Blue Whales: Return of the Giants 3D

Formative Evaluation with a family audience

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Knight Williams Inc.

Valerie Knight-Williams, Ed.D.
Barbara N. Flagg, Ed.D.
Rachael Dobrowolski, MESc
Divan Williams Jr., J.D.

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Introduction

With funding from the National Science Foundation (NSF), the multimedia *Blue Whales Project* (BWP) is directed by the California Science Center in partnership with HHMI Tangled Bank Studios[1], SK Films, and the STAR Library Education Network (*STAR Net*). The centerpiece of BWP is a 3D giant screen film entitled *Blue Whales: Return of the Giants* designed to appeal to science center audiences with a special focus on children in grades 3-5 (ages 8-11) and their families. As described on the project website:

> *Blue Whales: Return of the Giants 3D takes viewers on a journey of a lifetime to explore the world of the magnificent blue whale, a species rebounding from the brink of extinction. Following two scientific expeditions—one to find a missing population of blues off the exotic Seychelles Islands, the other to chronicle whale families in Mexico's stunning Gulf of California—the film transforms our understanding of the largest animal ever to have lived.*

To support and extend the impact of the film for these audiences, the project website hosts a variety of resources, including educational modules featuring activities, interactives, and videos. Starting in 2023 the BWP will also host outreach programs at partner science centers and libraries to broaden the reach of the film's content to diverse audiences.

Additionally, the BWP includes two phases of evaluation conducted by the independent evaluation firm, Knight Williams Inc. The first phase, the subject of this report, was a formative evaluation of the film to inform the development of the film's supplemental educational resources and programming. The second phase, to be completed in 2023-24, will comprise a more comprehensive summative evaluation of the impact of the BWP, including the film, educational modules, and outreach programming as experienced by families in science center and library settings. In preparation for the summative, the formative evaluation also served as a pilot of proposed measures.

To plan and implement the formative evaluation discussed in this report[2], the evaluation team collaborated with staff from the California Science Center to recruit local families to view the final version of the *Blue Whales* film in the science center's IMAX theater. Recruited families included youth in grades 4-6, each with an accompanying parent or caretaker.[3] After viewing, families completed age-appropriate surveys that assessed the film's appeal and the film content goals of increasing viewers' knowledge and interest in blue whales (size, feeding, and communication), the methods used to study them, their protection, and their impact on ocean health. Additionally, in response to Tangled Bank Studios' interest in viewers' experience of the emotion of awe during their viewing of film, the evaluation team integrated a set of supplemental awe questions into the adult survey, reported on separately in Appendix 1. Finally, after all participants completed the survey, the evaluation team led small group discussions on site with a subset of families to further elaborate on selected survey questions and to explore youth and parent responses to an additional viewing outcome of increased intergenerational conversations about the content goals described above.

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[1] Tangled Bank Studios is a production company of the Howard Hughes Medical Institute (HHMI).

[2] The evaluation conformed to IRB requirements (E&I Review Services, #23066-01).

[3] Parents and caretakers hereafter described as "parents." Most (95%) of the 57 adult participants identified themselves as being a parent of the youth they brought to the screening, and the other 5% were other family members (grandparents, sibling).

Phase 1: Participants' survey responses on their experience with the film

Method

Participants

A total of 112 participants completed post-viewing surveys that were usable for the analysis, including 57 parents and 55 youth.

Youth

As shown in Table 1, more than half (55%) of the youth were male and less than half (45%) were female. More than half (56%) were in 4th grade, one-fifth (20%) in 5th grade, and one-quarter (24%) in 6th grade.

Parents

Also shown in Table 1, the parent participant group was two-thirds (68%) female and one-third (30%) male. The parents ranged in age from 23 to 82, with a mean age of 42. The largest racial or ethnic groups were White (30%), Hispanic or Latino (28%), or Asian (25%). Almost two-thirds (63%) had seen two or more giant screen films prior to watching the *Blue Whales* film.

Table 1. Youth and parents' demographic and background information (N = 112)

Demographic/ background factor	Categories	Youth (N = 55)	Parents (N = 57)
Gender	Female	45%	68%
	Male	55%	30%
	No response	0%	2%
Grade	4th	56%	-
	5th	20%	-
	6th	24%	-
Age	Age range	-	23 to 82
	Mean	-	42
Racial/ethnic group	African American/Black	-	4%
	Asian	-	25%
	Hispanic or Latino	-	28%
	Multiracial	-	12%
	Native American Indian/Alaskan Native	-	2%
	White	-	30%
Prior giant screen/IMAX experience	Zero	-	14%
	One	-	18%
	Two or more	-	63%
	No response	-	5%

Evaluation outcomes and questions

The formative evaluation was designed both to (i) address the BWP team's interest in the findings to inform the project's outreach resources and programming and (ii) serve as a pilot for questions to be used in the 2023-24 summative evaluation. To meet the latter goal, the evaluation team developed the formative and summative questions in parallel. Table 2 below summarizes the BWP evaluation outcomes and questions based on the NSF proposal and topics presented in the film.

Table 2. BWP evaluation outcomes and questions

Evaluation outcomes	Evaluation questions
Audiences find the film appealing.	Q1: *To what extent do viewers find the film appealing?*
Audiences demonstrate increased knowledge and interest in blue whales' size, feeding, and communication. Audiences demonstrate increased knowledge and interest in the methods used to study blue whales. Audiences demonstrate increased knowledge and interest in the protection of blue whales and their impact on ocean health.	Q2: *To what extent does experiencing the film impact viewers' knowledge of blue whales' communication, the methods used to study them, their protection, and their impact on ocean health?* Q3: *To what extent does experiencing the film impact viewers' interest in six film topics?*
Audiences engage in intergenerational conversations about blue whales, the methods used to study them, their protection, and their impact on ocean health.	Q4: *To what extent does experiencing the film affect viewers' intergenerational conversations about these topics?*

Appendix 2 includes a breakdown of the formative evaluation survey questions and their anticipated use in the upcoming 2023-24 summative evaluation for *adults*, followed by the formatted adult survey used in the formative evaluation. Appendix 3 presents the *youth* survey questions and their related outcomes for the formative evaluation, followed by the formatted youth survey for use in the formative evaluation The formative evaluation survey for youth focuses on the same short-term outcome questions as adults, with the removal of questions about awe and the addition of open-ended questions to help guide development of outreach materials and programming. Results of youth piloting led to revisions in both surveys to increase the differentiation between pre-film and post-film knowledge scores and revisions to lower the reading level. Relevant demographic and background questions are also included in each adult and youth survey, as described in Table 1 on page 5.

Procedure

Family participants were recruited for an April 22, 2023, film evaluation through social media posts shared on the California Science Center's Facebook and Instagram accounts. The first recruitment post was shared on both platforms in late March 2023, and the second in mid-April. Each post reached more than 9,000 Facebook accounts and 3,000 Instagram accounts. The California Science Center informed the evaluation team that their followers on both platforms were predominately from the Los Angeles area and shared the informal observation that their social media followers were similar to their in-person guests ("families with young children, students, educators, and international fans"). Females comprised about two-thirds of the followers of both platforms, likely resulting in the two-thirds female representation in the participating parent sample, as noted in Table 1.

The language in all Facebook and Instagram recruitment posts was identical (a screenshot of one post is Image 1). All posts invited pairs of a parent and one 4th - 6th grade child[4] to participate in the evaluation of an upcoming 3D giant screen nature film. The recruitment posts connected parents to an online information page and consent form where they could learn more about the evaluation and, if interested, provide their child's grade, their consent, and the family's contact information. A member of the evaluation team then emailed parents in the order they signed up to confirm their participation and answer questions. Parents who indicated on the consent form that they and their child were interested in the post-screening discussion group were also invited to participate in that part of the evaluation in the order they signed up.

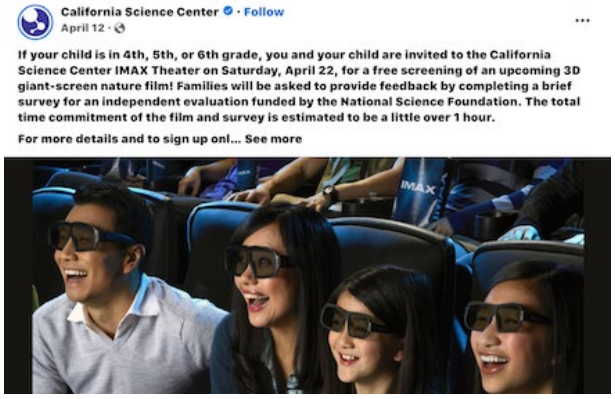


Image 1. Evaluation recruiting post shared by the California Science Center

On the day of the film evaluation, the independent team from Knight Williams Inc. coordinated the evaluation process with support from theater staff, as follows.

