 | | | | | | | | | | | | | | | 5.0 |
|------|-----------------------|-----------------------|-------|---|-----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-----|
| 0:00 | 4.5 | 4.86 | 4.69 | today on...kids spin until they are dizzy | | | | | | | | | | | | | | | | |
| 0:10 | 3.83 | 4.57 | 4.23 | today, kids get serious about the sun... | | | | | | | | | | | | | | | | |
| 0:20 | 3.83 | 4.71 | 4.31 | major funding is provided by... | | | | | | | | | | | | | | | | |
| 0:30 | 3.5 | 4.29 | 3.92 | major funding is provided by...Best Buy | | | | | | | | | | | | | | | | |
| 0:40 | 3.17 | 5 | 4.15 | Funding (cont.) National Science Foundation | | | | | | | | | | | | | | | | |
| 0:50 | 3.17 | 4 | 3.62 | intro sequence/theme music | | | | | | | | | | | | | | | | |
| 1:00 | 3.83 | 4.86 | 4.38 | intro sequence/theme music | | | | | | | | | | | | | | | | |
| 1:10 | 4.17 | 4.14 | 4.15 | intro sequence/theme music | | | | | | | | | | | | | | | | |
| 1:20 | 3.83 | 4.86 | 4.38 | dragonfly tv graphic , introduce hosts | | | | | | | | | | | | | | | | |
| 1:30 | 4.67 | 4.43 | 4.54 | Mariko/Michael talking | | | | | | | | | | | | | | | | |
| 1:40 | 4.33 | 5.29 | 4.85 | Mariko and Michael talking about sunscreen | | | | | | | | | | | | | | | | |
| 1:50 | 3.67 | 4.86 | 4.31 | surfers | | | | | | | | | | | | | | | | |
| 2:00 | 4 | 5.14 | 4.62 | Aaron, introduces himself, likes surfing | | | | | | | | | | | | | | | | |
| 2:10 | 3.5 | 4.86 | 4.23 | Justin, Introduces himself, likes bmx | | | | | | | | | | | | | | | | |
| 2:20 | 4.33 | 5.43 | 4.92 | kids and sun block, putting it on | | | | | | | | | | | | | | | | |
| 2:30 | 4.17 | 4.71 | 4.46 | some lotions have different spfs | | | | | | | | | | | | | | | | |
| 2:40 | 4.33 | 5.29 | 4.85 | what are uv rays anyway? | | | | | | | | | | | | | | | | |
| 2:50 | 4.33 | 4.57 | 4.46 | kids research uv rays on computer | | | | | | | | | | | | | | | | |
| 3:00 | 4 | 5 | 4.54 | tell what uv rays are | | | | | | | | | | | | | | | | |
| 3:10 | 2.83 | 4.57 | 3.77 | get water bottles that change colors in sun | | | | | | | | | | | | | | | | |
| 3:20 | 4.33 | 5 | 4.69 | more water bottles | | | | | | | | | | | | | | | | |
| 3:30 | 3.33 | 4.71 | 4.08 | color shouldn't change if spf is effective | | | | | | | | | | | | | | | | |
| 3:40 | 4.5 | 5.43 | 5 | test spf 4, spf 14, spf 30 and shortening | | | | | | | | | | | | | | | | |
| 3:50 | 3.67 | 4.71 | 4.23 | olive oil looks similar to tanning oil. | | | | | | | | | | | | | | | | |
| 4:00 | 4.17 | 5.29 | 4.77 | test by keeping bottles in the sun... | | | | | | | | | | | | | | | | |
| 4:10 | 4 | 4.71 | 4.38 | rate color change on scale from 1-5 | | | | | | | | | | | | | | | | |
| 4:20 | 4.5 | 5.29 | 4.92 | graphic with bottles changing colors/scale | | | | | | | | | | | | | | | | |
| 4:30 | 3.83 | 4.86 | 4.38 | Let's go to beach Song: I'm on my way | | | | | | | | | | | | | | | | |
| 4:40 | 4 | 5.29 | 4.69 | kids opening box, putting out bottles | | | | | | | | | | | | | | | | |
| 4:50 | 3.67 | 4.71 | 4.23 | 8 minutes, starting now. | | | | | | | | | | | | | | | | |
| 5:00 | 4.5 | 5.29 | 4.92 | looking at bottles | | | | | | | | | | | | | | | | |
| 5:10 | 3.83 | 4.57 | 4.23 | looking at bottles, 5 min. mark | | | | | | | | | | | | | | | | |
| 5:20 | 4.17 | 5.29 | 4.77 | shortening is not working, dark blue | | | | | | | | | | | | | | | | |
| 5:30 | 4 | 4.57 | 4.31 | rating bottles, with graphic | | | | | | | | | | | | | | | | |
| 5:40 | 4.5 | 5.43 | 5 | spf 4: 5 rating | | | | | | | | | | | | | | | | |
| 5:50 | 4.67 | 4.71 | 4.69 | spf 15: blocked more sun, 1 rating | | | | | | | | | | | | | | | | |
| 6:00 | 4.33 | 5.43 | 4.92 | any different between spf 15 and 30? | | | | | | | | | | | | | | | | |
| 6:10 | 4.17 | 4.71 | 4.46 | shortening : 5 didn't block any sun | | | | | | | | | | | | | | | | |

Viewing data suggests that children paid the most attention to the scenes that involved the rockets. More specifically, they seemed most attentive during parts where rockets were being launched or the altimeter reading was being taking. Observers noted that the students liked to count along out-loud with the altimeter readout.

The Do It, Get to It! segment managed to capture their attention much in the same way it had done during the previous program. Nevertheless, that we found that this type of segment had low student appeal. One possible explanation for this is that, while engaging, it appears "school-like" to these viewers. Perhaps, students perceive this segment to be more like science programs they've seen in the past (e.g. someone doing an activity, while a voiceover explains what is going on) and therefore believe it to be more important to listen to. Another possibility is the fact that the graphics used in conjunction with these segments help to capture viewers' attention.

General Findings

Research tells us that children use the formal features of television programs to help them selectively attend to on-screen stimuli. Audio seems to be one of the most important structural features when it comes to influencing what children attend to when viewing television. Changes from one audio source to another, sound effects, changes in voices, peculiar voices and children's voices are all audio features that seem to encourage attention (Anderson & Burns, 1991). Movement and program pacing also seem to encourage attention among children. Below we'll discuss some additional findings compiled from observers' notes and data with regards to viewing outcomes that relate to the program's structural features.

