

ENHANCING CHILDREN'S SCIENCE TELEVISION PROGRAMMING:
LEARNING, INTEREST, MOTIVATION AND BEHAVIORAL INTENT
RESPONSES TO MUSIC VIDEO AND MOTION GRAPHICS

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Fine Arts

in

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ABSTRACT

This study examines the effects of music video and motion graphic formal features on the learning, interest, future motivation and behavioral intent of 139 6th-8th grade students in Bozeman, MT. We created two original films containing the same scientific content, one music video and one narrative. A version of each was overlain with motion graphics for a total of four film treatments. The films can be found at: <http://vimeo.com/53824212> Students' learning performance decreased with the music video format and increased with motion graphics. There was no significant difference in measures of interest between the different treatments. However, when compared to neutral, all treatments scored higher than neutral for measures of interest. Results indicate that music video format may not be ideal for increasing learning, but the assistance of graphics will aid learning. High interest in all treatments indicates that production choices based on previous research can produce positive effects on interest. Results will aid in future design of educational television programming.

INTRODUCTION

There are many arguments for the dissemination and learning of science. The Royal Society of London's Report, *The Public Understanding of Science*, states that a better understanding of science by the public would improve society's prosperity, economy, health and quality of life (1985). To achieve the ideals of a scientifically educated public, we must first have a vessel of communication to the public. As mentioned by the report, one of the best manners is via media. Children's scientific media is of particular interest because it is during these formative years that youngsters will acquire their zeal (or aversion) for science (Maltese & Tai, 2010). Both older and burgeoning technologies—television, video games, iPads, and internet are being modified into venues for education. Falk (2001) writes concerning the employment of these new technologies and other science venues:

The proliferation of science information, and its impact on virtually every facet of our lives, demands that those concerned with public understanding of science not only accept but directly support the expansion and improvement of these free-choice venues for acquiring science information and understanding.” (p. 4)

The purpose of this study is to test filmic conventions in children's educational programming and improve our understanding of how best to disseminate scientific knowledge. We do this by showing four original film treatments containing the same scientific information and examining their impacts on learning and interest on 6th-8th graders.

Today's youth are receiving a significant amount of scientific information from sources other than academia (Falk, 2001; Falk & Dierking, 2010). Television, movies,

video games and the internet all contribute to children's knowledge and perception of science. Falk and Dierking's, "The 95 Percent Solution," (2010) reveals that when science exposure is totaled over an American's lifetime, only five percent of it occurs in the classroom. According to a report in *Science and Engineering Indicators* (National Science Foundation, 2012) a full 35 percent of Americans received their science information from television. Children age 8-18 spend an average of roughly 4 hours watching TV (partially over the internet) (Rideout, Foehr, & Roberts, 2010). With the rise of the internet, sources of scientific information are becoming wildly varied (de Semir, 2010; National Science Foundation, 2012). Therefore there is a need to supplement this available content with programs that are vetted, demonstrate sound production choices influenced by relevant data from peer reviewed studies and are capable of competing in the clamor of available media (Boiarsky, Long, & Thayer, 1999; S. M. Fisch, 2004; S. M. Fisch & Truglio, 2000).

Multiple studies on television and children have shown the positive impact of television on learning and academic readiness (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001; Boller et al., 2004; Huston, Wright, Rice, Kerkman, & St. Peters, 1990; Razel, 2001; Wright, Huston, Murphy, et al., 2001). The long-term effects of educational television have been examined in Anderson et al.'s, *Early Childhood Television Viewing and Adolescent Behavior: The Recontact Study* (2001). The investigators tracked students who watched educational television in preschool and found a significant positive correlation between early childhood viewership and academic performance and habits in high school.

There is a rich history of children's science programming, *Watch Mr. Wizard* is perhaps the most prominent early television science show and many notable shows have come along since: *Newton's Apple*, *3-2-1 Contact*, *Beakman's World*, *Bill Nye the Science Guy* and most recently, *Sid the Science Kid*. Science based television has demonstrated positive affects on learning (Center for Disease Control, 2005; Chen, 1984; Clifford, Gunter, & McAleer, 1995; S. M. Fisch, 2004; S. Fisch & McCann, 1993; Hall, Esty, & Fisch, 1990; Kaiser Family Foundation, 2004; Rideout, 2008). For example, a 2005 study by the Center for Disease Control showed that integrating health messages into fiction television has an impact on audience learning and behavior. 58 percent of viewers reported learning something new about medicine after watching drama/comedy shows for 6 months and 28 of those viewers were likely to take a health related action due to viewing. There are many reasons for using film to depict scientific ideas.

Scientific phenomena are often visual in nature, and film's qualities are ideal for their portrayal (S. M. Fisch, 2004). As Dhingra (2006), Kirkorian, Wartella and Anderson (2008) and Fisch and Truglio (2000) mention, television is well suited for the reiteration of ideas in ways that readily aid learning.

During pre-adolescence (6th-8th grade), youth begin to abandon vetted, education-based programming for flashier more "entertaining" shows that may contain little or no real science education (Calvert & Kotler, 2003). Calvert and Cotler's study indicated that during 6th grade, child viewers abandoned their desire to watch educational programs. As children migrate to less educational programming, the opportunity for program-based informal learning diminishes. However, according to a survey of science professionals

by Maltese and Tai (2010), 30 percent of scientists acquired their career interest in middle school. What's more, perhaps as a consequence or as a cause, there are few dedicated educational television shows available for this age demographic (6th-8th grade). It is for this reason we have chosen to work on programming for students in the pre-adolescent demographic.

Formal Features

The key to securing viewership lies in the appropriate composition of content and production elements (S. M. Fisch & Truglio, 2000). Huston and Wright (1983) defined these production techniques and conventions as *formal features*. Formal features are defined as “program attributes that result from production and editing techniques[...] applicable to many types of content” (p. 36). This includes “action, pace visual techniques, verbal and non-verbal auditory events” (p. 36). The study of formal features and their impacts on attention, learning and behavior in both adults and children has been refined over years. Features examined include the presence absence of adults (Alwitt, Anderson, Lorch, & Levin, 1980; Calvert, Huston, Watkins, & Wright, 1982; Schmitt, Anderson, & Collins, 1999), animation (Anderson & Levin, 1976; Schmitt et al., 1999), pacing (Anderson, Levin, & Lorch, 1977; Boiarsky et al., 1999; Campbell, Wright, & Huston, 1987; Wright et al., 1984) auditory features (Boiarsky et al., 1999; Calvert & Gersh, 1987; Huston & Wright, 1983) on screen text and graphics (Anderson & Levin, 1976; Deborah L. Linebarger, 2001; D. Linebarger, Piotrowski, & Greenwood, 2010) and cuts/pans/zooms (Anderson & Levin, 1976; Rice, Huston, & Wright, 1982; Schmitt et al.,

1999; Smith, Anderson, & Fischer, 1985). Huston et al. (1981) created the term “perceptually salient” to describe formal features with higher attention eliciting ability. Huston and Wright (1989) and Rice, Huston and Wright (1982) suggest that as children grow older, they will gravitate towards more formal feature-rich, complex viewing. In the present study, we chose to focus on two perceptually salient formal features of children’s educational television: music video format and motion graphics (moving text and pictures on screen).

Music Video Format

We believed that music video format would resonate well with our age group and encourage interest in scientific information. Music video viewing has been shown to peak in early adolescence (Roberts & Henriksen, 1990), and furthermore, the prevalence of music listening is commensurate with television viewing by late middle school (Rideout et al., 2010). Music videos have been scrutinized for their negative impacts on the behavior of youth (Beullens & Van den Bulck, 2008; Greeson & Williams, 1986; Johnson, Jackson, & Gatto, 1995; Roberts & Christenson, 2012) and there is limited research on their use in science programming. Smith, Anderson and Fischer (1985) have shown that montage (a common element of music videos) can yield good comprehension. Quick cutting and movement, found in most music videos, can also increase attention (Greer, Potts, Wright, & Huston, 1982; Schmitt et al., 1999) and these features are often linked to comprehension and learning (Bickham, Evans Schmidt, & Huston, 2012; Huston & Wright, 1983). Whereas verbal presentation may be more difficult to remember (Sloboda, 1985), songs may aid learning because they provide a melody which

cues recall of lyrics (Hyman & Rubin, 1990). Calvert and Tart 1993 studied college students' verbatim recall (word for word recall accuracy) of a spoken rendition and a song rendition of a *School House Rock* song. No difference in verbatim recall was found after a single viewing. However, after repeated exposure to each treatment, verbatim recall was enhanced by the song rendition. Calvert (2001) conducted a similar study with college students and 8-10 year olds. Results showed that viewers exposed to the song rendition were better able to recall verbatim material after repeated exposure, while viewers exposed to the spoken rendition were better able to understand the deeper meaning of the lyrics. Similar results were found with the Mexican version of *Sesame Street* (Gemark, 1994).