As participants entered the theater, theater staff directed them to the 3D glasses and assisted with seating. At the beginning of the 65-minute evaluation session, a member of the evaluation team welcomed participants, thanked them for taking the time to participate, and reminded them that the evaluation involved two parts: first watching the 42-minute film and then completing the survey for up to 20 minutes. They were then informed of the name of the film, *Blue Whales: Return of the Giants*.

After viewing the film, participants were invited to provide feedback about their film experience through either an adult or youth color-coded survey (Image 2). They were also asked to keep the following points in mind: 1) Participation was voluntary; 2) Survey responses were private and would be combined with those from other participants; 3) As the survey asked for their opinions, there were no right or wrong answers; 4) To please answer the questions the best they could without the help of others; 5) To take their time with the questions, as survey completion may take up to 20 minutes; 6) Their feedback would help inform the development of other film-related programming or materials; and 7) The film and evaluation were funded with support from National Science Foundation. Participants then completed the survey, and when finished, they returned their 3D glasses and handed their survey to a member of the evaluation team at a table outside the theater exit, at which point, family pairs received a gift card honorarium.

Image 2. Participants completing youth and parent surveys after viewing *Blue Whales* at the California Science Center's IMAX theater

[4] Families with two youth in 4th, 5th, or 6th grade were allowed to participate if a second parent accompanied the second youth.

Analysis

Basic descriptive statistics were performed on the quantitative data generated from the evaluation. Frequencies, means (*M*), and medians (*Mdn*) are reported in the text, as appropriate. Content analyses were performed on the qualitative data generated in the open-ended questions, coded independently by two of the team. Throughout this report, in cases where participants shared multiple responses to an open-ended question, category percentages add up to more than 100%. The content analysis was both deductive, drawing on the project's goals and objectives, and inductive, looking for overall themes, keywords, and key phrases. Illustrative quotes are in some cases lightly edited to correct spelling and improve readability.

Findings

Part 1. Film appeal

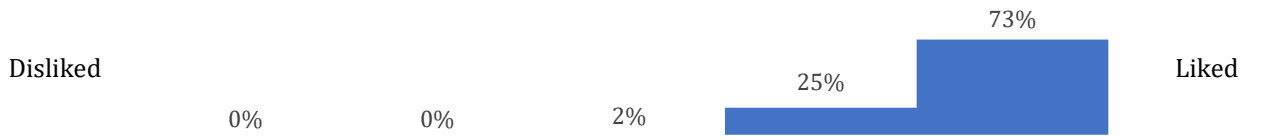
Almost all youth and parents indicated they liked film. In addition, parents thought the film was visually exciting, had an interesting story, and was a film they would recommend to others. The top features that youth and parents liked about the film included learning about blue whales, seeing blue whales, and aspects of the filmmaking, particularly the 3D effects. However, some youth and parents noted disliking aspects of the filmmaking, including pacing, 3D effects, or the volume of whale calls early in the film.

1.1 How much participants liked the film overall

Youth ratings of appeal

Youth rated how much they liked or did not like the film by check-marking one of five faces (see Appendix 3). For quantitative analysis, the unhappiest face was numbered 1 and the happiest, numbered 5. As shown in Table 3, almost all youth (98%) liked the film (*M* = 4.7, *Mdn* = 5.0) .

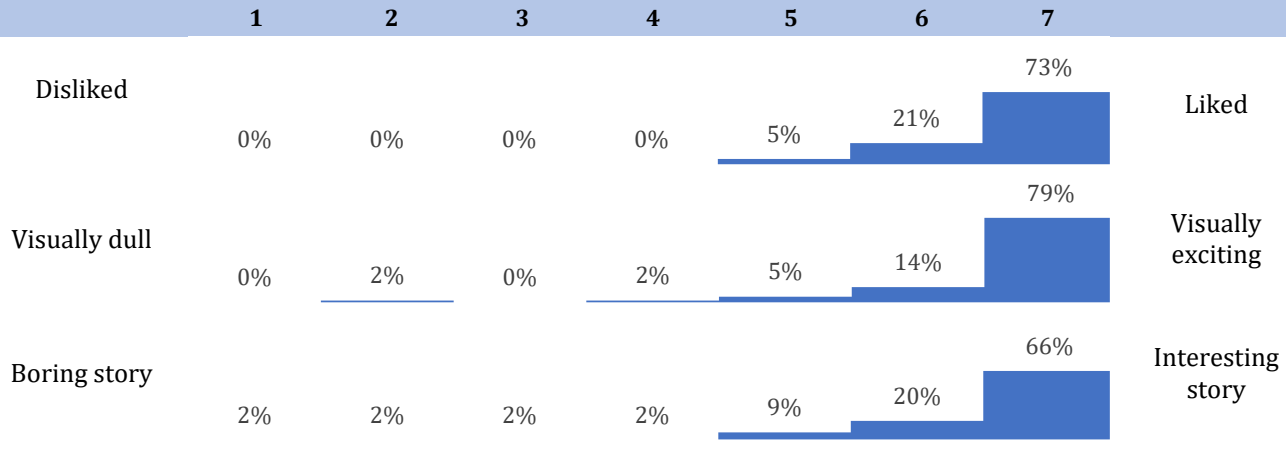
Table 3. Frequency distribution of youths' ratings of overall appeal (N = 55)



Parent ratings of appeal

On a numerical scale from 1 (lowest) to 7 (highest), with 4 being neutral, parents rated aspects of the appeal of *Blue Whales*. As shown in Table 4, most parents liked the film (*M* = 6.7, *Mdn* = 7.0), found it visually exciting (*M* = 6.6, *Mdn* = 7.0), and thought the story was interesting (*M* = 6.3, *Mdn* = 7.0).

Table 4. Frequency distribution of parents' ratings of overall appeal, visuals, and story (N = 57)



Additional parent rating of likelihood of recommending the film

Parents were also asked to rate the likelihood that they would recommend the *Blue Whales* film to others, using a scale from 1 (not at all likely) to 5 (very likely). As shown in Table 5, most parents (84%) thought they were very likely to recommend the film (*M* = 4.8, *Mdn* = 5.0).

Table 5. Frequency distribution of parents' ratings of likelihood of recommending the film (N = 57)

Not at all likely 1	A little likely 2	Somewhat likely 3	Moderately likely 4	Very likely 5
0%	0%	7%	9%	84%

1.2 What participants liked about the film

Youth and parents were asked to share what they liked about the film and why. As shown in Figure 1, youth most liked learning about blue whales (38%), seeing blue whales (27%), and/or an aspect of the filmmaking (20%), in particular the 3D effects. Two of these topics were also mentioned by the largest groups of parents: learning about blue whales (65%) and an aspect of the filmmaking (58%), with parents specifically pointing to the film's visuals, audio, or 3D effects. Examples of the things youth and parents said they liked are in Table 6 on the next page.