Throughout each observation, children seemed to enjoy the music. There were many cases where the children would sing along (or mouth the words) with songs that they knew. In other instances we saw feet tapping and what might be described as dancing in their seats. We noticed that certain songs, such as the Austin Powers theme song, "Ice Ice Baby", and the Jeopardy theme song, seemed to have the ability to pull in children's attention in cases where it had wandered away from the television. The music-video-like montages of photos held their attention well and seemed to add to their overall enjoyment of the program.

The number of eyes-on-screen throughout each program remained high. Even when there were disruptions in the classes, most children kept their eyes on the screen. Overall, 5th grade students seem to keep eyes-on-screen more than 4th graders. 4th graders' attention was clearly higher during the episode on *Mammals* than it was during the episodes that followed. This finding, combined with what we learned through survey data (i.e. 4th graders liked the *Mammals* episode significantly more than 5th grade viewers) supports the notion that there tend to be more eyes on screen when the topic appeals to children.

Eyes-on-screen was not the only way we had to tell that students were interested in DragonflyTV and paying attention. We noticed that many students were taking notes during the videos. One girl proudly showed an observer a stapled set of notes

entitled: "DragonflyTV Notes Book." There were also some points where students sitting near one another were discussing things happening on the show. In these cases, when eyes may not have been on screen, interest in the program seemed to be especially high.

There were many things that caused the children to laugh or go "ew," again indicating that they were not only following along with what was happening on the program, but also that there seemed to be interest and comprehension. Anderson and Burns (1991) suggested that attention follows comprehension and in the section on Learning Outcomes later in this report it should be noted that comprehension for the program and various segments was consistently high.

In sum, children were quite attentive. Most data indicated that the students were following along with the program even if their eyes weren't always onscreen, as there were many other indicators of interest and attention present throughout each observation session.

How do children respond to the show's structural features (e.g. pacing, use of music, etc.)?

Pacing

Many of the teachers commented on structural elements of the program that lent themselves to enjoyment by audiences at the 4th and 5th grade level. Some teachers were startled by the quick pace, but most thought that it was appropriate for their students.

- *It keeps the kids' attention because of the constant flash of music and scenes.*
- *I think it kept the students interested in watching it. It was fast-paced and the kids like that.*
- *Very energetic. Very colorful and vibrant. Very kid-friendly.*
- *Fast, visual and sound bites, children this age respond well to this.*
- *The kids like the idea that it is contemporary, looks of kids, music, etc.*

Most teachers felt that the concepts were presented clearly despite the quick pace. Some teachers that hinted that students' ability levels may have an impact on how much they ultimately gain from their exposure to the program. One teacher stated, "It is fine for the fast learners but lower-level learners were back on something else. It was too quick for low-end learners. However, for the high-end students it was great." Student data, on the other hand suggested that comprehension (at least to the extent that it could be self-reported) was somewhat consistent for students across academic performance levels, with higher level students reporting only slightly higher levels of comprehension.

Music

The children that we interviewed responded favorably about the music clips on the program, with 75% of the pairs of students that we interviewed at the end of the study indicating that they liked the music. Student surveys also suggest that students liked the music. The table below shows students' responses about the music from each episode.

Table 17: How Much Students Liked the Music

| How much did you like the music in... | Not at all | Not much | Some | A lot | Total: Like |
|---------------------------------------|------------|----------|-----------|-----------|-------------|
| 211: <i>Mammals</i> | 11% (53) | 16% (75) | 36% (167) | 37% (172) | 73% |
| 206: <i>Human Body</i> | 7% (33) | 11% (51) | 32% (145) | 50% (228) | 82% |
| 205: <i>Propulsion</i> | 8% (35) | 9% (42) | 29% (129) | 54% (240) | 83% |

We also noted during our observations several instances where the students were singing along with the music, or moving/dancing in their seats, when they heard songs they knew or liked.

Learning Outcomes

Based on this evaluation there seems to be little doubt that nine-to-twelve-year-old viewers find DragonflyTV entertaining (appealing and attention-holding), but we were also interested in studying the educational impact that the program has on children. We will now turn our attention to a discussion of the program's learning outcomes as identified through various evaluation activities.

Are children more interested in doing science projects after viewing DragonflyTV?

Several teachers indicated that they had seen evidence to suggest that their students are more interested in science since viewing DragonflyTV. Comments shared with us by teachers seem to indicate that students had greater confidence in their abilities to do scientific investigations.

- *I think the main thing is that they (the kids) mentioned that “we can do these experiments.” We (the kids) can do these (experiments) outside of the classrooms.*
- *The kids like the idea of thinking of their own experiments.*
- *They realized that little kids can make up science. [Before viewing the show] They thought science was just interpreted through books and teacher presentations. Now they know that science is hands-on.*
- *They’ve seen it [science] as more accessible.*
- *The students are more interested in doing their own investigations on their own.*

One teacher felt that the children's involvement in real science should be made even more explicit by somehow indicating that kids are doing the same thing as adult scientists. Showing more kids working side-by-side with adult scientists may be one way to accomplish this.

Generally speaking, teachers reported that their students wanted to do more research and more investigations as a result of viewing DragonflyTV. Furthermore, most teachers felt their students were better prepared to do science projects after viewing several episodes of DragonflyTV.

Student survey data also supports the finding that students are more interested in doing science projects. After viewing DragonflyTV, a slightly higher percentage of students than in the pre-study survey reported that they would like to do a science project on their own in the future “A lot” (48% versus 60%). (See Table 18)

Table 18: Change in Students' Interest in Doing Science Projects

| How much would you like to do a science project on your own in the future? | Not at all | Not much | Some | A lot |
|--|------------|----------|-----------|-----------|
| Pre-Study (n=447) | 9% (40) | 12% (52) | 31% (140) | 48% (214) |
| Post-Study (n=462) | 5% (24) | 10% (46) | 25% (113) | 60% (279) |

We also explored the question: Is there a statistically significant relationship between the appeal of DragonflyTV episodes and their interest in doing experiments?

Regression analysis showed that the best predictors of the extent to which students want to do a science project on their own in the future is their *liking* and *understanding* of the DragonflyTV videos. A strong, positive and statistically significant relationship was found between the extent to which students liked the DragonflyTV videos overall ($t=8.07, p<.001$) (average of all liking items across 3 videos) and the extent to which students understood the videos overall ($t=3.10, p<.01$), and how much they said they would like to do a science project on their own in the future (post-survey data). A one-point difference in the extent to which students liked the videos and understood the videos, is associated with a .63-point and .29-point difference in how much they would like to do a science project respectively. This is a moderately strong association with approximately 27 percent of the variation in how much students would like to do a science project associated with variation in the extent to which students liked and understood the videos ($F=84.51, p<.001$). Students who liked and understood the videos to a greater extent, were more likely to show changes in the extent to which they would like to do a science project in the future.