Motion Graphics

Graphic User Interfaces (GUI's) and motion graphics in film and other media are common components of adolescents' media experiences (Lee & Huston, 2003; Rideout et al., 2010). Motion graphics are well suited for conveying scientific concepts and ideas and are effective at circumventing production limitations. Fisch (2004) discusses the difficulty of displaying and explaining intricate machinery in the live action television show *3-2-1 Contact* and the ease of doing so in an animated program, *Cro*. Live action format would require building expensive props, which could be more cheaply drawn in animation. These production hurdles are now easily overcome due to the widespread availability of graphics software such as Adobe After Effects. Filmmakers can hybridize the two forms by having segments of a live action program superimposed with graphics. The study of motion graphics in educational programming is relatively limited, it has

been partially examined in some studies (Anderson & Levin, 1976; D. L. Linebarger & Piotrowski, 2010), though generally not as the centerpiece of inspection. Several studies have examined the use of on screen text as it relates to close captioning (Goldman & Goldman, 1988; D. Linebarger et al., 2010; Deborah L. Linebarger, 2001; Spath, 1989). Linebarger (2001) suggests that close caption text may serve as a focusing agent for children; it draws them away from the more salient features of programs “glam and glitz” and focuses their attention on the critical information being presented. Linebarger and Piotrowski (2010) also found that onscreen text in narrative structure programming was an effective strategy for assisting in learning vocabulary.

Study Design and Motivations

Although many studies of formal feature have been conducted, we know of only one other study (Campbell et al., 1987) that isolated these formal features by creating original films and standardizing content between them. Most studies examine extant television programs and are vulnerable to subject bias towards certain characters, plots or other features of the show. Studies that standardize content are rare, probably because undertaking a film production is an expensive and difficult endeavor. Our study is unique in that it isolates the elements of music video and graphics for more rigorous examination by eliminating possible confounding variables such as preexisting preferences. We accomplish this by organizing all aspects of the production of materials specifically for this study. In particular, we standardized the science content, story, cast and locations between films. In addition, the principal investigator in this study is part of

an academically unique Science and Natural History Filmmaking program. This adds a special hybrid component to our investigation, allowing it to straddle the divide between art and science. The result is a stronger study using well-informed production and study design inputs from both the humanities and formal sciences, respectively.

We pursue the subject of formal features for several reasons. (1) Only a limited number of studies (Mielke 1983, Boiarsky 1999) have looked into formal feature application in science programming. (2) The majority of inquiries into formal features use pre-existing programming that is subject to biases of preference. Our study circumvents those issues through the development of original programming. (3) We must consider that today's youth has an entirely different suite of media delivery types and formats unavailable to students in previous television eras when many formal feature studies were conducted. For instance, music video was a brand new film convention in the 1980's and motion graphics was not nearly as sophisticated or widely available. Therefore, formal features that may have provoked learning and raised measures of interest in previous decades, may no longer be good predictors of these dependent variables (learning and interest) today.

Rice et al. (1982) write: "The goal is to identify the production techniques that are maximally effective in gaining and holding children's attention and in communicating information to them in ways they will understand and remember" (p. 24). We would like to continue that impulse towards the creation of science programming for children that will motivate them to care about and act on science and conservation issues, will educate them maximally and will compete with other available programming.

Experimental Questions

In the present study, we are interested in maximizing the potential of children's educational science programming, with an emphasis on pre-adolescent children in the 6th-8th grade. By "maximizing potential" we refer to increasing *learning* (recall of concepts and material in a film), *interest* (the positive feeling of curiosity associated with a filmic stimulus), *future motivation* (ensuring viewers want to continue watching the series/share with others) and *behavioral intent* (the desire to pursue or imitate the science and behavior depicted in a film). For scientific content, we focus on *resource conservation* as defined by the Environmental Protection Agency (2012): reducing the consumption of goods, reusing goods and recycling them when they are no longer useable in order to decrease the use of resources (the reduce, reuse, recycle mantra). Our experimental questions are:

1. *Do students who watch films with graphics or music video format perform better or worse on a quiz concerning the film's scientific content than students watching films without these components?*
2. *Are students more interested in films with graphics or music video format? Does interest correlate with learning, future motivation and/or behavioral intent?*
3. *Are students more likely to watch similar films depending on the films' use of graphics or music video format?*
4. *Are students more likely to pursue the science or behaviors depicted in the film depending on the use of graphics or music video format?*

Hypotheses

Learning

It has been demonstrated that song elements of programs are effective at

boosting verbal recall (Calvert, 2001; Calvert & Tart, 1993; Gemark, 1994), but may not be as effective at generating deep understanding (Calvert, 2001; Gemark, 1994). Several studies have shown the ability of motion graphics to elicit attention (Anderson & Levin, 1976; S. Fisch & McCann, 1993; D. L. Linebarger & Piotrowski, 2010). Therefore we expect to see a decrease in learning with the use of music video format and but enhanced learning with the accompaniment of motion graphics.

Interest

Many studies use attention as their dependent variable on formal features (Anderson & Levin, 1976; Calvert & Scott, 1989; Campbell et al., 1987; Lorch, Anderson, & Levin, 1979; Reeves, 1970; Schmitt et al., 1999). We rely instead on interest, as it is a good proxy for attention (Ainley, Hidi, & Berndorff, 2002; McDaniel, Waddill, Finstad, & Bourg, 2000; Renninger & Wozniak, 1985; Silvia, 2006). Similar to Hidi and Renninger (2006), we define interest as a positive psychological state stimulated by the presence of some “environmental, text, or activity feature.” Beryline (1960) describes these features as collative properties: novelty, complexity, ambiguity, contrast, change. Both music video and motion graphics are capable of meeting the definition of these collative properties. Further, studies have shown that components of music video (Anderson & Levin, 1976; Greer et al., 1982; Schmitt et al., 1999; Smith et al., 1985) and motion graphics/text (Anderson & Levin, 1976; D. L. Linebarger & Piotrowski, 2010; Deborah L. Linebarger, 2001) have lead to increased attention of viewers. Therefore we hypothesize that both music video format and motion graphics will have a positive impact on interest.

Relation of Interest to Other Dependent Variables. We expect that the presence of music video format and graphics will heighten interest due to the perceptually salient nature of these features as well as their popularity within our demographic (Rideout et al., 2010) and commonality with other media venues (Lee & Huston, 2003). Interest has been shown to affect learning (Ainley et al., 2002; Hidi, 1990; Renninger, Hidi, Krapp, & Renninger, 1992; Silvia, 2006), motivation (Deci, 1992; Hidi, 2006; Sansone & Thoman, 2005) and behavior (Deci, 1992; Sansone & Harackiewicz, 1996). Therefore, we predict that these measures will be affected concomitantly with interest and we will see them increase with the presence of music video format and graphics.

Future Motivation

Children often make viewing decisions after just a few moments of watching a television program and will quickly change channels (Anderson & Lorch, 1983; Campbell et al., 1987; S. M. Fisch, 2004; Salomon, 1983). Music video and graphics are both elements of media environments with which the 6th-8th grade demographic is very comfortable (Rideout et al. 2010). Therefore, we believe their future motivation to watch films with these elements will be amplified by the presence of these features.

Behavioral Intent

Bandura's seminal work with social learning theory (A. Bandura, Ross, & Ross, 1963; Albert Bandura, 1977) and television has led to a plethora of behavior and television studies. Meta analyses of children's television have shown that prosocial television (television which encourages altruistic or positive behaviors) can have a

positive impact on children's behavior (Hearold, 1986; Mares & Woodard, 2005).

Formal feature studies have shown that behavior can be negatively affected by formal features (Greer et al., 1982) or not at all (Anderson et al., 1977).

While music videos are generally associated with their negative behavioral impacts (Beullens & Van den Bulck, 2008; Greeson & Williams, 1986; Johnson et al., 1995; Roberts & Christenson, 2012), both Hearold (1986) and Mares and Woodward (2005) found that viewing prosocial television had roughly twice the positive effect on behavior as viewing antisocial television. Furthermore, Greitmeyer (2009) and Jacob, Guégen and Boulbry (2010) found that listening to prosocial music can have positive impacts on behavior. It stands to reason that prosocial music videos can be equally good or better at influencing behavioral intent. Several authors have noticed increased feelings of motivation and self worth with the use of text in children's educational videos (Goldman & Goldman, 1988; Deborah L. Linebarger, 2001; Spath, 1989). In these studies, students aided by onscreen text felt better about their learning performances. Motion graphic features could lead to enhanced desire to modify behaviors based on scientific or resource conservation concepts demonstrated in the films. We propose that the presence of music video format and graphics will have a positive impact on behavioral intent.

METHODS

Study Site and Participants

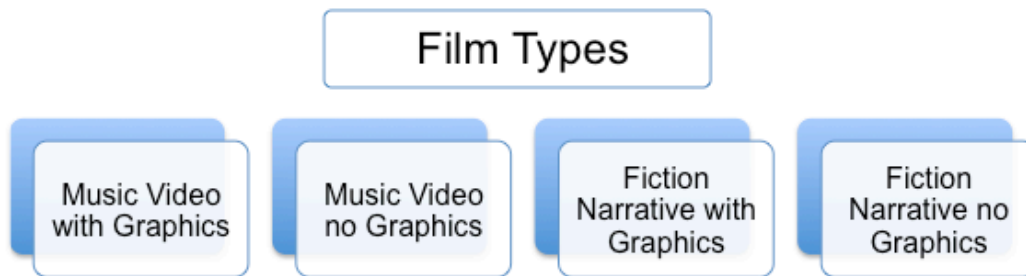
This study was conducted in January and February of 2012 at two middle schools, Monforton School and Chief Joseph Middle School, in Bozeman, MT. There were a total of 139 students grades 6-8 tested: 69 at Monforton (n 's= 43 girls and 27 boys) and 70 at Chief Joseph (n 's=40 girls and 29 boys). The student population at both schools is predominately white and middle class. Monforton is slightly more rural than Chief Joseph, located on the outskirts of the city. Bozeman is a college town with a fairly undeveloped recycling infrastructure, and little emphasis on other forms of resource conservation (reducing and reusing). Neither school had extensive recycling programs, although Chief Joseph's was slightly more developed. Other elements of resource conservation were not emphasized at either school, and neither school had a resource conservation curriculum.