Figure 1. What participants liked about the film

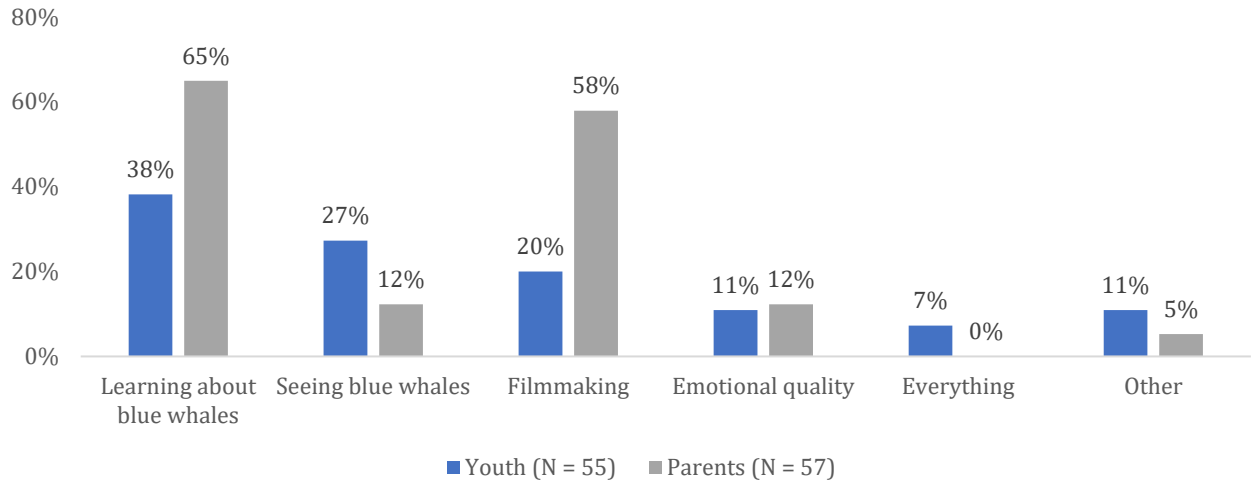


Table 6. What participants liked about the film and why

Youth (N = 55)	Parents (N = 57)
Learning about blue whales: (38%) *I liked hearing what they had to say about the blue whales because I thought it was interesting.* *I liked how they were talking about how important whales [are] because I learned a lot.* *I liked how whale eat krill -> whales poop, krill eat plankton.*	**Learning about blue whales: (65%)** *The story about the importance of blue whales in our ecosystem was great.* *I also enjoyed the facts about blue whales included in the film.* *Great to learn about blue whales.*
Seeing blue whales: (27%) *I have never seen a whale.* *I liked the drone shots because I followed the whales.*	**Seeing blue whales: (12%)** *I'm never likely, in real life, to see one up close like that.* *Seeing the beauty of whales…*
Filmmaking: (20%) *I liked the 3D effects and the overhead/underwater shots because it made the film feel more immersive.* *I liked the music and photography because the music really helped experience the film and the photography was phenomenal.* *I liked the 3D effects because it felt like you could just reach out and grab the PHYTOPLANKTON.*	**Filmmaking: (58%)** *The footage! The music! The build up! I could have watched another 2 hours. Loved the opening and feeling the whale calls.* *I love the 3D feature. I believe [it] makes the experience of the movie more fun and enjoyable.* *Captivating video images.* *The visuals were amazing.*
Emotional quality: (11%) *I liked how people were able to save the whales because it was just a beautiful moment.* *I liked how there was a happy end to the film because if there wasn't then it would be very sad.*	**Emotional quality: (12%)** *Wow it was so moving.* *I loved how at the end they gave us the comfort that whales are multiplying.* *It gave me hope about blue whales.*
Everything: (7%) *I liked all of it because I like the blue whales*	

Image 3. Blue whale tail

1.3 What participants disliked about the film

Youth and parents were asked to share what they disliked about the film and why. As shown in Figure 2, half of the youth (50%) and two-fifths of parents (40%) liked everything or said there was nothing they disliked. The next largest groups of youth (16%) and parents (34%) disliked an aspect of the filmmaking, including pacing, 3D effects, or the volume of whale calls early in the film. Other topics were mentioned by smaller groups of youth and parents. Examples of things participants disliked are in Table 7.

Figure 2. What participants disliked about the film

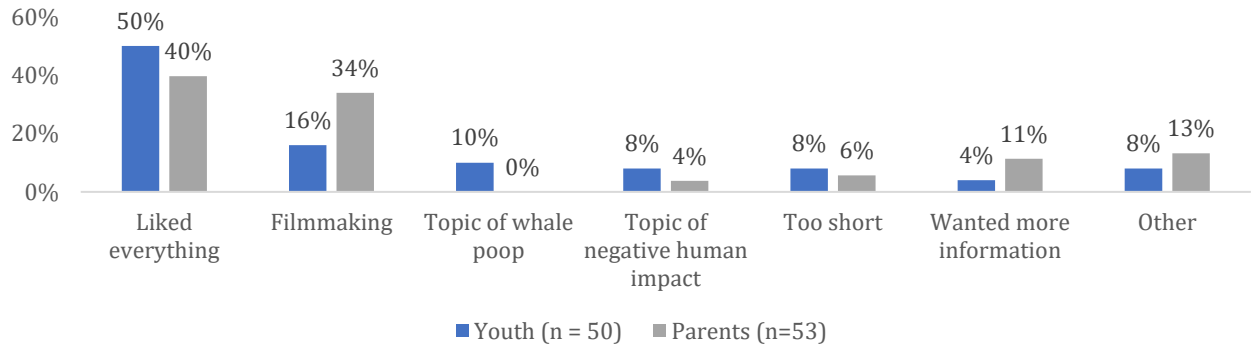


Table 7. What participants disliked about the film and why

Youth (n = 50)	Parents (n = 53)
Filmmaking: (16%) *I did not like that some parts of the movie were slow because I started to lose focus.* *I did not like that there was only a few things to touch because I want to touch stuff from the movie.* *I did not like that the whale sounds were too loud because it hurt my ears.*	**Filmmaking: (34%)** *At one point it started to drag a little - can't remember exactly when that was.* *At times it was a bit slow.* *Sometimes the 3D effect was not well-used.* *During the intro shots to the Gulf of Mexico, the sea lions seemed to be filmed behind glass at an aquarium. Really took away the value and majesty of the rest of the film.* *The sounds (mating) from whale was quite intense and hurt a little bit on the ears.*
Topic of whale poop: (10%) *I did not like when it showed the poop of a whale because it disgusted me.*	
Topic of negative human impact: (8%) *I did not like when the speaker said blue whales were killed :(because it made me cry a little bit.* *I did not like the sad part when all of the blue whales were getting hunted because they would extinct.*	**Topic of negative human impact: (4%)** *The stark beauty of human impact on our ecosystem - beautifully depicted but equal parts tragic and hopeful.*
Too short: (8%) *I did not like how short the film was…*	**Too short: (6%)** *Personally I would have enjoyed a longer film.*
Wanted more information: (4%) *More facts would be nice.*	**Wanted more information: (11%)** *I would have liked to have seen more historical data about the blue whale population rebound, and about summer/winter migration.* *Maybe a few more whale facts? Like how many babies do they normally have and how often, etc.*

Part 2. Most interesting things participants learned about blue whales

Youth were asked to share from the film the single most interesting thing they learned about blue whales, and parents were asked to share the most interesting things that they learned about blue whales. As shown in Figure 3, among youth, more than a quarter each pointed to what they learned about the importance of protecting blue whales (30%) and their impact on ocean health (28%). Nearly half of parents (45%) similarly mentioned blue whales' impact on ocean health, while about a third each mentioned something related to their feeding (36%) and/or the importance of protecting blue whales (31%). Given that parents were invited to list more than one thing they found most interesting, their responses in particular were quite diverse. A quarter (25%) shared other comments, for example finding blue whales' lifespan and/or migration most interesting. Table 8 on the next page has examples of participants' comments in each response category.

Figure 3. What participants found most interesting to learn about blue whales

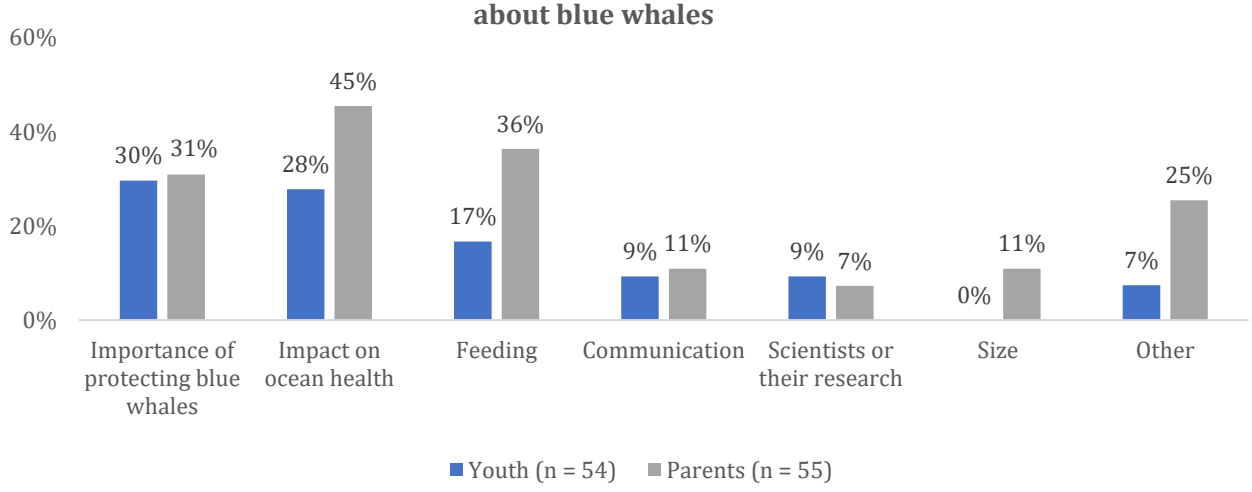


Image 4. Commercial hunting of blue whales

Table 8. Most interesting things participants learned about blue whales

Youth (n = 54)	Parents (n = 55)
Importance of protecting blue whales: (30%) *I learned that blue whales were hunted.* *Only 5% of the blue whale's population remains.*	**Importance of protecting blue whales: (31%)** *How almost extinct they were.* *How low their population was compared to now.*
Impact on ocean health: (28%) *That their poop is good for the ocean.* *About the blue whale pump.*	**Impact on ocean health: (45%)** *How blue whale poop helps the ocean.* *…[how important] blue whales are for the ecosystem.*
Feeding: (17%) *The way they eat.* *They eat animals that are small yet it keeps them full.*	**Feeding: (36%)** *The fact that the largest animal…eats something so small.* *How they double in size when they eat.*
Communication: (9%) *Whales make sounds for talking and food.* *That they can sing.*	**Communication: (11%)** *The sounds blue whales make to communicate for food, also how the different sounds [are made] when being a male or female.*
Scientists or their research: (9%) *That their poop helps the scientists study.*	**Scientists or their research: (7%)** *…the technique of tracking was fascinating.* *It was also nice seeing the people that are doing something to help the whales.*
	Size: (11%) *They are the biggest baby on earth.*
Other: (7%) *Learning that whales live to 80.* *That baby whales are called calf.*	**Other: (25%)** *They lived for 80+ years.* *The life span of whales.* *Their migration habits.* *Where they migrate.* *Whale snot smells. I always assumed it was clean water coming out.* *Everything was very important and super interesting.*

Part 3. Assessment of participants' knowledge of blue whales

The survey assessed participants' knowledge of blue whales in four content areas: methods used to study blue whales; calls of blue whales; ways blue whales impact the health of our oceans; and ways people can help blue whales have better lives. The majority of youth and parents were able to describe accurately at least two research methods and what scientists learn from those methods, focusing primarily on poop collection and drone photos. The majority of youth and parents could recall the blue whale call as presented in the film, with youth most frequently describing it as far-reaching and parents most frequently noting its feeding purpose. Most youth and parents described part or all of the whale pump cycle as the impact blue whales have on ocean health. Finally, when asked about ways to help blue whales, youth most frequently suggested a ban on whaling and parents most frequently suggested decreasing ship strikes.