Focus group participants said that the show gave them ideas for doing their own science projects (and information on how to do them better). In Chicago, participants said they'd like to see the show again, because they'd like to be able to do some of the experiments themselves.

Do children understand more about the scientific process and scientific inquiry?

It seemed clear to many teachers that children understood more about the scientific process and scientific inquiry as a result of watching DragonflyTV. Related teachers' comments include the following:

- *I thought they were great because they taught the kids inquiry. I think that's really important.*
- *New approach to science show because it featured the scientific-method.*
- *Nice job of showing steps of scientific investigation.*

- *It dealt with how to do a good lab experiment.*
- *The kids understand better how to go through each step of the scientific process.*
- *Good basis to introduce scientific method for the science fair.*
- *Good tool to demo for how to do an experiment.*

One teacher indicated that the show had helped to remind her of the importance of always stressing the scientific method and emphasizing the steps that are involved in doing good scientific research.

Sixty percent of students reported that they agreed with the statement that DragonflyTV helps them understand how to do a science experiment “a lot,” followed 31% who reported they agreed with it “some.”

The pre- and post-study interviews that we did with students allowed us explore their ideas for their own investigations on a preset topic and/or provide better descriptions of their investigations.

Research Prompt

Now I'd like you to take a few minutes to design your own science investigation/experiment. Kids drink a lot of soda (or pop), and many of these drinks contain caffeine (pause for comments). Can you help me think of an experiment that looks at one effect that caffeine has on something related to how kids do in school? There are no right or wrong answers, I'm just interested in learning more about how you would design this type of study: What specific effect you would study, what steps you'd take, and what you might expect to find. I want you to work together, and I'll give you about five minutes.

Students were scored by the interviewer using a rubric included in the Appendix. Scores from these rubrics were coded and analyzed. In particular we looked for whether or not the students included the following steps in their research design:

- Do preliminary research in the library or on the web?
- Use an extra person to help gather data?
- Repeat the same experiment several times?
- Keep testing conditions consistent between each trial?
- Write down what happens?
- Record data with any scientific instruments? (e.g. scale, stopwatch, other)
- Put what they find in a chart or graph?
- Use a computer to analyze their data?
- Share their findings with others (e.g. writing a report or giving a presentation)?

Unprompted responses were scored "2" while prompted responses were scored "1".

In general we found that the students included far more details during the post-study interviews than they had during the pre-interview studies. Table 19 shows the

comparative amount of detail in terms of research procedures that the students reported during the pre- and post-study interview investigation segment.

Table 19: Comparison of Students' Investigation Ideas

| | Pre-Study Interviews | | | | Post-Study Interviews | | | |
|----------------------|----------------------|-----------|-----------|------------|-----------------------|-----------|-----------|------------|
| | SF | CHI | BOS | All | SF | CHI | BOS | All |
| Yes, Unprompted | 1 | 15 | 6 | 22 | 6 | 25 | 12 | 43 |
| Yes, Prompted | 46 | 38 | 15 | 99 | 17 | 66 | 30 | 113 |
| Yes: Combined | 47 | 53 | 21 | 121 | 23 | 91 | 42 | 156 |

We compared the scores based on the steps that the students included when describing their investigations to the scores that were given based on the specific details they gave about their study, that is whether or not they:

- Identify/Define independent variables (e.g. types soda, amount of soda, etc.)?
- Identify/Define the dependent variable (the outcome they will be measuring)?
- Identify variables that are controlled/kept consistent in each trial?
- Identify a clear experimental question/clearly identify what is being investigated?
- Give a prediction or hypothesis for what they expect the outcome(s) to be?

Students included more general steps and specific components when describing their investigations in the post-study interviews as compared to the pre-study interviews. "Basic" scores were calculated based on the nine items listed on the previous page (i.e. procedural steps such as using measurement devices, creating charts, etc.). "Specific" scores were calculated based on the five questions listed above that include variable, control and hypothesis information.

Table 20: Students' Investigation "Basic" and "Specific" Scores Compared

| | Basic: Procedural Steps | Specific: Research Design |
|------------------------------|-------------------------|---------------------------|
| Pre-study Interviews | 2.63 | 1.80 |
| Post-study Interviews | 3.18 | 2.02 |

Researchers' overall scores were also tallied and checked against the total scores for students in the "Basic" and "Specific" categories and we found that they were generally consistent. Overall researchers' scores improved an average of .5 on a five-point scale in the post-study interviews as compared with the pre-study interviews.

Do they understand specific elements of the scientific model (e.g. defining questions, measurement, repeated trials, and reporting results)?

When asked what they remembered from the program they'd just viewed, the children in each of the three focus groups mentioned the specific program segments or content, as had many of the students in the post-interview sessions. Unlike the students who were interviewed, all focus group kids made note of the procedural things they'd learned (i.e., general skills and activities related to scientific

investigation). Students in the focus group sessions were also more specific about what they remembered learning from the content segments (e.g., instead of saying that they remembered the kids exercising in the *Human Body* episode, they told us that they learned that exercising helps people remember things, and joked that they might try exercising instead of studying in the future).

In each of the three focus group sessions, the children mentioned the importance of *graphing* as something they'd learned about through DragonflyTV.

- *It tells you to write down and use graphs.*
- *How to make graphs to find out the answers.*
- *How to make graphs and different ways to tell how or see who goes faster.*
- *Graphs can help you learn about things*

Many of the children in the Chicago focus group mentioned ideas they'd gotten for making graphs and charts. It seems that 4-H projects (not unlike those for science fairs) involve visual presentations with posters and other displays, several of which were on display in the room where the club met.

Focus group participants also indicated that they'd learned the importance of writing down results and using instruments to measure and record results. In the San Francisco focus group session, one child commented on how careful the children had been with the details of their investigations. Another noticed that kids started over and repeated the experiment several times.

Teachers felt that their students' understanding of specific elements of the scientific model were also enhanced as a result of viewing DragonflyTV. Several teachers commented on the fact that students had better comprehension of the specific steps of the scientific method and a better grasp on the detail necessary to conduct a scientific investigation.