Film Treatments

Children were randomly shown one of four film treatment types, which were all live action: (a) narrative only, (b) narrative with motion graphics, (c) music video format only and (d) music video format with motion graphics, resulting in a 2 (no motion graphics vs. with motion graphics) X 2 (no music video format vs. music video format design). Only two distinct films were shot (narrative and music video), then overlain with motion graphics, yielding four films total (Figure 1). Scientific content was standardized

across all four treatments, and all of the actors and locations in the films remained the same across treatments. The films can be found at: <http://vimeo.com/53824212>

Figure 1. Film Treatment Types.



All the films were live action fiction set-ups, based around the three-act structure commonly found in film and television. Research by Huston and Wright (1983), Fisch (2000) and Furman, Dorfman, Hasson, Davachi and Dudai (2007) indicates that films with a story/plot help increase attention and recall; therefore both the narrative and music video format films revolve around a storyline (the same storyline for both). The narrative of both films centers on the interactions between the protagonist, Bjorn the Viking, two teenagers, Brenda and Mickey, and their biology teacher, Mr. Wilson (see Figure 2). Fisch and Truglio (2000) recommend a diverse cast to reflect the often-diverse viewership of children's educational programming, therefore we made our best efforts to represent diversity in our casting decisions. The child actors were slightly older than our target demographic, as this may also increase appeal (S. M. Fisch, 2004).

Figure 2. Principal cast. Bjorn rebukes Mr. Wilson, Brenda and Mickey after their initial effort to educate Bjorn about resource education.



Initially, Bjorn is not a firm believer of resource conservation, and his actions are driven by archaic, Norse sensibilities about taking what he wants, when he wants and disposing of items that could be conserved. The children and Mr. Wilson, through their educational interventions, help lead Bjorn to the conclusion that resource conservation is indeed worth-while, and essential if he is to preserve the natural world he loves (see Figure 3). It is during these reflections on the environment and why to conserve resources that we incorporated validation research from Werner, Stoll, Birch and White (2002) on recycling, as well as previous studies on creating a favorable perception of reducing, reusing and recycling (Werner et al., 1995; Werner & Makela, 1998).

Figure 3. Discussing environmental impacts. The initial impetus for Bjorn's interest in resource conservation is the death of a sea turtle from eating a plastic bag it mistook for a jellyfish. Brenda and Mickey use this to segue into environmental impacts of a materials economy.



Humor in educational programming can increase viewer attention (Bryant, Zillmann, & Brown, 1983; Zillmann & Bryant, 1988); therefore we incorporated humorous elements into the films as well. There are numerous puns, jokes based on Bjorn's anachronisms and comic relief flashbacks peppered throughout the film (see Figure 4). There are elements of physical humor and audio humor as well, in the form of musical stings and funny sound effects.

Figure 4. Humorous flashback. Bjorn reflects nostalgically on “Viking school.”



We avoided using full-on animation as older children often consider animation to be too “childish” (Calvert & Kotler, 2003; Huston & Wright, 1989; Wright, Huston, Vandewater, et al., 2001). Motion graphics incorporate only a small amount of text, and are often coupled with an image, which reflects or interacts with the text (see Figure 5). The motion graphics used serve to emphasize the dialogue of the cast.

Figure 5. Motion graphic example. A bulldozer pushing text that says “disposal” into a pile to illustrate the final phase in a materials economy.



Anderson, Lorch, Field and Sanders (1981) and Rice et al. (1982) have shown that selecting appropriate content difficulty has a positive effect on attention, therefore, film science content on resource conservation was adapted from the Environmental Protection Agency's (2012) instructional materials for 6th-8th grade students. The films take viewers (vicariously through Bjorn, Brenda, Mickey and Mr. Wilson's interactions) through each step of a materials economy: extraction, production, transportation, consumption and disposal. After explaining the steps to a materials economy, Bjorn then learns the environmental consequences of each (see Figure 6). Finally, Mr. Wilson, Brenda and Mickey delineate the positive impacts of reducing, reusing and recycling, and organize the methods in terms of which are most and least effective at conserving energy and resources. In addition to using EPA instructional materials, the films were deemed to

be age appropriate by middle school science teachers who reviewed the scripts and final films.

Figure 6. Materials economy explanation. Brenda limns out the five different phases in a materials economy.



Assessment of Learning

Students were randomly assigned to watch one of the four different films described in Figure 1. Immediately following viewing, students were asked to take a short test to gauge learning based on the content of the films (see Figure 7, see Appendix A for full test). The test consisted of an assortment of multiple choice, fill in the blank and short answer questions. Possible scores ranged from 0-21 points. Learning results were analyzed using a 2X2X2 analysis of variance (ANOVA). Further analyses were conducted for grade effects using a 3X2X2 ANOVA.

Figure 7. Sample Question from the Post-Viewing Test.

- 1.) What's the best way to describe *resource conservation*?
- A. preventing pollution by being an active community member
 - B. making it easier to get a hold of raw materials like trees, metals and oil
 - C. using less natural resources by reducing, reusing and recycling
 - D. making the air, land and water cleaner by driving less

Assessment of Interest, Future Motivation and Behavioral Intent

Survey

After the test, students were asked to fill out a twenty question, five item Likert survey adapted from Schraw, Bruning and Svoboda (1995) concerning their interest in the film, future motivation to watch similar films and behavioral intent with regards to reducing, reusing and recycling (see Figure 8, see Appendix B for full survey). The survey contained a total of five interest, four future motivation and five behavioral intent questions. It also had three interest subscale questions about what types of films children like and three subscale questions about their initial interest in resource conservation. Interest, future motivation and behavioral intent results were analyzed using a 2X2X2 analysis of variance (ANOVA). We used a Pearson's correlation test to determine any correlation between interest and learning, interest and future motivation and interest and behavioral intent.

Figure 8. Sample Questions from the Post-Viewing Survey.

INSTRUCTIONS: Please circle how much you agree or disagree with each of the sentences below.				
1. I thought the film was very interesting.				
Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
2. I enjoy resource conservation very much.				
Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

Interview

After the survey, a randomly selected subset of each grade (4 students, 1 per treatment) was selected to remain for a brief one-on-one interview to get a more nuanced assessment of participants' experience of interest, future motivation and behavioral intent as a function of the films (see Figure 9, see Appendix C for full survey). The questions were meant to attain specific details regarding the children's opinions on the film, such as whether they found it interesting, what they liked/didn't like about it, and whether they would be interested in watching it again.

Figure 9. Sample questions for post-viewing, one-on-one interview.

3.) <u>What could have made this movie better?</u>
4.) <u>Did you learn anything new? What did you learn?</u>
5.) <u>Did the movie affect how you thought about resource conservation? How?</u>

RESULTS

Overview of Analyses

All analyses tested for any systematic interactions with grade level or with school location. Some main effects emerged, and these are noted. Nevertheless, no consistent patterns emerged indicating that the pattern of results held true no matter the location of the school and across all grade levels, suggesting robust results.

Learning

Do students who watch films with graphics or music video format perform better or worse on a quiz concerning the film's scientific content than students watching films without these components?

If graphics were a significant supplement to learning in a film, then a main effect of their presence can be predicted. In addition, if the music video convention stimulates interest in a film, we would see a main effect of the presence of the music video convention. We predicted no effect of study site on quiz scores. We performed a 2 (yes graphics vs. no graphics) X 2 (yes music video vs. no music video) X 2 (Chief Joseph site vs. Monforton site) analysis of variance (ANOVA) to evaluate the effect of these variables on learning, using quiz score as the dependent variable. Both music and graphics had independent main effects on learning. No statistically significant interaction emerged between graphics and music video format on learning. No other main effects or interactions among the variables was significant.

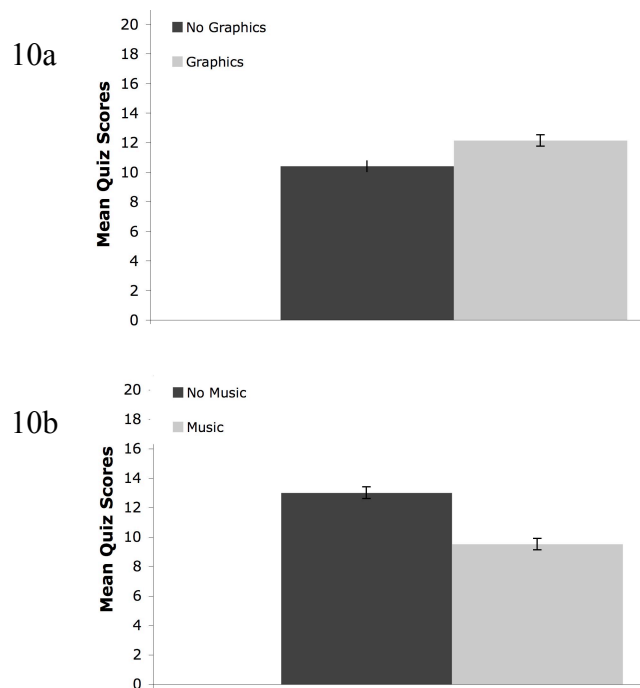
Graphics

As seen in Figure 10a, results showed students watching videos with graphics had significantly higher quiz scores ($M = 12.13$, $SE = .390$) than those watching videos without graphics ($M = 10.39$, $SE = .393$), $F(1, 131) = 9.82$, $p < .01$.