3.1 Learning about methods used to study blue whales

The survey assessed both knowledge of methods used to study blue whales and knowledge of what scientists learn from each method. Through the sentence completion format, youth were asked to "tell about two methods scientists in the film use to study blue whales and what they learn from those methods." Parents were asked to "list as many methods as you can that scientists use to study blue whales" in the left-hand column of a gridded table, and in the right-hand column, asked to "describe what they hope to learn from each method that you list." Participant responses were coded into the seven different methods demonstrated or described in the film, including observation, pictures, drone photos, listening, snot collection, poop collection, and tagging. What scientists hope to learn, depending upon the method, included such findings as body condition, communication, digestive system, health, identification, location, migration, and population changes.

Three-quarters (75%) of youth described as requested two methods and what scientists learn from those methods. Only one youth (2%) could not describe both a method and findings from that method. Six-tenths (61%) of parents described three to six of the seven methods and what scientists learn from those methods. One-tenth of parents (9%) could not describe both a method and what scientists learn.

Table 9 on the next page presents the percentages of youth and parents reporting seven methods and categories of what scientists learn from those methods, with responses illustrating the coded categories. Youth most frequently mentioned poop collection (47%), snot collection (31%), and drone photos (42%, Image 5), methods from which scientists learned about digestive system, health, and body condition. Parents most frequently mentioned drone photos (51%), poop collection (49%), and tagging (47%), methods from which scientists learned about body condition, health and digestive system, and migration.

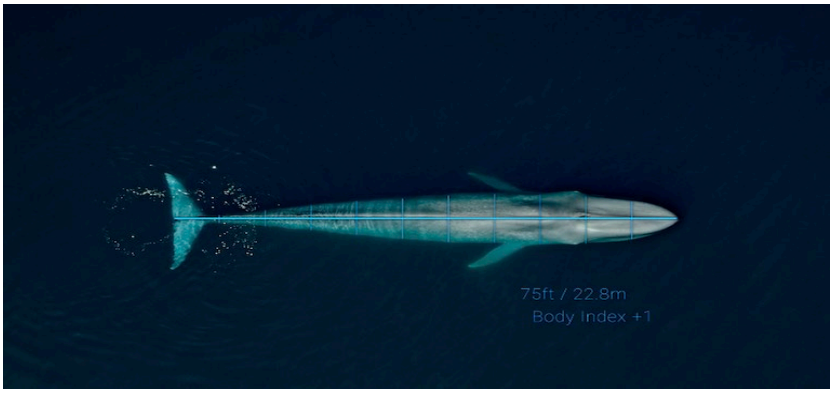


Image 5. Drone photo to learn about whale body condition

Table 9. Participants' knowledge of methods used to study blue whales and what scientists learn from the methods

Youth (N = 55) Method used and *what scientists can learn*	Parents (N = 57) Method used and *what scientists can learn*
Poop collection: (47%)	**Poop collection: (49%)**
Learn about health (24%) *Whale poop (clever)….about their DNA and stress.* *They look at the poop…. if they have a disease if they are healthy.*	***Learn about health (33%)*** *Poop samples…health of the whales.* *Poop collection….check for health.*
Learn about digestive system (24%) *Analyzing their poop….what they digest.* *Picking up whale poop….the whale's digestive system.*	***Learn about digestive system (11%)*** *Collect poop….digestive wellness.* *Waste sample….digestion ability.*
Drone photos: (42%)	**Drone photos: (51%)**
Learn about body condition (40%) *A photo from above the whale….their length and size.* *A drone to see the length of whale….the fat in their body if they are healthy.*	***Learn about body condition (47%)*** *Drone….to measure length and width.* *Drones….size, weight, and overall health.*
Snot collection: (31%)	**Snot collection: (46%)**
Learn about health (25%) *Collecting snot….if it's healthy.* *Drone snot collector….whale's health.*	***Learn about health (42%)*** *Using a drone to get their snot….how healthy the whale is.* *Getting their snot….to see how healthy they are.*
Pictures: (24%)	**Pictures: (30%)**
Learn about identification (20%) *Taking pictures….if they have already catalogued the whale.* *Taking pictures….which whale it is.*	***Learn about identification (25%)*** *Fin and back images….identification of individual whales.* *Photography….markings.*
Learn about population changes (2%) *Taking pictures of them….if they are the same whales in a later date.*	***Learn about population changes (5%)*** *Catalog (Diane's)….track family history and number of babies.*
Learn about body condition (2%) *Take pictures ….to see how big.*	***Learn about body condition (2%)*** *Pictures….health.*
Tagging: (18%)	**Tagging: (47%)**
Learn about migration (16%) *Tagging them and seeing where they go….if a whale is passing by or local.*	***Learn about migration (46%)*** *GPS tag….to follow location of whales.*
Observation*: (13%)*	**Observation*: (39%)***
Learn about health (5%) *How much smoke they blow….how they are healthy.*	***Learn about health (11%)*** *Observing….Health, condition.*
Learn about identification (4%) *Their back spots….who is this whale.*	***Learn about identification (7%)*** *Observation….Identify and count animals.*
Learn about location (2%) *Going out into the deep ocean….where whales go and where they live.*	***Learn about location (14%)*** *Visual sighting….Tracking.*
Listening*: (5%)*	**Listening*: (26%)***
Learn about communication (5%) *A thing that you can hear under the sea….how they sound and contact.*	***Learn about communication (23%)*** *Sound….Mating sounds/Feeding sounds/Social sounds.*

For scoring participants' knowledge about methods, each correct method and each correct category of what scientists learn received ½ point, so youth could receive a score of 0 to 2 and parents, 0 to 7. Table 10 presents the youth and parent score ranges, means, and medians.

Table 10. Scoring of learning about methods used to study blue whales

	Youth (N = 55)	Parents (N = 57)
	Possible score (0-2)	**Possible score (0-7)**
Range	0-2	0-6
Mean	1.8	2.7
Median	2.0	3.0

3.2 Learning about calls of blue whales

Through the sentence completion format, youth were asked to "tell about one thing you learned from the film about the calls of blue whales." Parents were asked in an open-ended question to "describe as many things as you can recall from the film about the calls of blue whales." Participant responses were coded into five descriptors of blue whale calls as presented in the film: powerful, far-reaching, disrupted by humans, mating purpose, feeding purpose, and unspecified purpose as a more general alternative to the two specific purpose descriptors.

Eight-tenths (80%) of youth were able to describe the blue whale call with one of the film descriptors. Two-thirds (67%) of parents responded with one to four of the five call descriptors. Almost all of the one-third (33%) of parents who did not describe something learned about calls ignored the last part of the question "about the calls of blue whales" and instead responded only to the beginning of the question: "describe as many things as you can recall from the film." [5]

Table 11 on the next page presents the percentages of youth and parents reporting any of the descriptors about blue whale calls, with responses illustrating the coded categories. Parents who misread the question were not included in the parent n for Table 11. Youth most frequently described whale calls as far-reaching (29%), having a feeding purpose (24%), or an unspecified purpose (15%) of communication. Those parents who correctly read the question most frequently reported whale calls as having a feeding purpose (73%), a mating purpose (65%), and/or being far-reaching (35%).

[5] In light of how these parents misinterpreted this question, it will be revised for the summative evaluation.