A few teachers saw evidence of their students' new understanding in the lab reports they were submitting. These teachers reported that their students were doing a noticeably better job outlining the steps for in-class experiments and were including more details in their descriptions. Specific comments were as follows:

- *They learned how important it is to repeat steps as issues come up.*
- *I do think the kids learned about creating a hypothesis and testing it.*
- *[Scientific research] takes many tries and is very repetitious. You have to have more than one test subject.*
- *Techniques for reporting and trials are improved.*
- *You have to do a test multiple times to compare results.*
- *Use graphing approach for data results for May 1st science fair.*

The show's emphasis on details also influenced student behavior, according to some teachers. They indicated that their students were more aware of all the steps that are involved in doing a good investigation.

- *The show clearly showed the steps and how to set up experiments. Students' procedures and steps improved for labs...details that were included also improved.*

- *My kids are paying more attention towards details. The show coincided with them expanding their knowledge towards specifics.*

We examined students' pre-post survey reports on the importance of repeating the same experiment several times, writing down whatever happens in your experiment, doing everything the same each time, and putting what you find out in a graph or chart. We found only a slight pre-post change in students' ratings of importance for graphing results. Prior to viewing the videos, 54% of students (n=436) rated this as "very important" compared to 67% (n=463) after viewing the videos.

Although students' importance ratings for the other activities were essentially unchanged, a higher percentage of students reported that it is "very important" to write down whatever happens in your experiment (pre=74%; post=81%) when compared to the importance of other activities.

Our analysis of the survey data also helped us to understand the nature of the relationship between viewing DragonflyTV and understanding the importance of experimental methods in general. Scores for students' level of knowledge related to doing experiments were averaged together for analysis. Paired sample t-tests of means showed that students' understanding or knowledge about the importance of experimental tasks overall changed after viewing the DragonflyTV episodes and this positive change was found to be statistically significant at the .001 level of significance ($t=3.48, p<.001$). Additional analysis using regression was conducted to examine what, if anything, related to DragonflyTV and viewing of the videos it was significantly associated with this positive change in the extent to which students' understanding of experimental concepts and tasks.

Regression results indicated that individually, the extent to which students understood the videos overall (overall comprehension), the extent to which students felt that the topics on DragonflyTV interested them (topic appeal), and the extent to which they felt DragonflyTV helped them understand how to do a science experiment (science process comprehension) were all statistically significant predictors of the change in students' experimental knowledge (i.e. combined scores for the items listed under "When doing a Science project, how important is it to...").

Interestingly, although no statistically significant differences were found in *changes* in experimental knowledge based on grade, gender, city, academic performance or involvement in activities, there was a gender difference on the pre-survey. Regression analysis on the importance of experimental tasks prior to exposure to DragonflyTV showed that girls started out with a significantly better understanding of the importance of experimental tasks when compared to boys ($t=2.88, p<.01$) with a mean of 2.35 on a scale from 0 to 3 versus 2.19 for boys. As the children gained more exposure to DragonflyTV through viewing the three episodes, the boys gained a better understanding of the importance of experimental tasks. This improvement reduced the gender differences and yielded no statistically significant finding.

Do they actually do more science projects after viewing DragonflyTV?

And

What is the nature of the relationship between viewing (e.g. what frequency of viewing) and doing science projects?

Perhaps it is too soon to tell just how much change will result from students actually undertaking more science projects, but survey and interview data suggest that a real interest in doing science has been kindled among the program's viewers.

We did find a small, but statistically significant positive relationship between how much students agreed that the topics on DragonflyTV interested them and changes in their desire to conduct science projects in the future ($t=2.48, p < .05$).

Students who stated they viewed television shows about science prior to viewing DragonflyTV had an average score for their desire to conduct science projects that was .65 points higher ($t=6.55, p < .001$) than those who did not view television shows about science. This explains about 9 percent of the variation in the desire to conduct a science project.

Comprehension differences between higher and lower academically achieving students

We found a significant difference, related to students' academic achievement, through the analysis of survey data indicating that high academically performing students reported a higher level of comprehension (mean of 2.50) of the videos overall than low and average academically performing students (mean of 2.38) ($t=2.47, p < .05$). However, even though students at a higher level of academic performance were able understand the program slightly better than their lower performing peers, there was not a great difference in the mean scores, indicating that higher level and lower level students are both showing an ability to comprehend the program well.

Other findings

Many teachers commented that the program was a good fit with the science standards and benchmarks for fourth and fifth grade students. Teachers felt that the program did a good job of complementing and confirming things that are being taught at this grade level. Furthermore, they felt that the content was presented in an age-appropriate fashion at an age-appropriate level.

Teachers also indicated that the show had given them ideas for things to try in their own classroom. Some listed specific experiments that they wanted to replicate with their students, while others suggested new ideas that they'd gotten from the program.

Several teachers shared a desire to tape future episodes of the program airing on their local PBS stations for educational use. Most suggested that they'd prefer showing pertinent segments from the show rather than showing an entire program in a single class period. The interview data indicated that each teacher had found some educational value in the program and sensed its appeal with their students. Many teachers noted that DragonflyTV was not only educational, but that it was also fun and entertaining (the proverbial "spoonful of sugar to help the medicine go down").

One teacher commented that there is not much spare time at school for doing science. She felt that DragonflyTV was better than most science shows because it held her students' interest. Another teacher stated that 75% of her students had demonstrated more interest in science since viewing DragonflyTV.

Participation in DragonflyTV

Seventy-five percent of students interviewed after viewing all three episodes indicated that they'd want to be on DragonflyTV. Among those that indicated a desire to be on DragonflyTV 35 stated that they wanted to be on the program because they like science and would like to do experiments. Fourteen students indicated that they'd like to be on television and twelve students replied that they thought it would be fun. Other reasons given included: having the opportunity to share what they'd done with others (7), being able to work with other kids (4), and getting a chance to meet the show's hosts (2). A handful of students said that they wouldn't want to be on DragonflyTV because they were too scared or shy (7), or thought that it would be too much work (4).

Our survey data also revealed that three quarters of students wanted to be on DragonflyTV either "a lot" or "some." After viewing all three episodes of DragonflyTV, slightly more than half (58%, n=278) of students reported they wanted to be on DragonflyTV "a lot." An additional 17% (n=83) reported they would like to be on DragonflyTV "some," 13% (n=61) reported "not at all," and only 6% (n=30) reported "not much." Focus groups and interviews also allowed us to go into more depth on factors that have an influence on children's desire and ability to participate more fully.

What's necessary to attract more participants?