Music Video Format

Students watching music videos had significantly lower quiz scores than those watching the narrative pieces $F(1, 131) = 39.74$, $p < .01$. Watching a music video format film ($M = 9.52$, $SE =$ versus a narrative format film ($M = 13.0$, $SE =$ produced a performance drop in quiz scores (see Figure 10b).

Figure 10. a: Quiz Results in Relation to the Presence of Graphics
b: Quiz Results in Relation to the Presence of Music Video Format



Note: Error bars indicate SE.

Study Site

There was an unpredicted effect of study location on learning, $F(1, 131) p < .01$. Chief Joseph students outperformed Monforton students on quizzes ($M_s = 12.06, 10.466$ respectively). However, as with music and graphics, there were no significant interactions among other variables.

Interest, Future Motivation and Behavioral Intent

Main effects of the presence of graphics and music video format would be seen if students preferred these treatments. We performed a 2 (yes graphics vs no graphics) X 2 (yes music video vs no music video) X 2 (Chief Joseph site vs. Monforton site) analysis of variance (ANOVA) to evaluate the effect of these treatments on interest, future motivation and behavioral intent using survey scores as the dependent variables. None of the film treatments had significant effects. There was no effect of grade level on interest measures so grades were combined for all analyses. No other main effects or interactions among the variables were significant.

Interest

Are students more interested in films with graphics or music video format? Does interest correlate with learning, future motivation and/or behavioral intent?

Graphics and Music Video Format

Neither the presence of graphics nor the presence of music video had any significant effect on students' interest. Films without graphics ($M = 3.509, SE = .096$) had

equally high interest as those with graphics ($M=3.486$, $SE=.095$), $F(1, 131) = .030$, $p=.863$. Films without music video ($M=3.503$, $SE = .096$) reported equally high levels of interest as those with music video format ($M=3.492$, $SE=.094$), $F(1, 131) = .006$, $p=.937$.

Interest, Learning, Future Motivation and Behavioral Intent Correlations

If interest in treatments was a determinant of learning, future motivation or behavioral intent, then we would see a positive correlation between quiz score and these variables. We performed a Pearson's correlation test and found no linkage between interest and learning ($r(139)=-.01$, $p=.983$), a very strong correlation between interest and future motivation ($r(139)=.84$, $p<.01$) and a strong correlation between interest and behavioral intent ($r(139)=.56$, $p<.01$).

Future Motivation

Are students more likely to watch similar films depending on the films' use of graphics or music video format?

Graphics and Music Video Format

Neither the presence of graphics nor the presence of music video format had any significant effect on students' future motivation. Films without graphics ($M=3.563$, $SE=.101$) performed equally well than those with graphics ($M=3.546$, $SE=.100$), $F(1, 131) = .013$, $p=.908$. Films without music video format ($M=3.570$, $SE = .102$) reported equally high levels of future motivation as those with music video format ($M=3.538$, $SE=.100$), $F(1, 131) = .051$, $p=.822$.

Behavioral Intent

Are students more likely to pursue the science or behaviors depicted in the film depending on the use of graphics or music video format?

Graphics and Music Video Format

Neither the presence of graphics nor the presence of music video format had any significant effect on students' behavioral intent. Films without graphics ($M=3.86$, $SE=.073$) performed equally well than those with graphics ($M=3.855$, $SE=.072$), $F(1, 131) = .002$, $p=.961$. Films without music video format ($M=3.951$, $SE = .073$) reported equally high levels of behavioral intent as those with music video format ($M=3.765$, $SE=.072$), $F(1, 131) = 3.318$, $p=.071$.

Secondary Analysis of Interest, Future Motivation and Behavioral Intent

Although tests for effects of film treatments did not yield significant differences between each other, the films increased measures of interest, future motivation and behavioral intent when compared to neutral (3) on the survey's five-item Likert scale. Secondary analysis indicates that all means for interest and motivational items were very high (1 sample t-test). For every film treatment, students indicated significantly high levels of interest, motivation and intent $p<.01$ (See Table 1).

Table 1. T-test Results for Interest, Future Motivation and Behavioral Intent Compared Against Neutral

Treatment	Variable	p	Mean	SE	t	df	N
Narrative No Graphics	Interest	<.01	3.4706	0.15544	3.027	33	34
	Future Motivation	<.01	3.5515	0.13994	3.941	33	34
	Behavioral Intent	<.01	3.9882	0.12059	8.195	33	34
Narrative With Graphics	Interest	<.01	3.5221	0.1335	3.911	33	34
	Future Motivation	<.01	3.5784	0.16119	3.589	33	34
	Behavioral Intent	<.01	3.9137	0.09886	9.243	33	34
Music Video No Graphics	Interest	<.01	3.531	0.14481	3.670	34	35
	Future Motivation	<.01	3.560	0.13561	4.126	34	35
	Behavioral Intent	<.01	3.731	0.11029	6.632	34	35
Music Video With Graphics	Interest	<.01	3.45	0.10642	4.228	35	36
	Future Motivation	<.01	3.5139	0.13618	3.773	35	36
	Behavioral Intent	<.01	3.7972	0.07416	10.75	35	36

Note: Neutral is 3 on the five-item Likert Scale.

Interview

The findings for the interview section of this study were derived from 12 separate one-on-one interviews, one individual per treatment, per grade. We only conducted interviews at Chief Joseph Middle School. Interviews were conducted using a standard set of 13 questions and averaged about 8 minutes. The interview portion of the study was an effort to obtain a more real-world gauge of students' impressions of the films and formal features used within them. It was also meant to get a general sense of what types of science media interest students in this age demographic. We have selected excerpts from their interviews that reflect these goals.

Music Video Format

Many students reflected on the appeal of music videos. They mentioned the presence of story, entertainment level and music's addictive qualities as attention-soliciting features:

They're awesome. [...] they make you hooked to video more with music in the background and everything." (8th Grade, Male)

I like them because not only are you listening, you can also see and you pay more attention to it because it's just entertaining. (8th Grade, Male)

I'm really into music and watching how the music tells a story is pretty cool. (8th Grade, Female)

However, as appealing as the music video format was, some students realized it was impeding their absorption of the film's educational content. This further corroborates the learning results from music video format. Music's hypnotic qualities, fast pacing and high action levels were a distraction to viewers:

Sometimes I paid too much attention to the people and I didn't really remember any of the information that I was supposed to be learning. (8th Grade, Male)

Some of it was going to a little too fast to actually take in. (7th Grade, Female)

I love music but it kind of distracts you and so if you listen to the music and you just kind of rock out you don't really listen to the actual words. (6th Grade, Male)

Graphics

The presence of motion graphics was generally well received. Students felt that it grabbed their attention and assisted with comprehension:

It gets the viewer's attention a lot. (6th Grade, Male)

I think they help bring the mental message, when I think of *Bill Nye* when they show those pictures and they give words and they make them move like that. For some people, I bet it's different for everyone, but for some people it helps you get the mental image in your mind. (7th Grade, Female)

There were some reservations about motion graphics. In general, viewers felt some modicum of graphics acceptable and helpful, but an excessive amount could be detrimental. Specifically, they felt that graphics could become a visual annoyance and large amounts would cause disinterest:

[...] if there's a lot of it, it kind of gets annoying but not a lot is good. (8th Grade, Male)

Just as long as it's not too long. Then you start to loose interest in having to read it all. (8th Grade, Female)

Interest

As indicated by survey results, all of the film treatments were well received by students. The interviews also reflect this trend. One student reflected on the presence of story in films and its capability to connect with viewers' lives:

Yeah, they kind of make more sense cause [...] if it had a back-story or something that would actually happen in real life, it could kind of connect with our lives I guess. (8th Grade, Male)

Other students felt that both the presence of a story and humor intertwined were helpful. Factual information seemed less daunting when delivered with some levity, and in some cases a fact punctuated by humor was capable of assisting recall later on:

Well if it's just one telling you a bunch of facts it gets boring but with a story it's kind of amusing.” (8th Grade, Male)

I liked that some parts of it they put some humor into it and it wasn't just like there was a person sitting in a chair giving you facts. They made a story out of it. They made it interesting. They put a setting. They put characters. [...] I also liked some of the little bits and pieces like they put factual information into it but without making it so serious." (7th Grade, Female)

[...] with funny characters it brings more attention because they can make jokes about it and those jokes can help you later on. (7th Grade, Female)

Behavioral Intent for Resource Conservation

As indicated by the survey responses, students were motivated to participate in resource conservation after watching the treatments. When asked what they would do differently after viewing the film, students indicated they would try to follow some of the resource conservation advice given and consider the matter more seriously:

Trying to buy things with less packaging, greener things, like if you can find a notebook that was made out of recycled paper. (8th Grade, Male)

I'll definitely think about it differently. Cause my family doesn't recycle everything and I guess I'm starting to take that into consideration [...] We throw away every big piece of plastic and cardboard that we have and maybe I could go home tonight and say, 'well, we should probably take this more seriously,' because so little can do so much. (7th Grade, Female)

Learning Limitations

There were certain messages in the films that students had difficulty retaining even though they were very explicitly stated. For instance, one message was that recycling is the least effective form of resource conservation because it uses the most energy and resources. However, some students stated the opposite:

Recycling is better because you're not really doing anything by reducing and reusing. (6th Grade, Male)

However, there were a few students that interpreted the information properly. For one student, finding that reducing and reusing are more effective than recycling seemed quite revelatory:

Everyone talks about recycling and you don't hear a lot about reducing and reusing. You hear more about 'you should recycle that you should recycle that.' And I actually found out that was the least effective and efficient way to do it. (7th Grade, Female)

DISCUSSION

The purpose of this study was to empirically test if the formal feature attributes of music video format and motion graphics could aid in learning and impact measures of interest among pre-adolescent viewers. Taken collectively, the results from the present study suggest that a film lesson with graphics or with narrative (no music video) enhanced learning the material equally well with no additive effects. These data provide an important contribution to the current body of literature on formal film features and give valuable recommendations for the further development of educational programming.