Table 11. Participants' knowledge of the calls of blue whales

Youth (N = 55) One thing I learned about calls of blue whales is _____	Parents (n = 40) Describe as many things as you can recall from the film about the calls of blue whales
Far-reaching: (29%)	**Far-reaching: (35%)**
It can be heard from one hundred miles away. *How far other whales can hear it.*	*I can be heard by other whales hundreds of miles away.* *Heard by others over long distances.*
Feeding purpose: (24%)	**Feeding purpose: (73%)**
They make a big hum sound to tell there's food. *They have a call to invite others for eating.*	*Communication for feeding areas.* *The call for food found is slightly higher and more melodic.*
Unspecified purpose: (15%)	**Unspecified purpose: (5%)**
That is how blue whales communicate. *That they have different types of calls.*	*Different calls for different purposes.*
Powerful: (7%)	**Powerful: (30%)**
They use booming to talk.	*They are very loud and can be felt!*
Disrupted by humans: (4%)	**Disrupted by humans: (13%)**
The noise pollution from cargo ships can interfere with the blue whales' calls.	*Ship sounds can interfere.*
Mating purpose: (2%)	**Mating purpose: (65%)**
That the males call out a courtship song to acquire a mate.	*They have calls for mating.* *Mating calls.*

For scoring participants' knowledge about calls, each of the five descriptors could receive one point. The alternative of unspecified purpose received one point and replaced possible points for mating or feeding purposes. Youth could receive a score of 0 to 1 and parents, 0 to 5. Table 12 presents the youth and parent score ranges, means, and medians. Parents who misread the question were not included in the parent n for the descriptive statistics in Table 12.

Table 12. Scoring of learning about calls of blue whales

	Youth (N = 55) Possible score (0-1)	Parents (n = 40) Possible score (0-5)
Range	0-1	0-4
Mean	0.8	1.5
Median	1.0	2.0

3.3 Learning about ways blue whales impact health of our oceans

Through the sentence completion format, youth were asked to "tell one way that blue whales impact the health of our oceans." Parents were asked in an open-ended question to "describe in as much detail as you can how blue whales impact the health of our oceans." Participant responses were coded into four categories of ways that blue whale impact ocean health: whale poop; poop fertilizes/gives nutrients to ocean; describes part or all of feeding cycle; and notes terms pump or cycle.

Seven-tenths (73%) of youth and nine-tenths (88%) of parents could accurately describe the impact of blue whales on the health of our oceans.

Table 13 presents the percentages of youth and parents reporting any of the categories about how blue whales impact ocean health, with responses illustrating the coded categories. Youth most frequently described part or all of the feeding cycle (40%) or that poop fertilizes the ocean (29%). Parents most frequently responded with part or all of the feeding cycle (46%) and that poop fertilizes the ocean (47%).

Table 13. Participants' knowledge of impact of blue whales on health of our oceans

Youth (N = 55) One way blue whales impact the health of our oceans is _	Parents (N = 57) Describe in as much detail as you can how blue whales impact the health of our oceans
Describes part or all of feeding cycle: (40%)	**Describes part or all of feeding cycle: (46%)**
By pooping they help plankton. *The whales poop, it feeds the plankton, the plankton feed the krill, the krill feeds the whales.*	*Their feces helps feed ocean life.* *The poo enrich plants in the ocean that other sea animals feed on.*
Poop fertilizes/gives nutrients to ocean: (29%)	**Poop fertilizes/gives nutrients to ocean: (47%)**
Their feces fertilizes the oceans. *When they poop they give the ocean nutrients.*	*They nourish the ocean from poo.* *Their fecal matter turns to nutrients and helps with the environment in many ways.*
Whale poop: (16%)	**Whale poop: (7%)**
Their poop. *Pooping.*	*Their feces alone helps the ocean.*
Notes terms pump or cycle: (4%)	**Notes terms pump or cycle: (37%)**
The blue whale pump.	*The health of our oceans would improve if we had more blue whales and their blue whale pump system.* *It helps to keep the ocean life cycle healthy.*

For scoring participants' knowledge of the impact of blue whales on ocean health, simply stating "whale poop" received ½ point and each of the other three categories received one point. Youth could receive a score of 0 to 1 and parents, 0 to 3. Table 14 presents the youth and parent score ranges, means, and medians.

Table 14. Scoring of learning about ways blue whales impact ocean health

	Youth (N = 55)	Parents (N = 57)
	Possible score (0-1)	**Possible score (0-3)**
Range	0-1	0-3
Mean	0.8	1.3
Median	1.0	1.0

3.4 Learning about ways people can help blue whales have better lives

Through the sentence completion format, youth were asked to "tell one way people can help blue whales have better lives." Parents were asked the open-ended question of "based on what you learned from the film, how can people help blue whales have better lives." Participant responses were coded into five categories of ways to help that were implied in the film: establish marine protected area; ban whaling; decrease ship strikes; decrease noise pollution; and study them. One additional category was not polluting, which was not an action suggested in the film and one that those who had not watched the film might suggest.

Two-thirds (65%) of youth were able to describe from the film one of the five ways to help blue whales have better lives. Six-tenths (63%) of parents responded with one to three of the five ways to help blue whales.

Table 15 on the next page presents the percentages of youth and parents reporting any of the categories about how people can help blue whales have better lives, with responses illustrating the coded categories. Youth most frequently described a ban on whaling (38%). Parents most frequently responded with suggestions to decrease ship strikes (26%) and decrease noise pollution (23%).

Table 15. Participants' knowledge of how people can help blue whales have better lives

Youth (N = 55) One way people can help blue whales have better lives is _____	Parents (N = 57) Based on what you learned from the film, how can people help blue whales have better lives
Ban whaling: (38%) *Not killing them.* *Stopping illegal poaching all together.*	**Ban whaling: (21%)** *Stop whale hunting.* *Stop whaling.*
Not polluting [not scored]: (18%) *Keeping our ocean clean.* *Not littering.*	**Not polluting [not scored]: (25%)** *Don't pollute waters.* *Discontinue using plastic bottles, disposable masks, etc. that end up in our ocean.*
Study them: (11%) *Put a tracking device on them to see where they go.*	**Study them: (2%)** *We can donate to foundations that study blue whales.*
Decrease ship strikes: (7%) *Stop sending ships.*	**Decrease ship strikes: (26%)** *By not having commercial tankers in waters where they migrate.* *Hopefully people and container ships out in the ocean can be more aware of these mammals and not hit them.*
Decrease noise pollution: (5%) *Use eco-friendly ships that are less loud so noise pollution is under control.*	**Decrease noise pollution: (23%)** *Reduce or mitigate oceanic noise pollution.* *Lower impact of shipping noise.*
Establish marine protected area: (4%) *Protecting more in natural habitats.*	**Establish marine protected area: (12%)** *Protect areas idyllic to their lifestyle.*

For scoring participants' knowledge of ways people can help blue whales, each of the five categories received one point but the additional category of not polluting did not. Table 16 presents the youth and parent score ranges, means, and medians.

Table 16. Scoring of learning ways people can help blue whales

	Youth (N = 55) Possible score (0-1)	Parents (N = 57) Possible score (0-5)
Range	0-1	0-4
Mean	0.7	0.8
Median	1.0	1.0

Part 4. Youth confusions and curiosities after viewing

One-quarter of youth found something confusing about the film, noting scientists or their research, blue whale behavior, whaling, and/or whale poop nutrients. A majority of youth shared questions about blue whales that were stimulated by watching the film – questions about the study of blue whales, negative human impact, and such whale behaviors as feeding, breeding, bodily functions, and communication.

4.1 Things youth found confusing in the film

Youth were asked if there was anything confusing in the film that they wanted explained further. As shown in Figure 4, the largest group (75%) said there was nothing they found confusing. Less than a tenth each described finding something confusing about: scientists or their research (9%); blue whales (7%; including about their calves, how they eat, and whether they attack dolphins); whaling (6%); and/or whale poop nutrients (4%). Table 17 presents some of the youths' comments about the things they found confusing.

Figure 4. Things youth found confusing in the film (n = 54)

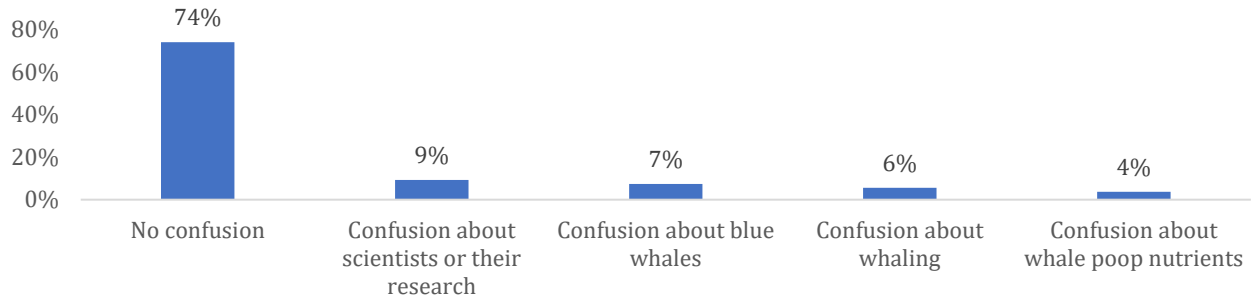


Table 17. Things youth found confusing in the film (n = 54)

Confusion about scientists or their research: (9%)

Did the scientists find where blue whales go?
Why [did] they want to track blue whales?
Why did the person put pool noodles on the drone?