In our focus group and interview sessions, we sought responses from children and adults about what might be necessary to attract more applicants to participate in DragonflyTV. A summary of our findings from the post-study interviews is presented in the table below.

Table 21: Things that would make children want to apply

| Response | # of Students (in pairs) |
|--|---------------------------------|
| Incentives: Money/prize | 25 |
| Like science/experiments/learning, Like show | 22 |
| Competition/Recognition | 18 |
| Being on TV | 3* |
| If classmates did it/other kids | 3 |

*Note there were more responses that indicated the appeal of being on TV when asked why they'd like to be on DragonflyTV. Being on television was a more prevalent response in focus group sessions.

Only slightly more students indicated that they'd want tangible incentives than those indicating that the intrinsic educational value—to learn new things, or to share what they've learned with others—was incentive enough. Students indicated that they'd also be motivated by competition, by being on television, and by having peers doing it as well. Below we will discuss two more important factors that came out during our interviews and focus group sessions with children and adults.

Adult mentoring

It seemed apparent to the children that we interviewed that adults had played some role in helping the children with their investigations, even if they weren't shown. Roughly three times more students (60:21) thought that adults had provided some help as opposed to kids doing all the work themselves. Only eight children felt that adults had really done all the work.

When asked why they thought adults had helped, about 19 students said that the investigations looked too hard, suggesting that adults might have come up with the ideas and/or helped the kids to do the research correctly. Twelve of the students that we interviewed mentioned a need for adult supervision on specific activities, such as the rockets and kart-racing. Several students also mentioned needing to have adults help the children get supplies.

Those who thought that adults hadn't helped as much indicated that they didn't see any adults, and the kids were doing most of the work (20 students gave this response). Twelve students indicated that help wasn't needed, since the kids seemed smart and/or knew what they were doing. Interestingly, some of the participants thought that there wasn't as much adult involvement, because the kids made mistakes. Other's thought that children had access to enough resources (e.g. the Internet) to do these investigations on their own.

Most of the children in our focus group sessions also felt that there had been more adult participation in the investigations than was shown on the program. In Boston, six out of nine participants felt that there was a lot of adult support behind the scenes. And in Chicago, one participant asked, "How else could they do all that stuff?" in response to our question about how much adult mentoring there'd been. One participant in San Francisco cited the use of computers for the go-kart segment to support his assertion that adults had helped. Others mentioned the need for supplies, supervision and help with math as reasons why they felt that adults had been involved. Another San Francisco participant suggested that the rockets experiment definitely needed adult help because of the math involved in that project. Focus group participants in other sites also indicated the need for equipment and materials (and the money to purchase these things), suggesting that this was another reason they'd need help from adults.

In addition to the tangible materials needed to do an investigation, participants in Chicago felt that adults were instrumental in helping children find and refine their research topics. Many children felt that coming up with ideas would be the most challenging part of doing their own investigation. When asked what they might be interested in researching, many of the children were able to come up with unique

ideas. Their thoughts about doing investigations seem tied to the program(s) they viewed. There is clearly a need to find new ways to get them to think outside the proverbial box (a.k.a. the television set in this instance).

The 4-H leaders were particularly interested in DragonflyTV. When we spoke with the club's leaders they suggested that DragonflyTV's producers try contacting groups such as theirs, because they do a lot of science-related projects as part of their programming (e.g., raising butterflies and releasing them into the wild, worm composting, and food science). Since their club is located in the city, they can't do many of the animal projects that people associate with 4-H, but they do participate in an annual embryonic project where they hatch chickens and send them to local farms. Unfortunately, the 4-H model for doing investigations seems to involve doing set activities rather than promoting original investigation, though there is no doubt that the skills gained from doing the 4-H activities would transfer to doing better investigations on their own.

Direct recruitment/awareness campaigns

The general sentiment among teachers was that greater awareness about the show and the application process was necessary to generate more idea submission. Several teachers thought that it would be best to have someone from the production team or past show participants visit schools and groups to encourage participation. Teachers felt this method would be best because it would enforce the fact that this is a show about real kids and real science and not something being scripted and acted out in Hollywood like other programs they are used to seeing on television. Other suggestions included inviting local schools/students/teachers to view show tapings, visiting schools to screen episodes in a fashion similar to that of this research study, or sending teachers tapes on a regular basis.

One teacher suggested that she might be less inclined to help her students apply, not knowing what the selection process entailed. Were she more aware of how the investigations were picked (and how competitive a process it was), she thought she'd be more willing to encourage her students to participate.

Teachers noted that promotional materials should be straightforward in explaining the selection process and criteria and giving some indication of the likelihood of being picked to be on the show. "Don't sell them a dream through media or letters," warned one teacher. One teacher also emphasized the fact that the show should let the kids know that there is no idea or science experiment that is stupid. Some kids think "What if I tell them [Dragonfly producers] that this is what I can do and they say that my ideas are stupid?"

Additional info about the selection process (criteria, competition, etc.)

Most teachers felt that their students had a fair chance of being selected, while others felt that their students lacked the necessary skills/abilities to be successful in conducting investigations of the caliber shown on the program. Teachers were pretty evenly split in terms of whether or not they thought their students could be successful in being selected to be on the program.

Students, on the other hand, were far more confident in their ability to be chosen. Thirty-three said that they thought it was "very" likely that they'd be chosen, and another thirty-five thought that it was "somewhat" likely.

Table 22: Likelihood of Being Chosen

| Likelihood | # of Students |
|------------|---------------|
| Very | 33 |
| Somewhat | 35 |
| Not Very | 17 |
| Not at all | 3 |

Among the reasons the gave for why they thought they'd be chosen if they submitted an application to DragonflyTV students said:

- They were not shy, or would be good performers
- They were smart/intelligent
- They had good ideas for projects
- They like science and like the show

Among the reasons they gave for why they thought they wouldn't be chosen if they submitted an application:

- There were too many competitors
- They weren't what they were looking for or weren't good enough
- They were too shy or too scared
- They thought that their projects wouldn't be good enough

What are the barriers that keep kids from sending ideas/applying to be on the show?

Only slightly more than half (57%) of students we surveyed reported that they believed the statement that the kids on the show actually came up with their experiments "a lot," followed by 27% who reported they agreed with the statement "some." This finding supports the students' perception of the need for adult mentoring or assistance, which may not be readily available to them.

In some cases there were specific obstacles that teachers felt would prevent their students from participating. One teacher felt that her students had been discouraged from participating because they hadn't seen other kids like themselves on the show (e.g., lower class/minorities). Another teacher felt that her students' language abilities might keep them from being able to fully participate. Greater diversity might stimulate participation from a more diverse group of students, though we suspect that it is a bit of a chicken-egg conundrum (i.e. wanting to include diverse groups of children, but needing some way to recruit them from the start).