The use of motion graphics proved efficacious at assisting in learning. Both music video and narrative treatments benefited from the use of graphical aids. This reflects previous studies' findings that on screen text is capable of boosting comprehension and learning (Goldman & Goldman, 1988; D. Linebarger et al., 2010; Deborah L. Linebarger, 2001; Spath, 1989). Again, we propose a mix of mechanisms to explain this result. Lorch et al. (1979) and Huston & Wright (1983) developed the feature-signal hypothesis to attribute children's attention to certain elements of television. They suggest that a viewer's attention is drawn to certain features that signal important or enjoyable content. Motion graphics, in this sense, act as signposts or beacons for attention. This is especially relevant for the music video treatment, as the graphics can be a lighthouse in the choppy seas of audio-visual cognitive overload. Through a process called "perceptual grouping" it is possible that audio and visual streams conveying the same information are unified to strengthen a message and thus learning (Baddeley, 2001; Treisman, Kahneman, & Burkell, 1983).

We must be careful not to recommend full-on bombardment of text. Several of our students embraced motion graphics' utility, but also mentioned they could be a nuisance in excess. Linebarger and Piotrowski (2010) echo these sentiments, they found that text used in a narrative format was effective at assisting learning, but that in an expository format show, it became overbearing for viewers. Bergen, Grimes and Potter (2005) found similar results in a study on the use of tickers and text graphics on CNN—too much lead to cognitive overload and lowered retention of information. Mayer and Moreno (2003) suggest that graphics can be detrimental to learning if overused, but when used to highlight or organize important information, they can serve to enhance learning.

Results indicated that the music video format was detrimental to learning, as we predicted and was demonstrated by earlier research (Calvert, 2001; Gemark, 1994). The fact that the story/narrative thread, characters and content remained constant in all treatments confirms the validity of this outcome. We believe there are several psychological and neurological mechanisms involved in our findings. The rapid pacing of music video format may be too overwhelming to follow (Calvert, 1999; Lang, 2000; Singer, 1980; Wright et al., 1984). The music video was 7 minutes 29 seconds long and the narrative setup was 11 minutes 28 seconds long. Singer (1980) states that television is often too fast-paced for any significant reflection on material. Learning may be reduced simply due to the fact that music videos are fast paced and there is little time for rumination on the material. Music videos are capable of captivating viewers, as evidenced by our high interest scores, but they are riddled with what Garner, Gillingham and White (1989) call “seductive details.” They found that bits of extraneous information

in written passages could detract from the main message, and thus inhibit learning. In a similar study, Harp and Meyer (1998) had college students read variations of a text on the formation of lighting. Researchers found through experimental manipulations that seductive details “do their damage” by integrating irrelevant information into texts, which activates the formation of erroneous schemas on the topic of study. Although our study examines a different media type, it is possible to see music video creating a similarly erroneous schema creation effect. The continual bombardment of music, lyrics and quick cutting of a music video create a preponderance of seductive details, which become overwhelming for a viewer, and parsing out the relevant details and information becomes difficult with the multiple information streams. This concept of overstimulation obscuring the science content segues into Sweller’s (1988, 1989) cognitive load theory. He posits that our brains are only capable of processing and internalizing a finite number of information sources. And if the themes of those sources are disparate or variable, retention of information suffers (Chandler & Sweller, 1991). Although mellifluous, a music video can be equally cacophonous at the neurological level.

We must not become too far-reaching in our production recommendations based on results. Although music video format did not garner more interest than traditional narrative treatment, in our interviews, many students reflected on the appeal of music videos, therefore it may be hasty to discount them as a learning or motivating device. Fisch (2004) suggests that music elements of programming are good reiterative measures to reinforce learning. Perhaps the music video by itself is overwhelming, but when used to revisit the text, it may reinvigorate and reinforce ideas covered by the program.

We did not find that learning was correlated to interest—we again attribute this to the impact of the music video format, which received high interest scores but proved to be a poor agent for conveying information. We did however find that both motivation and behavioral intent measures were highly correlated with interest, which is consistent with previous work on the relation between interest, motivation and behavior (Deci, 1992; Hidi, 2006; Sansone & Harackiewicz, 1996; Sansone & Thoman, 2005). Many students seemed motivated to participate in resource conservation when asked what they would do differently after viewing the film. Although motivation was highly correlated to interest, behavioral intent was slightly less so. This may be due to the level of commitment implied by each measure. That is, it's easier to state motivation to watch similar shows or talk about the present one, than it is to make the lifestyle change of embracing resource conservation.

The current data showed no meaningful differences in motivation or behavioral intentions by type of film. Although some studies have shown the behavioral impacts of formal features (Greer et al., 1982), others have shown no effect (Anderson et al., 1977), which is perhaps why we found such homogeneity between our interest, motivation and behavioral intent results. Interest compared to neutral in all of the treatments was high, implying that the formal features tested were high overall, resulting in a restricted range statistically. Thus, students overwhelmingly enjoyed the lesson and were motivated to conserve resources no matter the treatment.

Interviews and survey results confirmed students' enthusiasm for the films. We believe the acceptance of all treatments for all measures of interest was the result of

sound production decisions based on previous research on: narrative structure (S. M. Fisch, 2000; Furman et al., 2007; Huston & Wright, 1983), humor inputs (Bryant, Hezel, & Zillmann, 1979; Bryant et al., 1983; Zillmann & Bryant, 1988), choice of live action setup (Calvert & Kotler, 2003; Huston & Wright, 1989; Wright, Huston, Vandewater, et al., 2001), age-appropriate child actors (S. M. Fisch, 2004), age-appropriate level of difficulty (Anderson et al., 1981; Rice et al., 1982) and effective persuasive techniques (Werner & Makela, 1998; Werner et al., 2002).

Perhaps one of the most informative quotes was in reference to what types of science-content programming a student watched:

I just watch what's good. (8th Grade, Female)

It may seem simplistic, but it is telling of the M² generation and of our all-enveloping media environment. Interviews revealed that students were attaining their science information from a wide range of media sources—*Nova*, *Bill Nye the Science Guy* episodes seen at school, *Myth Busters*, science vignettes on YouTube, NPR podcasts, National Geographic, Discovery Channel, etc. There are literally thousands of sources of entertainment, and it does not matter if they are music videos or podcasts or video games, media consumers are hungry for content. In his book, *Convergence Culture*, Henry Jenkins (2006) addresses this phenomenon—media cross-pollination is causing a convergence culture wherein all sorts of media types are intersecting. It is heartening that so much science content is available, however, these shows may or may not be interested in maximizing learning, and some, such as YouTube content, may not even be scientifically accurate (de Semir, 2010). Therefore, the favorable reception of our

treatments is encouraging. It demonstrates that research-based decisions can both increase interest and learning simultaneously, and that such a concept is viable for attaining viewership in the glut of available media.

Limitations and Future Directions

Although we had quiz scores as high as one hundred percent on our learning measures, the mean quiz scores for even our most effective treatments were not exceptional. Because our films covered the span of resource conservation, the content material did not repeat itself often. Had the treatments employed more repetition, we may have increased recall (Crawley, Anderson, Wilder, Williams, & Santomero, 1999; S. M. Fisch & Truglio, 2000; Kirkorian et al., 2008; Skouteris & Kelly, 2006). This may be especially true of the music video format as indicated by Calvert & Tart (1993) and Calvert (2001). Students' responses reflect this research, many requested "more examples" and felt that information went by too quickly. Future investigators may want to limit the breadth of science material to allow for deeper learning.

Even though all treatments explicitly stated that recycling is the least effective form of resource conservation, there were still students who believed it to be the superior method. Annie Leonard's (2010) the *The Story of Stuff* laments this difficult problem—recycling is often the most visible of the reduce, reuse, recycle triad, even though it is the least effective method of conserving resources. Viewers come preloaded with knowledge, opinions and misconceptions that may not be easily overcome in a single

viewing. Choosing more obscure subject matter may be helpful in avoiding these outside influences.

There was an impact of study site on quiz scores as mentioned in the results. It does not appear to be linked to student aptitude, Science CRT scores for Monforton's 8th grade were actually higher than those of Chief Joseph. Monforton at the time did not have a very developed recycling program, and Chief Joseph's was slightly more advanced. In addition, recycling and resource conservation opportunities may have been more limited for Monforton students due to their more rural location. Again, picking a less common learning topic free of local and extraneous influence would help avoid affecting results of future studies.