Confusion about blue whales: (7%)

How [do] the blue whales feed?
Yes! It did not explain why calves were missing a lot.
Do the dolphins and whales attack each other?

Confusion about whaling: (6%)

Why would people want to kill them?
Why did they kill 500 in a month?

Confusion about whale poop nutrients: (4%)

How [does] the poop make nutrients?

4.2 Questions youth had about blue whales after viewing the film

Youth were also asked if they had any questions about blue whales after viewing the film. As shown in Figure 5, the largest group (42%) said they didn't have any questions. About a tenth each shared questions about the study of blue whales (13%), negative human impact on blue whales (10%), and blue whales' feeding (10%). Less than a tenth each had questions about blue whale breeding or calves (8%); bodily functions like their blow, poop, and pee (8%); blue whales' communication (6%); and blue whales' size (4%). More than a tenth (13%) shared other questions, asking about their lifespan, swimming, social groups, sleeping, and impact on ocean ecosystem. Examples of youths' questions after watching the film are in Table 18.

Figure 5. Youths' questions about blue whales (n = 52)

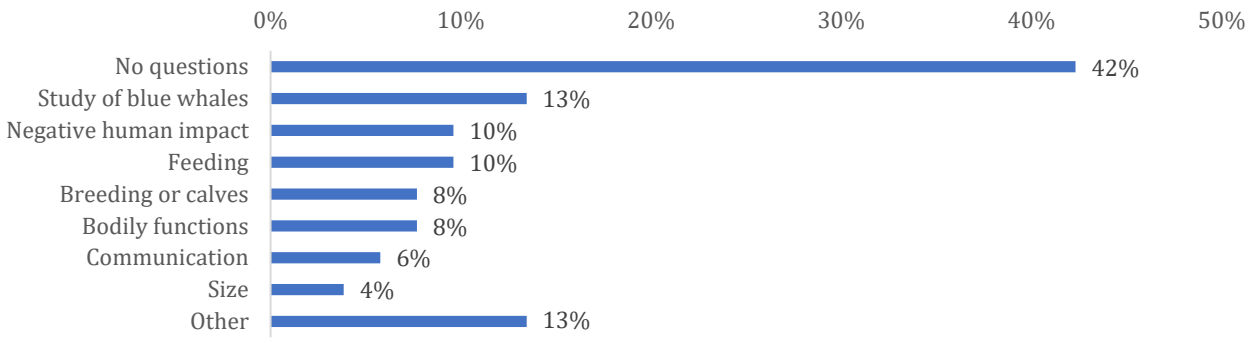


Table 18. Youth questions about blue whales after viewing (n = 52)

Study of blue whales: (13%)

How [do] they track the blue?
How did they feel being next to the whales and dolphins?

Negative human impact: (10%)

How many whales are killed by container ships per year? Can we find a way through the ocean that doesn't [affect them]?
Do people still hunt blue whales?

Feeding: (10%)

Why do the blue whales only eat krill?
How tiny krill feed a mammal that large!

Breeding or calves: (8%)

How long is the breeding process?
[Do] calves just drink milk or [do] they eat anything their parents eat?

Bodily functions: (8%)

Why is the feces of a blue whale that color?
Do they pee?

Communication: (6%)

How do they produce the sound for their calls?

Size: (4%)

Why are blue whales so big

Part 5. Impact of film on participants' interest

After watching the film, a majority of youth indicated they were very interested in the film's topics of the importance of protecting blue whales, how blue whales communicate, the impact of blue whales on the health of our oceans, and the size of blue whales. A majority of adults were very interested in the same four film topics as well as the additional topics of methods to study blue whales and how blue whales feed. Additionally, a majority of parents thought they were very likely to visit the film's website.

5.1 Participants' interest in film topics

Youth ratings of interest

Youth rated their interest in six topics from the film by check-marking one of five faces (see Appendix 3). For quantitative analysis, each face was given a number, with the unhappiest face numbered 1 and the happiest, numbered 5. Across the six film topics on average, youth were moderately to very interested (*M* = 4.4, *Mdn* = 4.5). As shown in Table 19, youth were most interested in the importance of protecting blue whales (*M* = 4.7, *Mdn* = 5.0), how blue whales communicate (*M* = 4.6, *Mdn* = 5.0), the impact of blue whales on the health of our oceans (*M* = 4.5, *Mdn* = 5.0), and the size of blue whales (*M* = 4.3, *Mdn* = 5.0). They were also less interested on average in methods to study blue whales (*M* = 4.2, *Mdn* = 4.0) and how blue whales feed (*M* = 4.2, *Mdn* = 4.0), although they still found these topics moderately interesting.

Table 19. Frequency distribution of youths' ratings of their interest in film topics (N = 55)

	Not at all interested 1	Slightly interested 2	Somewhat interested 3	Moderately interested 4	Very interested 5
Importance of protecting blue whales	0%	0%	4%	24%	73%
How blue whales communicate	0%	2%	4%	29%	65%
Impact of blue whales on the health of our oceans	2%	0%	5%	29%	64%
The size of blue whales	0%	2%	15%	31%	53%
Methods to study blue whales	2%	0%	20%	29%	49%
How blue whales feed	0%	2%	13%	45%	40%

Parent ratings of interest

Using a numerical scale from 1 (not at all interested) to 5 (very interested), parents also rated their interest in the six topics. Across the six film topics on average, parents were very interested (*M* = 4.7, *Mdn* = 4.8). As shown in Table 20, they were most interested in the impact of blue whales on the health of our oceans (*M* = 4.9, *Mdn* = 5.0), how blue whales communicate (*M* = 4.9, *Mdn* = 5.0), the importance of protecting blue whales (*M* = 4.8, *Mdn* = 5.0), and methods to study blue whales (*M* = 4.6, *Mdn* = 4.0). They were slightly less interested on average in the size of blue whales (*M* = 4.5, *Mdn* = 5.0) and how blue whales feed (*M* = 4.5, *Mdn* = 5.0), although the majority still found these topics very interesting.

Table 20. Frequency distribution of parents' ratings of their interest in film topics (N = 57)

	Not at all interested 1	Slightly interested 2	Somewhat interested 3	Moderately interested 4	Very interested 5
Impact of blue whales on the health of our oceans	0%	0%	4%	5%	91%
How blue whales communicate	0%	0%	0%	14%	86%
Importance of protecting blue whales	0%	0%	4%	16%	81%
Methods to study blue whales	0%	0%	9%	26%	65%
The size of blue whales	0%	4%	7%	25%	65%
How blue whales feed	0%	2%	12%	23%	63%

5.2 How likely parents thought it was that they would visit the website

Parents were asked to rate the likelihood that they would visit the *Blue Whales* website, using a scale from 1 (not at all likely) to 5 (very likely). As shown in Table 21, the majority of parents thought they were very likely to visit the film's website (*M* = 4.4, *Mdn* = 5.0).

Table 21. Frequency distribution of parents' ratings of likelihood of visiting the *Blue Whales* website (N = 57)

Not at all likely 1	A little likely 2	Somewhat likely 3	Moderately likely 4	Very likely 5
0%	2%	14%	26%	58%

Part 6. Anticipated impact of the film on participants' intergenerational conversations