Adults (teachers and group leaders) also discussed the barriers that they felt would keep them from helping students to apply. Among these were:

Lack of Time

For many teachers, time was a prohibitive factor. No matter what incentives were offered, there simply didn't seem to be enough time in the day to facilitate their participation at the level they perceived to be necessary. Other teachers asserted that they'd find a way to make the time if their students showed genuine interest in submitting an idea for the show.

The "Coolness" Factor

Focus group participants suggested that some kids might not think that it is cool to be on an educational program, offering this as one thing they suspect to be keeping some kids from applying. Coolness aside, almost all the focus group participants said that they'd like to be on the show, noting a desire simply to be on television as the main reason, but also mentioning a desire to try or learn new things.

Fear

We encountered a handful of students that said that they were too scared to be on the show. Some of these, however, indicated that they'd still be interested in doing things for the show, or helping their friends come up with ideas, even if they didn't want to appear on screen themselves.

Is there a difference in how much average kids want to be on the show compared to kids that are involved in extra-curricular science-related activities?

The idea of doing their own investigations understandably appeals more to some kids than to others. However, an opportunity to be on television seems to be a universal incentive. According to teachers, many of the students were interested in applying to be on the program. The most common reason given for why teachers felt their students would want to be on the program was simply a desire to be on television. One teacher also suggested that there was desire on the part of the kids to share their ideas and show others what they could do.

"I'd say half of my class is interested. I think its because they are realizing that a lot of the science we've done in class, they can do outside of class. My students [are interested because] they want other kids to see what they've done."

Survey data supported the notion that more-involved kids were most likely to want to be on DragonflyTV. Regression analysis showed that there is a positive, statistically significant relationship between student involvement in outside activities and how much they want to be on DragonflyTV ($t=2.975$, $p<.05$). A 1.00-point difference in activities involvement overall is associated with a .05-point difference in how much they want to be on the show. Although the relationship was found to be significant (probably due to our large sample), the association between involvement in activities and students who want to be on the show is not very strong and only accounts for two percent of the variation in this variable.

To further examine differences based on involvement in activities, we created a categorical variable: low, average, and high involvement. Categories were developed

based on percentile ranks from descriptive statistics. Low involvement reflected the zero to 25th percentile range, average was created using the 25th to 75th percentile range (middle 50%) and high was created using scores above the 75th percentile. Table 23 shows the frequency breakdown of how much students want to be on DragonflyTV based on involvement in activities. As you can see in Table 23, students with low involvement in activities were less likely to want to be on DragonflyTV.

Additional supporting regression analyses using the low, average, and high categories, showed that students who reported low involvement in activities were significantly less likely ($t=2.39, p<.05$) to want to be on DragonflyTV than students who reported average to high involvement in activities.

Analysis also showed that students' desire to be on the show varies significantly by grade (see Table 24) with 4th grade students stating they want to be on the show slightly more than 5th grade students ($t=2.19, p<.05$). No differences were found based on gender, academic performance, or city.

Table 23: Desire to be on DragonflyTV by Involvement Level

| I want to be on DragonflyTV... | Involvement Level | | |
|--------------------------------|-------------------|---------------|-------------|
| | Low (.00) | Medium (1.00) | High (2.00) |
| Not at all | 17.0% (15) | 11.4% (24) | 10.3% (8) |
| Not much | 6.8% (6) | 4.8% (10) | 11.5% (9) |
| Some | 28.4% (25) | 17.1% (36) | 14.1% (11) |
| A lot | 47.7% (42) | 66.7% (140) | 64.1% (50) |

Table 24: Desire to be on DragonflyTV by Grade Level

| I want to be on DragonflyTV... | Grade Level | |
|--------------------------------|-----------------|-----------------|
| | 4 th | 5 th |
| Not at all | 12.2% (24) | 14.3% (36) |
| Not much | 4.6% (9) | 7.9% (20) |
| Some | 15.7% (31) | 20.6% (52) |
| A lot | 67.5% (133) | 57.1% (144) |

Could prizes, recognition and other incentives motivate greater participation?

In our focus group sessions it was clear that merely being on television was the biggest incentive for applying to be on DragonflyTV. However, some participants felt that additional incentives might be necessary to attract some applicants. Focus group participants suggested the following incentives:

- Prizes, such as a contest where the winner could win a trip (perhaps to a site where they'd be able to conduct their own research).
- Posting information about them and their projects on the web.
- Turning them into cartoons for a segment on the program.

In our post-study interviews with students, we also found that students recognized the intrinsic value of being on DragonflyTV (e.g., learning new things or being on

television, with nearly twice as many stating the former than the latter) to be a greater incentive for participation than extrinsic things such as prizes. Students also mentioned the fact that they'd want to be on the show because it looked fun, because they'd be able to share their findings with others, and they'd get to work with other kids. A few even mentioned that they'd like to be on the show so that they could meet the hosts.

For most students and adults with whom we spoke with, there was an intrinsic value in being on DragonflyTV—the opportunity to be on television. Incentives would certainly be welcome, but the lack of incentives does not seem to be a major barrier preventing participation. Rather, children seem to be hindered most by the lack of adult motivators and mentors and adults seem to be hindered by lack of program awareness and time.

About half of the teachers indicated that additional incentives (monetary compensation or supplying resources) would be necessary to get them to invest the necessary time to mentor/support their students.

- *I don't need a personal incentive to help my kids submit ideas to the show. I would do it if someone would give me supplies to do the science. If my kids came up with an idea and someone gave us the supplies to do it with them, I would do it.*
- *I already put in 10 hours a day teaching and tutoring. So if I were to put in extra hours, I would want to be paid \$35/hour.*

Does adult guidance/mentoring motivate participation?