Another limiting aspect of the study was the lack of a naturalistic viewing component. Calvert and Cotler (2003) have argued that a naturalistic viewing approach may be the most accurate form of testing children's responses to programming, as it reflects a real-world viewing at home versus results generated in an experimental setting. Although it may be difficult to conduct a completely naturalistic study with formal feature preference and learning in mind, future studies may involve adding a free choice component which allows viewers to choose between films, or watch different films and reflect on their preferred viewing experience. We believe that further research merits this approach. Simultaneously, we recognize that many teachers are currently using supplemental media materials similar to our treatments in their classroom instruction. This mimics the experimental viewing design in our study.

Formal features such as graphics can be helpful in garnering interest and conveying information. Others like music video appear to stimulate interest, but subtract from learning. This does not preclude the use of music video as an educational device, it does however, caution against it as the *sole* means of instruction. Further investigation will need to examine music video as a reiterative measure, mixed with other formats. It would also be prudent to examine the intricacies of onscreen graphics to pin point the ideal quantity and variations of fonts and colors that elicit better learning responses.

Conclusion

Many students would still prefer deriving information from a movie rather than a book, a student reflects:

I like how we do science movies instead of read from a book, like just sit there and read, cause science movies are way helpful. They just explain to us better sometimes than books. (6th Grade, Female)

The two will not be separate forever; with the invention of interactive “itextbooks” capable of playing media couched in text, we continue to integrate such media in new ways. Further informed studies that investigate how to manipulate film’s inherent strengths will be useful in moving forward with educational media.

It is well worth revisiting formal features. The state of media is not static, it is perpetually dynamic. What may have been stimulating and interesting a decade ago, may no longer be novel today. There are many excellent children’s television series: *Sesame Street*, *3-2-1 Contact*, *Blues Clues*, *Bill Nye*, but none are perfect. As the media landscape continues to be a moving target for researchers and filmmakers alike, we must

continue to research and refine children's educational programming.

REFERENCES CITED

- Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *Journal of Educational Psychology*, 94(3), 545–561. doi:10.1037//0022-0663.94.3.545
- Alwitt, L. F., Anderson, D. R., Lorch, E. P., & Levin, S. R. (1980). Preschool Children's Visual Attention to Attributes of Television. *Human Communication Research*, 7(1), 52–67. doi:10.1111/j.1468-2958.1980.tb00550.x
- Anderson, D. R., Huston, A. C., Schmitt, K. L., Linebarger, D. L., & Wright, J. C. (2001). Early Childhood Television Viewing and Adolescent Behavior: The Recontact Study. *Monographs of the Society for Research in Child Development*, 66(1), 1–9. doi:10.1111/1540-5834.00121
- Anderson, D. R., & Levin, S. R. (1976). Young Children's Attention to "Sesame Street." *Child Development*, 806–811.
- Anderson, D. R., Levin, S. R., & Lorch, E. P. (1977). The effects of TV program pacing on the behavior of preschool children. *Educational Technology Research and Development*, 25(2), 159–166.
- Anderson, D. R., & Lorch, E. P. (1983). Looking at Television: Action or Reaction? *Children's Understanding of Television: Research on Attention and Comprehension* (pp. 1–34). New York, New York: Academic Press, Inc.
- Anderson, D. R., Lorch, E. P., Field, D. E., & Sanders, J. (1981). The effects of TV program comprehensibility on preschool children's visual attention to television. *Child Development*, 151–157.
- Baddeley, A. D. (2001). Is working memory still working? *American Psychologist*, 56(11), 851–864. doi:http://dx.doi.org.proxybz.lib.montana.edu/10.1037/0003-066X.56.11.851
- Bandura, A., Ross, D., & Ross, S. A. (1963). Imitation of film-mediated aggressive models. *The Journal of Abnormal and Social Psychology*, 66(1), 3–11.
- Bandura, Albert. (1977). *Social learning theory*. Englewood Cliffs NJ: Prentice Hall.
- Bergen, L., Grimes, T., & Potter, D. (2005). How attention partitions itself during simultaneous message presentations. *Human Communication Research*, 31(3), 311–336.
- Berlyne, D. E. (1960). *Conflict, arousal, and curiosity*. New York, NY: McGraw-Hill.

- Beullens, K., & Van den Bulck, J. (2008). News, music videos and action movie exposure and adolescents' intentions to take risks in traffic. *Accident Analysis & Prevention*, 40(1), 349–356. doi:10.1016/j.aap.2007.07.002
- Bickham, D. S., Evans Schmidt, M., & Huston, A. C. (2012). Attention, Comprehension, and the Educational Influences of Television and Other Electronic Media. *Handbook of Children and the Media* (2nd ed., pp. 113–138). Los Angeles: Sage.
- Boiarsky, G., Long, M., & Thayer, G. (1999). Formal features in children's science television: Sound effects, visual pace, and topic shifts. *Communication Research Reports*, 16(2), 185–192. doi:10.1080/08824099909388716
- Boller, K., Vogel, C., Johnson, A., Novak, T., James-Burdumy, S., Crozier, L., & Uhl, S. (2004). *Using Television as a Teaching Tool: The Impacts of Ready to Learn Workshops on Parents, Educators, and the Children in Their Care* (Final Report). Princeton, NJ: Mathematica Policy Research, Inc.
- Bryant, J., Hezel, R., & Zillmann, D. (1979). Humor in children's educational television. *Communication Education*, 28(1), 49–59. doi:10.1080/03634527909378329
- Bryant, J., Zillmann, D., & Brown, D. (1983). Entertainment Features in Children's Educational Television: Effects on Attention and Information Acquisition. *Children's Understanding of Television: Research on Attention and Comprehension* (pp. 221–240). New York, NY: Academic Press, Inc.
- Calvert, S. L. (1999). *Children's Journeys Through the Information Age* (1st ed.). Boston, MA: McGraw-Hill.
- Calvert, S. L. (2001). Impact of Televised Songs on Children's and Young Adults' Memory of Educational Content. *Media Psychology*, 3(4), 325–342. doi:10.1207/S1532785XMEP0304_02
- Calvert, S. L., & Gersh, T. L. (1987). The selective use of sound effects and visual inserts for children's television story comprehension. *Journal of Applied Developmental Psychology*, 8(4), 363–375.
- Calvert, S. L., Huston, A. C., Watkins, B. A., & Wright, J. C. (1982). The relation between selective attention to television forms and children's comprehension of content. *Child Development*, 53(3), 601–610.
- Calvert, S. L., & Kotler, J. A. (2003). Lessons from children's television: The impact of the Children's Television Act on children's learning. *Journal of Applied Developmental Psychology*, 24(3), 275–335. doi:10.1016/S0193-3973(03)00060-1

- Calvert, S. L., & Scott, M. C. (1989). Sound effects for children's temporal integration of fast-paced television content. *Journal of Broadcasting & Electronic Media*, 33(3), 233–246. doi:10.1080/08838158909364079
- Calvert, S. L., & Tart, M. (1993). Song versus verbal forms for very-long-term, long-term, and short-term verbatim recall. *Journal of Applied Developmental Psychology*, 14(2), 245–260. doi:10.1016/0193-3973(93)90035-T
- Campbell, T. A., Wright, J. C., & Huston, A. C. (1987). Form cues and content difficulty as determinants of children's cognitive processing of televised educational messages. *Journal of Experimental Child Psychology*, 43(3), 311–327.
- Center for Disease Control. (2005). *TV Drama/Comedy Viewers and Health Information* (Porter Novelli HealthStyles Survey).
- Chen, M. (1984). *A Review of Research on the Educational Potential of 3-2-1 Contact: A Children's TV Series on Science and Technology. A Report for the Children's Television Workshop and the National Science Foundation*. Washington D.C.: National Science Foundation. Retrieved from <http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED265849>
- Clifford, B. R., Gunter, B., & McAleer, J. (1995). *Television and Children: Program Evaluation, Comprehension, and Impact*. Hillsdale, NJ: Psychology Press.
- Council of the Royal Society. (1985). *The Public Understanding of Science* (Report of a Royal Society ad hoc Group endorsed by the Council of the Royal Society). London, UK: The Royal Society of London.
- Crawley, A. M., Anderson, D. R., Wilder, A., Williams, M., & Santomero, A. (1999). Effects of repeated exposures to a single episode of the television program Blue's Clues on the viewing behaviors and comprehension of preschool children. *Journal of Educational Psychology*, 91(4), 630.
- de Semir, V. (2010). Meta-Review: The crisis of media, the relocation of the journalists' world and the decline of science sections in the context of the Internet communicative and social revolution (pp. 1–69). Presented at the Media for Science Forum, Barcelona, Spain: Media for Science. Retrieved from http://www.mediaforscience.org/Resources/documentos/booklet_en.pdf
- Deci, E. L. (1992). The Relation of Interest to the Motivation of Behavior: A Self Determination Theory Perspective. *The Role of Interest in Learning and Development* (pp. 43–70). Psychology Press.