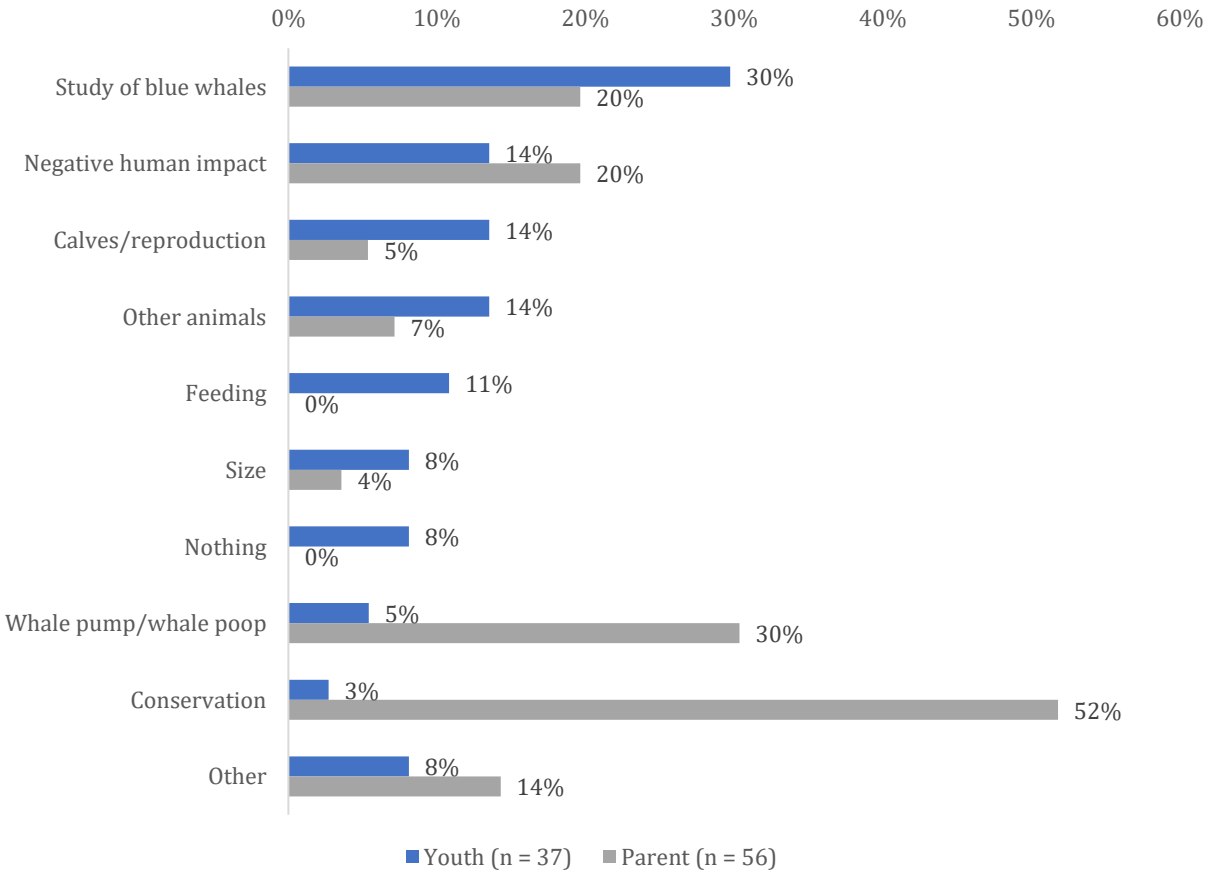
Youth and parents were asked what topics from the film they would like to talk about with one another. Among those who answered the question, nine-tenths (92%) of the youth and all (100%) of the parents thought they would talk about topics from the film.[6]

As shown in Figure 6, three-tenths (30%) of the youth thought they would talk about the study of blue whales, and more than a tenth each thought they would talk about the negative impact of humans on blue whales (14%), calves/reproduction (14%), other animals such as orca and dolphins (14%), and blue whales' feeding (11%), with other topics being shared by smaller groups of youth.

In comparison, more than half of the parents (52%) thought they would talk about conservation with their youth, three-tenths (30%) thought they would talk about the whale pump or whale poop, and one-fifth each thought they would talk about the study of blue whales (20%) and/or the negative impact of humans on blue whales (20%). Other topics were shared by smaller groups of parents.

Table 22 on the next page presents examples of the topics each group thought they would talk about.

Figure 6. Topics participants wanted to talk about with their families



[6] Participants who did not point to a film topic were not included in the youth n or parent n for Figure 6.

Table 22. Topics participants thought they would talk about with one another

Youth (n = 37)	Parents (n = 56)
Study of blue whales: (30%) *I would talk about how the drones collected information…* *…how the scientists [took] the whale's poop, and all about the scientists.* *I [would] talk about how the people in Seychelles worked in the film and...found them.*	**Study of blue whales: (20%)** *I will talk about the scientist studying these animals because it is important to learn how to help them keep alive.* *What types of jobs, if he is interested in becoming a marine biologist.*
Negative human impact: (14%) *I would like to talk about which country hunted the most whales.* *I'd like to discuss whale hunting7*	**Negative human impact: (20%)** *How our actions affect our environment and wildlife.* *Daughter will have questions about whaling history now.*
Calves/reproduction: (14%) *I learned that at first there were no babies and now there are babies.* *I would wanna talk about the whale calves.*	**Calves/reproduction: (5%)** *How a blue whale [has] a big baby (newborn).*
Other animals: (14%) *Orcas and all the animals they eat.* *I would talk about the flipping dolphins.*	**Other animals: (7%)** *I think I will discuss more about sea life…* *Ocean animals.*
Feeding: (11%) *The topic I would talk about is what they eat.* *The blue whales eating the most tiny food.*	
Size: (8%) *Is the blue whale the largest animal?* *How big is the whale?*	**Size: (4%)** *Mostly the size of these giants. It's hard to imagine.*
Whale pump/whale poop: (5%) *How do poop of the whales work?*	**Whale pump/whale poop: (30%)** *The whale feces-phytoplankton-krill cycle.* *He'll probably want to talk about the whale poop.*
Conservation: (3%) *I'd like to discuss…conservation.*	**Conservation: (52%)** *How it's important to care for all animals.* *What we can do to help save the blue whales.* *Symbiosis, how we are all connected, and how we have to protect our whole earth and all creatures.* *We will definitely discuss extinction and how important it is to prevent it.*

Phase 2: Post-viewing discussions and interests among a subset of participants

To assist in the development of BWP outreach programming and materials, Phase 2 explored families' experience with the *Blue Whales* film with respect to their post-viewing discussions about the film and their interest in finding out more about featured topics. To address these areas, the evaluation team facilitated group discussions with two groups of youth-parent pairs after they watched the film and completed the post-viewing survey.

Method

Participants

Recruitment

The family pairs that participated in the Phase 2 discussion groups learned about a second part of the evaluation – a post-film discussion – through the same process described in Phase 1 of the report (p. 7). Parents who indicated on the online information page and consent form that they and their child were interested in the discussion group were invited to participate in the order they signed up. A member of the evaluation team emailed them to confirm their participation, remind them of the anonymity of their feedback, and explain that the discussion group would be audio recorded to allow for transcription of responses and then the recording destroyed. Family pairs received honoraria for participating.

Demographic and background information

Table 23 presents demographic and background information for the 11 parent/youth pairs who participated in two separate discussion groups.[7] All but two parents were female, while there was a balance of youth male and female participants. Parents ranged in age from 34-48, with a mean of 39. Most youth were in grade 4, although a few were in grade 6 and one was in grade 5. The predominate racial/ethnic groups were Hispanic or Latino and White, with one family each identifying as African American/ Black, Asian, or Multiracial.

Table 23. Discussion group youth and parents' demographic and background information (n = 22)

Demographic/ background factor	Categories	Youth (n = 11)	Parents (n = 11)
Gender	Female	6	9
	Male	5	2
Grade	4th	7	-
	5th	1	-
	6th	3	-
Parent age	Age range	-	34 to 48
	Mean	-	39
Racial/ethnic group	African American/Black	1	1
	Asian	1	1
	Hispanic or Latino	4	4
	Multiracial	1	1
	White	4	4

[7]As the post-viewing surveys were collected outside the theater, discussion participants were asked to again complete the demographic and background questions presented in Table 23 during the discussion session.

Procedure

After all participants completed the Phase 1 surveys in the theater, two consecutive discussion groups were held in a museum conference room. Science center staff members met and then escorted the first group of five pairs immediately following survey completion, while the second group of six pairs were escorted one hour later. Those participating in the second session were provided $20 in cash to eat a snack or lunch while waiting for their session to begin.

Both discussion sessions were led by the same evaluation moderator and two assistants. After welcoming participants, the moderator informed participants: that their participation was voluntary; that only their opinion mattered and there were no right or wrong answers; that their names and identities would be protected in the reporting. The discussion sessions ran approximately 60 minutes. Table 24 presents the timing of activities, which included a welcome and introductions, an ice-breaker activity, discussion of open-ended questions with facilitating probes, and wrap-up. The table also summarizes the evaluation outcome addressed and the session timing allotted to that outcome.

Table 24. *Blue Whales* evaluation outcomes and discussion questions

Outcome	Discussion questions	Timing
Welcome	Welcome, introductions and explanation of procedure Participants wrote first names on name tags.	3 mins
Outcome: *The film will engage families in intergenerational conversations about blue whales, the methods used to study them, their protection, and their impact on ocean health.*		
Icebreaker	Please spend a few minutes talking about the film's topics with the person who watched the film with you. [Pairs talk]	5 mins or less
Conversation	[Ask adult first, then child, using first names] [First name adult] What did you and [first name child] talk about? [First name child], was there anything else that you talked about or that you would like to talk about with your family when you get home?	15 mins (2 min per adult, 1 min per child)
Outcome: *Assist BWP team in development of outreach programming and materials.*		
Outreach	If the California Science Center was to host a program or activity to go along with the film, what topics from the film what would you like to hear or see more about? [ask group in general and then prompt as needed]	15 mins
Outcome: Assist evaluation team in piloting measures to be used in summative evaluation.		
Survey clarity	[Pass out blank adult and youth surveys to participants] Did you find any of the survey questions confusing, or did you have difficulty with any of the wording of the survey questions? [Ask others how they feel about the various suggestions.]	Remaining time
Provide honoraria/ Goodbye		1 min

Two primary issues were explored in the discussions: 1) what film topics families talked about shortly after viewing, and 2) what film topics they were interested in hearing or seeing more about. Additionally, in the remaining session time, the moderator asked participants to review a blank copy of the post-viewing survey previously completed in the theater and to comment on question wording, confusions, or difficulty. Results from this final segment of the session will inform summative evaluation measures.