Teachers unanimously agreed that there appeared to be a great deal of adult mentoring that had gone on behind the scenes for most of the investigations in the episodes they'd seen. They felt that there must be adult supervision for many of the activities and there also seemed to be mentoring in terms of investigation design, analysis, and reporting (e.g. what to look for, and how to talk about it in a scientifically appropriate way). Specific comments included:

- *I'm sure they had a fair amount [of adult mentoring]. I saw the cat experiment and to know that this one cat participated and that the other cats didn't and to say that they can't be conclusive about the results, I thought either these kids have a strong background in science or their parents helped them a lot. Also, I thought the rocket was sophisticated.*
- *A lot [of adult mentoring]. I don't think the students could do the investigations unless they had high ipi's. I don't think the students could have generated the thought on their own. It looks as if the students on the show were from affluent areas and for less affluent areas there would have to be a different mentoring process. There is more differentiated need in a less affluent school.*
- *Probably quite a bit. I think that children generally need guidance and they [the kids on the show] were doing stuff that was new to them. The experiments could not have been done without adult help.*
- *The rockets had to have some adult help. I think the cat experiment they could do on their own. There had to be adult mentoring to help set-up their experiments. There had to be adults telling them how many trials to have and guide along the science inquiry.*

A few of the teachers indicated that that they'd been encouraging their students to come up with good science experiments that interested them so that they might be able to apply to be on the show.

What types of adult involvement are most beneficial to encouraging participation?

Children thought that adults could provide the most help by supplying them with ideas or helping to supply materials. Some children also indicated that they thought adults would be able to help them refine their investigations.

Other findings and conclusions

Educational and Entertaining

Children in each of the three sites indicated that DragonflyTV was fun, interesting and educational. In fact, the theme of the program being fun and educational permeated each of the focus group sessions and many of the post-viewing interviews. At each site, focus group participants cited the program's educational value as one of the reasons for liking it. One student noted that DragonflyTV "teaches you science can be fun when you understand and enjoy it" and another suggested that "it's interesting, educational, and it teaches you about new stuff."

Science Appeal

Most teachers indicated that their students already liked science. This was perhaps a by-product of the fact that many of the teachers willing to participate in our study were quite interested in science themselves—a personal interest that they seem to be quite skilled at transferring to their students. DragonflyTV also seems to possess a contagious quality that leads its viewers to be more excited about science.

Students' general opinions about science also improved as a result of viewing DragonflyTV. After viewing three shows, a slightly higher percentage of students reported liking science “a lot” (48% versus 60%). We conducted additional analyses to learn more about how DragonflyTV contributed to students' general liking of science.

Table 25: Pre and Post-Study Scores for Science Appeal

| How much do you like Science? | Not at all | Not much | Some | A lot |
|-------------------------------|------------|----------|-----------|-----------|
| Pre-Study (n=450) | 4% (18) | 10% (46) | 38% (172) | 48% (214) |
| Post-Study (n=465) | 3% (16) | 9% (40) | 28% (131) | 60% (278) |

Students rated the extent to which they liked science before viewing the DragonflyTV episodes and after viewing. Paired sample t-tests of means showed that students reported a statistically significant increase in their ratings after viewing the episodes. Additional analyses examined whether a student's general “liking” or “understanding” of the videos (score created by averaging across all video items measuring “liking” and “understanding.”) is significantly associated with this positive change in the extent to which students like science. Interestingly, although numerous models were run to see what best predicts this change, it was not students' liking of DragonflyTV, but the extent to which they reported *understanding* the videos overall that was the statistically significant ($t=2.36$, $p<.05$) predictor of the changes we measured in students' liking of science. Students who reported a better understanding of the DragonflyTV episodes had a better attitude toward science, perhaps indicating that DragonflyTV succeeds in reaching students who have traditionally been turned off by science programming that they find confusing or difficult to understand.

Students' pre-study attitudes about science were also found to be a significant predictor of the extent to which they enjoyed the videos overall and individually ($t=9.55$, $p<.001$) and understood the video content ($t=6.61$, $p<.001$). Students who

reported liking science more initially, also reported that they enjoyed and understood the videos to a greater extent.

Tables 26 and 27 below highlight specific reasons for liking and disliking science, given by children in our pre-study interviews.

Table 26: Reasons Given for Liking Science

| Reason Given | # of Student Pairs Responding |
|---|-------------------------------|
| Activities/ Hands-on projects/Experiments | 39 |
| Specific Projects/Activities | 24 |
| Learn/Discover | 12 |
| Writing/Presentations | 10 |
| Animals | 8 |
| Solar System | 8 |
| Multimedia: computers, movies, fieldtrips, etc. | 8 |
| Teacher/Class | 7 |
| Equipment | 4 |

Table 27: Reasons Given for Disliking Science

| Reason Given | # of Student Pairs Responding |
|----------------------------------|-------------------------------|
| Difficulty/too hard/Confusing | 14 |
| Boring/Repetitive | 10 |
| Writing | 7 |
| Gross/Dirty/Messy | 7 |
| Dangerous (Chemicals/Explosions) | 6 |
| Teacher/Class | 6 |
| Failure/Mess-up/etc. | 4 |
| Time/takes too long | 3 |
| Safety Equipment/Equipment | 3 |

Gender Differences

As the table below shows there is a slight difference in how interested students are in seeing another episode of DragonflyTV based on gender, with girls slightly more interested than boys. Although the difference is small (mean of 2.51 versus 2.33 on a scale from 0-3), it is statistically significant ($t=2.26$, $p<.05$). Overall, there is high interest regardless of gender.

Table 28: Gender Differences in Students' Interest in Seeing More DragonflyTV

| Interest in seeing another episode of DragonflyTV... | Grade Level | | Total |
|--|-------------|-------------|-------------|
| | Male | Female | |
| Not interested at all | 6.3% (14) | 4.1% (9) | 5.2% (23) |
| Not very interested | 11.6% (26) | 4.1% (9) | 7.9% (35) |
| Sort of interested | 25.4% (57) | 24.8% (54) | 25.1% (111) |
| Very interested | 56.7% (127) | 67.0% (146) | 61.8% (273) |

Televising Viewing Habits and Preferences

Table 29: Television Show Preferences

| TV Show | # of Student Responses (In Pairs) |
|-----------------------|-----------------------------------|
| BET | 14 |
| That's So Raven | 13 |
| The Simpsons | 9 |
| SpongeBob Squarepants | 8 |
| Hey Arnold | 8 |
| Rugrats | 8 |
| Sister Sister | 8 |
| The Proud Family | 8 |
| Discovery Channel | 8 |
| Lizzie McGuire | 7 |
| Animal Planet | 7 |
| Dexter | 6 |
| Dragonball Z | 6 |
| Zoom | 5 |
| Wrestling | 5 |
| MTV | 4 |
| Dragontales | 4 |
| Yu-Gi-Oh | 4 |
| Discovery Kids | 4 |
| ESPN | 4 |
| Kim Possible | 4 |
| The Cosby Show | 4 |
| Ed, Edd, Eddy | 4 |
| Fairly Odd Parents | 3 |
| Jimmy Newtron | 3 |
| All That | 3 |
| Johnny Bravo | 3 |
| PowerPuff Girls | 3 |
| Arthur | 3 |
| Cyberchase | 3 |
| Smart Guy | 3 |
| Even Stevens | 3 |