- Dhingra, K. (2006). Science on television: Storytelling, learning and citizenship. *Studies in Science Education*, 42(1), 89–123. doi:10.1080/03057260608560221
- Environmental Protection Agency. (2012). Resource Conservation. *Resource Conservation*. Retrieved from <http://www.epa.gov/epawaste/conserve/>
- Falk, J. H. (2001). Free-Choice Science Learning: Framing the Discussion. *Free-Choice Science Education: How We Learn Science Outside of School* (pp. 3–20). New York, NY: Teachers College Press.
- Falk, J. H., & Dierking, L. D. (2010). The 95 Percent Solution: School is not where most Americans learn most of their science. *American Scientist*, 98(6), 486–493.
- Fisch, S. M. (2000). A Capacity Model of Children's Comprehension of Educational Content on Television. *Media Psychology*, 2(1), 63–91. doi:10.1207/S1532785XMEP0201_4
- Fisch, S. M. (2004). *Children's Learning From Educational Television: Sesame Street and Beyond*. Mahwah, N.J.: Taylor & Francis.
- Fisch, S. M., & Truglio, R. T. (2000). Why Children Learn from Sesame Street. "G" is for Growing: *Thirty Years of Research on Children and Sesame Street* (pp. 233–259). Mahwah, N.J.: Lawrence Erlbaum Associates, Inc.
- Fisch, S., & McCann, S. (1993). Making broadcast television participative: Eliciting mathematical behavior through Square One TV. *Educational Technology Research and Development*, 41(3), 103–109. doi:10.1007/BF02297360
- Furman, O., Dorfman, N., Hasson, U., Davachi, L., & Dudai, Y. (2007). They saw a movie: Long-term memory for an extended audiovisual narrative. *Learning & Memory*, 14(6), 457–467. doi:10.1101/lm.550407
- Garner, R., Gillingham, M. G., & White, C. S. (1989). Effects of "Seductive Details" on Macroprocessing and Microprocessing in Adults and Children. *Cognition and Instruction*, 6(1), 41–57. doi:10.1207/s1532690xc0601_2
- Gemark. (1994). *Plaza Sesamo IV later summative research: Musical segments* (unpublished research report). New York: Children's Television Workshop.
- Goldman, M., & Goldman, S. (1988). Reading with close-captioned TV. *Journal of Reading*, 31(5), 458–461.

- Greer, D., Potts, R., Wright, J. C., & Huston, A. C. (1982). The effects of television commercial form and commercial placement on children's social behavior and attention. *Child Development*, 53(3), 611–619.
- Greeson, L. E., & Williams, R. A. (1986). Social Implications of Music Videos for Youth: An Analysis of the Content and Effects of MTV. *Youth & Society*, 18(2), 177–189. doi:10.1177/0044118X86018002005
- Greitemeyer, T. (2009). Effects of songs with prosocial lyrics on prosocial thoughts, affect, and behavior. *Journal of Experimental Social Psychology*, 45(1), 186–190. doi:10.1016/j.jesp.2008.08.003
- Hall, E. R., Esty, E. T., & Fisch, S. M. (1990). Television and Children's Problem-Solving Behavior: A Synopsis of and Evaluation of the Effects of Square One TV. *Journal of Mathematical Behavior*, 9, 161–174.
- Harp, S. F., & Mayer, R. E. (1998). How Seductive Details Do Their Damage: A Theory of Cognitive Interest in Science Learning. *Journal of Educational Psychology*, 90(3), 414–434.
- Hearold, S. (1986). An Analysis of 1,043 Effects of Television on Social Behavior. In G. Comstock (Ed.), *Public communication and behavior* (pp. 66–135). New York, NY: Academic Press.
- Hidi, S. (1990). Interest and Its Contribution as a Mental Resource for Learning. *Review of Educational Research*, 60(4), 549–571. doi:10.2307/1170506
- Hidi, S. (2006). Interest: A unique motivational variable. *Educational Research Review*, 1(2), 69–82. doi:10.1016/j.edurev.2006.09.001
- Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational Psychologist*, 41(2), 111–127.
- Huston, A. C., & Wright, J. C. (1983). Children's Processing of Television: The Informative Functions of Formal Features. *Children's Understanding of Television: Research on Attention and Comprehension* (pp. 35–68). New York, NY: Academic Press, Inc.
- Huston, A. C., & Wright, J. C. (1989). The Forms of Television and the Child Viewer. In G. Comstock (Ed.), *Public Communication and Behavior* (Vol. 2, pp. 103–153). San Diego, CA: Harcourt Brace Jovanovich.

- Huston, A. C., Wright, J. C., Rice, M. L., Kerkman, D., & St. Peters, M. (1990). Development of television viewing patterns in early childhood: A longitudinal investigation. *Developmental psychology*, 26(3), 409.
- Huston, A. C., Wright, J. C., Wartella, E., Rice, M. L., Watkins, B. A., Campbell, T., & Potts, R. (1981). Communicating More than Content: Formal Features of Children's Television Programs. *Journal of Communication*, 31(3), 32–48. doi:10.1111/j.1460-2466.1981.tb00426.x
- Hyman, I., & Rubin, D. (1990). Memorabilia: A naturalistic study of long-term memory. *Memory & Cognition*, 18(2), 205–214. doi:10.3758/BF03197096
- Jacob, C., Guéguen, N., & Boulbry, G. (2010). Effects of songs with prosocial lyrics on tipping behavior in a restaurant. *International Journal of Hospitality Management*, 29(4), 761–763. doi:10.1016/j.ijhm.2010.02.004
- Jenkins, H. (2006). *Convergence Culture: Where Old and New Media Collide*. New York, NY: NYU Press.
- Johnson, J. D., Jackson, L. A., & Gatto, L. (1995). Violent Attitudes and Deferred Academic Aspirations: Deleterious Effects of Exposure to Rap Music. *Basic & Applied Social Psychology*, 16(1/2), 27–41.
- Kaiser Family Foundation. (2004). *Entertainment Education and Health in the United States*. Menlo Park, CA: Kaiser Family Foundation.
- Kirkorian, H. L., Wartella, E. A., & Anderson, D. R. (2008). Media and young children's learning. *The Future of Children*, 18(1), 39–61.
- Lang, A. (2000). The limited capacity model of mediated message processing. *Journal of Communication*, 50(1), 46–70. doi:10.1111/j.1460-2466.2000.tb02833.x
- Lee, J. H., & Huston, A. C. (2003). Educational televisual media effects. In E. L. Palmer & B. M. Young (Eds.), *The Faces of Televisual Media: Teaching, Violence, Selling To Children* (pp. 83–106). Mahwah, N.J.: Taylor & Francis.
- Leonard, A., & Conrad, A. (2010). *The Story of Stuff: How Our Obsession with Stuff Is Trashing the Planet, Our Communities, and Our Health - and a Vision for Change*. New York, NY: Free Press.
- Linebarger, D. L., & Piotrowski, J. T. (2010). Structure and strategies in children's educational television: The roles of program type and learning strategies in children's learning. *Child development*, 81(5), 1582–1597.

- Linebarger, D., Piotrowski, J. T., & Greenwood, C. R. (2010). On-screen print: the role of captions as a supplemental literacy tool. *Journal of Research in Reading*, 33(2), 148–167. doi:10.1111/j.1467-9817.2009.01407.x
- Linebarger, Deborah L. (2001). Learning To Read from Television: The Effects of Using Captions and Narration. *Journal of Educational Psychology*, 93(2), 288–98.
- Lorch, E. P., Anderson, D. R., & Levin, S. R. (1979). The relationship of visual attention to children's comprehension of television. *Child Development*, 50(3), 722–727.
- Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the Fridge: Sources of early interest in science. *International Journal of Science Education*, 32(5), 669–685. doi:10.1080/09500690902792385
- Mares, M. L., & Woodard, E. (2005). Positive Effects of Television on Children's Social Interactions: A Meta-Analysis. *Media Psychology*, 7(3), 301–322. doi:10.1207/S1532785XMEP0703_4
- McDaniel, M. A., Waddill, P. J., Finstad, K., & Bourg, T. (2000). The effects of text-based interest on attention and recall. *Journal of Educational Psychology*, 92(3), 492–502.
- National Science Foundation. (2012). *Science and Technology: Public Attitudes and Understanding*. Science and Engineering Indicators. Washington D.C.
- Razel, M. (2001). The complex model of television viewing and educational achievement. *The Journal of Educational Research*, 94(6), 371–379.
- Reeves, B. F. (1970). *The First Year of Sesame Street: The Formative Research*. (Final Report) (p. 200). New York, NY: Children's Television Workshop. Retrieved from <http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED047822>
- Renninger, K. A., Hidi, S., Krapp, A., & Renninger, A. (Eds.). (1992). *The Role of interest in Learning and Development*. Psychology Press.
- Renninger, K. A., & Wozniak, R. H. (1985). Effect of interest on attentional shift, recognition, and recall in young children. *Developmental Psychology*, 21(4), 624–632. doi:10.1037/0012-1649.21.4.624
- Rice, M. L., Huston, A. C., & Wright, J. C. (1982). The Forms of Television: Effects on Children's Attention, Comprehension, and Social Behavior. *Television and Behavior: Ten Years of Scientific Progress and Implications for the Eighties* (Vol. 2: Technical Reviews, pp. 24–38). Maryland: U.S. Department of Health and Human Services.

- Rideout, V. (2008). *Television as a Health Educator: A Case Study of Grey's Anatomy* (Research Report). Menlo Park, CA: Kaiser Family Foundation.
- Rideout, V., Foehr, U. G., & Roberts, D. F. (2010). *Generation M2: Media in the Lives of 8- to 18-Year-Olds*. Menlo Park, CA: Kaiser Family Foundation.
- Roberts, D. F., & Christenson, P. G. (2012). Popular Music: The Sountrack of Adolescence. *Handbook of Children and the Media* (Second., pp. 479–500). Los Angeles, CA: Sage.
- Roberts, D. F., & Henriksen, L. (1990). Music Listening vs. Television Viewing among Older Adolescents. Presented at the International Communication Association Annual Meeting, Dublin, Ireland. Retrieved from <http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED323583>
- Salomon, G. (1983). The differential investment of mental effort in learning from different sources. *Educational Psychologist*, 18(1), 42–50. doi:10.1080/00461528309529260
- Sansone, C., & Harackiewicz, J. M. (1996). “I don’t feel like it”: The function of interest in self-regulation. In L. L. Martin & A. Tesser (Eds.), *Striving and Feeling: Interactions Among Goals, Affect, and Self-regulation* (1st ed., pp. 203–228). Mahwah, N.J.: Psychology Press.
- Sansone, C., & Thoman, D. B. (2005). Interest as the Missing Motivator in Self-Regulation. *European Psychologist*, 10(3), 175–186. doi:10.1027/1016-9040.10.3.175
- Schmitt, K. L., Anderson, D. R., & Collins, P. A. (1999). Form and content: looking at visual features of television. *Developmental psychology*, 35(4), 1156–1167.
- Schraw, G., Bruning, R., & Svoboda, C. (1995). Sources of situational interest. *Journal of Literacy Research*, 27(1), 1–17. doi:10.1080/10862969509547866
- Silvia, P. J. (2006). *Exploring the Psychology of Interest*. New York, NY: Oxford University Press.
- Singer, J. L. (1980). The power and limits of television: A cognitive-affective analysis. *The entertainment function of television*. (pp. 31–65). Hillsdale, NJ: Erlbaum.
- Skouteris, H., & Kelly, L. (2006). Repeated-viewing and co-viewing of an animated video: an examination of factors that impact on young children’s comprehension of video content. *Australian Journal of Early Childhood*, 31(3), 22–30.

- Sloboda, J. A. (1985). *The musical mind: the cognitive psychology of music*. New York, NY: Clarendon Press.
- Smith, R., Anderson, D. R., & Fischer, C. (1985). Young children's comprehension of montage. *Child Development*, 56(4), 962–971.
- Spath, S. L. B. (1989). *A study of closed-captioned television and word recognition for third and fourth-grade below average readers* (Ed.D.). Retrieved from <http://search.proquest.com.proxybz.lib.montana.edu/docview/303705465>
- Sweller, J. (1988). Cognitive Load During Problem Solving: Effects on Learning. *Cognitive Science*, 12(2), 257–285. doi:10.1207/s15516709cog1202_4
- Sweller, J. (1989). Cognitive Technology: Some Procedures for Facilitating Learning and Problem Solving in Mathematics and Science. *Journal of Educational Psychology*, 81(4), 457.
- Treisman, A., Kahneman, D., & Burkell, J. (1983). Perceptual objects and the cost of filtering. *Perception & psychophysics*, 33(6), 527–532.
- Werner, C. M., & Makela, E. (1998). Motivation and Behaviors That Support Recycling. *Journal of Environmental Psychology*, 18(4), 373–386. doi:10.1006/jevp.1998.0114
- Werner, C. M., Stoll, R., Birch, P., & White, P. H. (2002). Clinical Validation and Cognitive Elaboration: Signs That Encourage Sustained Recycling. *Basic and Applied Social Psychology*, 24(3), 185–203. doi:10.1207/S15324834BASP2403_2
- Werner, C. M., Turner, J., Shipman, K., Shawn Twitchell, F., Dickson, B. R., Brusckhe, G. V., & von Bismarck, W. B. (1995). Commitment, behavior, and attitude change: An analysis of voluntary recycling. *Journal of Environmental Psychology*, 15(3), 197–208. doi:10.1016/0272-4944(95)90003-9
- Wright, J. C., Huston, A. C., Murphy, K. C., St Peters, M., Piñon, M., Scantlin, R., & Kotler, J. (2001). The relations of early television viewing to school readiness and vocabulary of children from low-income families: the early window project. *Child development*, 72(5), 1347–1366.
- Wright, J. C., Huston, A. C., Ross, R. P., Calvert, S. L., Rolandelli, D., Weeks, L. A., Raeissi, P., et al. (1984). Pace and Continuity of Television Programs: Effects on Children's Attention and Comprehension. *Developmental Psychology*, 20(4), 653–66.

- Wright, J. C., Huston, A. C., Vandewater, E. A., Bickham, D. S., Scantlin, R. M., Kotler, J. A., Caplovitz, A. G., et al. (2001). American children's use of electronic media in 1997: A national survey. *Journal of Applied Developmental Psychology, 22*(1), 31–47.
- Zillmann, D., & Bryant, J. (1988). Guidelines for the Effective Use of Humor in Children's Educational Television Programs. *Journal of Children in Contemporary Society, 20*(1), 201–221.

APPENDICES

APPENDIX A:

POST-VIEWING TEST

1.) What's the best way to describe *resource conservation*?

- A. preventing pollution by being an active community member
- B. making it easier to get a hold of raw materials like trees, metals and oil
- C. using less natural resources by reducing, reusing and recycling
- D. making the air, land and water cleaner by driving less

2.) What are 3 natural resources that we use to a make our goods?

- 1.
- 2.
- 3.

3.) Name a negative consequence from extracting each of those resources (in #2 above).

- 1.
- 2.
- 3.

4.) When you use rechargeable batteries, what part of Reduce, Reuse, Recycle are you participating in? *Please circle one.*

Reduce

Reuse

Recycle

5.) Please put the three big steps to resource conservation (RRR) in order of which is ***least*** effective at conserving natural resources, to which is most effective.

Least Effective

Most Effective

- 1.
- 2.
- 3.

6.) Why is the least effective option in question #5 the worst?

7.) How many pounds of trash a day does the average family make?

8.) What are 2 hazardous substances in a disposable battery that could harm the environment?

1.

2.

9.) When people melt down scrap metal and use it to make new things, what part of Reduce, Reuse, Recycle are they participating in? Please circle one:

Reduce

Reuse

Recycle

10.) Please fill in the blanks.

_____, Production, Distribution, _____, and Disposal

11.) The steps above (in question #10) are all part of what type of economy?

12.) What does *finite* mean in terms of resources?

13.) When you buy something with minimal packaging, what part of Reduce, Reuse, Recycle are you participating in? Please circle one:

Reduce

Reuse

Recycle

APPENDIX B:

POST-VIEWING SURVEY

INSTRUCTIONS: Please circle how much you agree or disagree with each of the sentences below.

1. I thought the film was very interesting.

Strongly disagree Disagree Neutral Agree Strongly Agree

2. I enjoy resource conservation very much.

Strongly disagree Disagree Neutral Agree Strongly Agree

3. I'd like to discuss this film with others at some point.

Strongly disagree Disagree Neutral Agree Strongly Agree

4. I like music videos.

Strongly disagree Disagree Neutral Agree Strongly Agree

5. This film made me want to Reduce, Reuse and Recycle.

Strongly disagree Disagree Neutral Agree Strongly Agree

6. I liked this film a lot.

Strongly disagree Disagree Neutral Agree Strongly Agree

7. I would watch this film again if I had the chance.

Strongly disagree Disagree Neutral Agree Strongly Agree

8. This film made me think about what types of natural resources I use.

Strongly disagree Disagree Neutral Agree Strongly Agree

9. I got caught up in the film without trying to.

Strongly disagree Disagree Neutral Agree Strongly Agree

10. Reducing, reusing and recycling is fun to do.

Strongly disagree Disagree Neutral Agree Strongly Agree

11. I would like to watch this film again.

Strongly disagree Disagree Neutral Agree Strongly Agree

12. I like shows with moving pictures and text.

Strongly disagree Disagree Neutral Agree Strongly Agree

13. After watching this film, I will probably try to buy less stuff.

Strongly disagree Disagree Neutral Agree Strongly Agree

14. I think most people I know would be interested in this film.

Strongly disagree Disagree Neutral Agree Strongly Agree

15. After watching this film, I will try to reuse more stuff.

Strongly disagree Disagree Neutral Agree Strongly Agree

16. The film was one of the most interesting things I've seen in a long time.

Strongly disagree Disagree Neutral Agree Strongly Agree

17. I think Reduce, Reuse, Recycle is boring.

Strongly disagree Disagree Neutral Agree Strongly Agree

18. I would like to watch other films like this one.

Strongly disagree Disagree Neutral Agree Strongly Agree

19. I like shows that tell a story.

Strongly disagree Disagree Neutral Agree Strongly Agree

20. After watching this film, I will try to recycle more.

Strongly disagree Disagree Neutral Agree Strongly Agree

21. Please tell us about you.

Age _____

Gender: Male ☐ Female ☐

Grade: 6th ☐ 7th ☐ 8th ☐

APPENDIX C:

INTERVIEW QUESTION SHEET

- 1.) What did you like about the movie?
- 2.) What did you dislike about the movie?
- 3.) What could have made this movie better?
- 4.) Did you learn anything new? What did you learn?
- 5.) Did the movie affect how you thought about resource conservation? How?
- 6.) What would you do differently (if anything) in your life after watching this movie (in terms of RRR)?
- 7.) Do you think you would spread the knowledge from the movie to your friends
- 8.) What do you think about music videos?
- 9.) What do you think about motion graphics (animated texts and pictures)?
- 10.) What do you think about science movies with a story?
- 11.) Do science movies interest you? Which ones?
- 12.) Do you like funny characters in science movies?
- 13.) Do you think you can learn and have fun while watching a science movie? Or are they hard to sit through?