Table 30: Reasons Given for Why They Like TV Shows

| Reason Given | # of Student Responses (In Pairs) |
|---|-----------------------------------|
| Funny | 33 |
| Learn new things | 21 |
| Can relate to characters/ Like your own | 14 |
| Music | 9 |
| Entertaining/Enjoyable | 8 |
| Animals | 8 |
| Action/Adventure | 7 |

Table 31: Reasons Given for Why They Enjoy Science TV Shows

| How Much | # of Students |
|------------|---------------|
| A Lot | 49 |
| Some | 32 |
| Not Much | 6 |
| Not at All | 4 |

Note: We found it quite interesting that, when asked to tell us their favorite television shows, most children responded with television *channels* (e.g. BET, Disney, Cartoon Network, Nickelodeon, etc.) rather than specific programs. It seems that children are less specific about what/when they watch vs. *where* they watch (i.e. they pick channels to watch rather than programs to watch).

Table 32: Enjoyment of Science TV Shows

| Not at All | Not Much | Some | A Lot |
|------------|----------|------|-------|
| 4 | 6 | 32 | 49 |

In our pre-study interviews with children we asked them to tell us what they'd do if they were asked to design a science television show for children their age. Their responses are presented in the Table 33, below.

Table 33: What Children Would Include in Science TV shows

| Desirable Traits | # of Student Responses (In Pairs) |
|---------------------------------|--|
| Shows new things/teach things | 28 |
| Activities/Experiments | 23 |
| Animals | 17 |
| Funny | 9 |
| Kid Hosts/Interesting Hosts | 8 |
| Entertaining | 5 |
| Kid Language/Easy to understand | 4 |
| Space | 4 |
| Real (i.e. not a cartoon) | 3 |
| Dinosaurs | 2 |

Reality

The “reality” of DragonflyTV seems to be one of its greatest strengths. Teachers like the fact that it shows real kids and students seem better able to relate to it as a result. One teacher remarked that they liked DragonflyTV because it didn't seem like a canned show. "I liked the Bill Nye show, but I liked DragonflyTV better because it was a real show with real kids."

Teachers and kids noted that they'd like to see some things fail from time to time because that is more in line with what happens in the real world. One teacher stated that she liked the investigation with the cats, because the cats didn't always cooperate and this made the segment seem all the more real.

Titles

The program titles are too vague or somewhat misleading and don't capture viewers' interest. One teacher commented that she felt that the titles didn't always match what was in the video. Many felt that it would have been hard to tell what the programs were about based only on the titles. More compelling titles may help to stimulate additional interest in the program and might generate more viewership from those who come across program listings.

Time Slot

One of the greatest obstacles that the program seems to be facing in the markets where we conducted our study is the early morning time slot. Teachers felt that their students would be more likely to view the program if it were on at a better time: "I'm guessing that the 7 a.m. viewing time is the issue and not the show," stated one teacher. Though some teachers indicated that their students were actually getting up earlier to catch the show when it aired:

"My students have already demonstrated a great interest in science. What has changed is that they've demonstrated interest in wanting to actually see DragonflyTV. My kids are getting up earlier to catch the show at 7a.m."

Pre-test survey data also suggests that most students either hadn't heard of DragonflyTV or hadn't been able to view it at home. Slightly more students had seen the program in

Chicago, but generally speaking, less than a quarter of the students had seen DragonflyTV prior to this study.

Table 34: Previous Viewing of DragonflyTV (by City)

| Have you ever seen DragonflyTV? | City | | | Total |
|---------------------------------|-------------|-------------|---------------|-------------|
| | Boston | Chicago | San Francisco | |
| No | 87.6% (120) | 77.9% (120) | 88.1% (140) | 84.4% (380) |
| Yes | 12.4% (17) | 22.1% (34) | 11.9% (19) | 15.6% (70) |

During the study there was only a slight increase in the percentage of students who reported they watched the DragonflyTV at home. Approximately 16% (n=70) of all students (n=450) reported they had seen DragonflyTV prior to the study and 21% (n=96) of all students (n=457) reported they had seen DragonflyTV at home during the study. In some cases, however, during the time that our research conducted, students would not have been able to see an episode at home due to local broadcast schedules.

Website

During the study there was an increase in the percentage of students who reported they had visited the DragonflyTV website. Approximately 4% (n=19) of all students (n=443) reported they had visited the DragonflyTV website prior to the study and 13% (n=58) of all students (n=457) reported they had visited the DragonflyTV website during the study.

In our focus group sessions, students could readily give the program's web address. Some participants suggested putting some things on the website to give them ideas on what to research or experiments. Others thought it would be cool to see their ideas appear on the website even if they weren't selected for the show.

Response to Program Sponsors

As Table 35 shows, students' ratings of how much four different stores (Best Buy, Sears, Target, & Wal-Mart) care about helping kids learn new things only showed significant pre-post change for Best Buy. A significantly higher percentage of students reported that Best Buy cares "a lot" about helping kids learn new things after viewing the videos (73%, n=331) than prior to viewing the videos (36%, n=152). With more than double the number of students indicating that Best Buy cares about helping kids learn new things it is clear that the program sponsorship is effective.

Table 35: Students' Thoughts on How Much Different Stores Care about Helping Kids Learn New Things

| | | Not at all | Not much | Some | A lot |
|-----------------|--------------------|------------|-----------|-----------|-----------|
| Best Buy | Pre-Study (n=423) | 14% (60) | 23% (99) | 26% (111) | 36% (152) |
| | Post-Study (n=453) | 6% (25) | 6% (29) | 15% (68) | 73% (331) |
| Sears | Pre-Study (n=414) | 30% (124) | 28% (116) | 28% (114) | 15% (60) |
| | Post-Study (n=437) | 26% (114) | 22% (98) | 29% (128) | 22% (97) |
| Target | Pre-Study (n=414) | 14% (58) | 20% (82) | 35% (145) | 31% (129) |
| | Post-Study (n=437) | 17% (72) | 20% (86) | 30% (129) | 34% (150) |
| Wal-Mart | Pre-Study (n=424) | 12% (51) | 19% (81) | 31% (132) | 38% (160) |
| | Post-Study (n=438) | 13% (55) | 17% (75) | 30% (132) | 40% (176) |

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