Analysis

After the discussion groups were transcribed, two members of the evaluation team collaborated on content analyses of on the qualitative data generated from the two open-ended questions related to intergenerational conversations and future science center programming and resources. The analysis drew on the film outcomes, and in particular the four topics included in the BWP outcome related to engaging families in intergenerational conversation (about blue whales, the methods used to study them, their protection, and their impact on ocean health) and on findings that emerged in the Phase 1 evaluation. As such, the analyses were deductive, drawing on the project's outcomes and formative results, and inductive, looking for overall themes, keywords, and key phrases. In the reporting, distinctions between youth-parent pairs and youth and parent individual responses are presented where applicable.

Findings

1.1 What film topics families talked about after viewing

Leading into the discussion groups, the youth-parent pairs were invited to spend a few minutes talking about the film*: Please spend a few minutes talking about the film's topics with the person who watched the film with you.* All of the youth-parent pairs were observed to talk about the film for the full five minutes allotted for this activity. None stopped their film discussions before the moderator directed pairs back to the group. The pairs were then asked what they had talked about, and youth were asked if there were additional topics they would like to talk about with their family.

Overview

More than half of the 11 youth-parent pairs talked about the protection of blue whales, their behaviors, and/or the filmmaking, while just under half talked about methods to study blue whales and/or the impact of blue whales on ocean health, and a few talked about their size. Details and example quotations are below, with the parent perspective primarily presented, as they were asked to provide the summary of their pair conversations. Where applicable, youth comments are situated within the same quotation as their parent's feedback in the tables below.

Detailed findings

Seven youth-parent pairs talked about the protection of blue whales, discussing the negative impact of humans through whaling and boats, asking about the logistics of how whaling was banned, and wondering how to help. Examples of their comments about this topic are in Table 25.

Table 25. Youth-parent pair comments about the protection of blue whales (n = 7)

Parent*: The thing that we mentioned earlier in the film that struck me was about how the whales are almost driven to extinction within just a few months. The Russian sailors that instead of going down in population before that, but just how close they came to almost being wiped out and the fact that they were able to recover, that was kind of amazing. At least, It's going in the right direction.*

Parent*: We were curious maybe elaborating a little bit about the fake uses [of the blubber]. And why they were, they did touch on that, that happened, but you know, maybe not everybody knows what was going on at that time period, or why.* ***Youth****: [And] why would you waste that much whale blubber for just one use or a few uses when an indigenous tribe that has been with almost like nothing, like they live in a natural place and they don't even use any like technology to get it or anything. They just use it all, so usefully. And then…the Russian people also, they don't use it for anything. They barely use it for anything. And I'm like, why would you waste that much and like make [the whales] extinct again?*

Parent*: …we're talking about, oh, boats are super dangerous and boats are horrible…*

Parent*: I was also interested in what, what treaty, what, what is keeping everyone from hunting the like, what did we all agreed to that we're not allowed to hunt these whales anymore. Cause I can't imagine or believe, or maybe it's true that United States, Russia, North Korea, Brazil, all these countries have agreed to not hunt these whales. It's amazing if that's . If that's the case, I'd be interested in how that came to be and how we can we use that, how we protect them, around the Seychelles? Like what, how this all works, like who's in charge of it?*

Parent*: The importance of saving them and making sure, I mean, we didn't even know it was a problem until we saw the film. We realized, oh my goodness, there's an issue. What can we do to help?*

Six pairs talked about some of the behaviors of blue whales, including communication, mother-calf behavior, migration, and/or feeding. Examples of their comments are in Table 26.

Table 26. Youth-parent pair comments about the behaviors of blue whales (n = 6)

***Parent**: We were just talking about all the fun facts we learned that we, you know, were not aware of before coming into this. Mainly the communication that the whales have and how far that expands.*

***Parent**: We talked a lot about echolocation, so she wanted to know the exact distance of what 500 miles is in feet. So we did that as like 5,000 feet times 500. So it's a huge amount of distance that they span.*

***Parent:** We talked about how after seven months the, the calf goes away from the mom and basically, as opposed to other social mammals, um, that live in families like the orcas, the whales spend most of their life away from each other and they're isolated.*

***Parent**: We talked about the mom's trip, like the five years, I think they said without seeing any baby whales and then all of a sudden they saw a couple calves that year.*

***Parent**: We enjoyed discussing…how they migrate. **Youth**: [I want to know more about] how far they travel. Do they travel less when they're younger or is it about the same?*

***Parent**: We [talked about] their feeding habits…I also had no idea, with the krill and how it's abundant, I noticed the film maybe contradicted itself a little bit. It said the whales were thin, which led me to believe there wasn't enough [krill]. Then the film said it's the most abundant thing in the ocean. So it was kind of like, maybe they're both true. I don't know how [though].*

Six pairs talked about the filmmaking, including positive comments about the cinematography and pacing and feedback about the film's 3D effects. Example comments are shared in Table 27.

Table 27. Youth-parent pair comments about the filmmaking (n = 6)

***Parent**: I want to acknowledge the beauty of the film…the simplicity and the cinematography was just breathtaking to me. I thought it was, you know, not like today's movies that we go to and everything's so fast paced and. I kind of liked the pace and the slowness…I felt calm watching it, and I felt I just was absorbing the beauty.*

***Parent**: She was also talking about the graphics, like the 3D aspect. **Youth**: Yeah, I think it makes it more realistic and was cool.*

***Parent**: The irony is I don't like 3D films, so I was like, I like this…I feel like it was right in front of you, but it wasn't as much of the stuff like thrown at you, like [someone else was saying]. [But my son] was saying that he wanted more of it. **Youth**: I definitely feel like I would like a little bit more of…[stuff] flying out at you [that] almost feels like you can grab it.*

***Parent**: To say the cinematography was absolutely brilliant at using drones. I thought that was amazing…[it] was so good that it looked unreal. The lighting was so perfect…I [also liked] the 3D effects [but] I agree [with another participant] that it would've been a little bit more enhanced to have a little bit more of that, because the capability is there.*

***Parent**: To me it's like how much of this is CGI? How much of this is animated? Because we didn't see until like the very end. All that behind the scenes work. And that to me, like as the parent is like, that's the part that I'm like, how did they do that? How did they get that close? How did they get those shots and those angles safely? Like, isn't this scaring them? Isn't this harming them? Isn't this traumatizing them? Like we're talking about, oh, boats are super dangerous and boats are horrible, and yet now we've flying drones and we're bringing boats in….So for me, knowing a little bit more of the how it's made would be interesting. Something that I would definitely look into on like an FAQ page or something like that, or watch an extra, you know, YouTube snippet or something like that.*

Five pairs talked about the methods used to study blue whales, including visual identification, drones, snot collection, and tagging. Example comments are in Table 28.

Table 28. Youth-parent pair comments about the methods used to study of blue whales (n = 5)

***Parent**: I know Diana was saying she could identify [the blue whales] by their patterns and when we went snorkeling, um, we did the Manta race snorkel and the guides knew the mantas by their patterns and they'd say, oh, this one has 11 spots, so it's Betsy or whatever. [We also thought it would be neat to see] images of Diana's that show like this blue whale and it's this years old, or if they've tracked the pods or anything like that. Or if there's a live tracker that could be linked to.*

***Parent**: One of the things that we talked about was the use of the drone because we had a little drone…and we talked about what happened when it passed, you know, how. they got it to go right through the snot…and what that must have been like and um, what they were going to do, what they were going to test it for. **Youth**: And I thought it was really cool… the different ways that scientists like collected data from the whales . To find out like their health and stuff.*

***Youth**: When they were talking about [the] snot of the whale. And they said it smelled horrible, but they said that their poop didn't smell as bad.*

***Youth**: [I would have liked to] have like a little snippet about how the trackers worked, what, how they put them on. Cause all we really saw was just the gun and the, and [missed shot].*

***Youth**: How they were trying to find them and tag them to help them? Cause of all the other people that went and hurt them a lot. **Parent**: I was kind of thinking, you know, the importance of tagging them because then you could kind of get more data and, info on where they go to mate or how, you know, what, where they go.*

Five pairs talked about the impact of blue whales on ocean health, particularly the role of whale poop on the ocean ecosystem, as shared in the example quotations in Table 29.

Table 29. Youth-parent pair comments about the impact of blue whales on ocean health (n = 5)

***Parent**: Another thing that we talked about was like the droppings too, like the full circle. That would be kind of fun to elaborate a little bit more on. [I would have liked] to see more of the full cycle…like just a little bit more information given instead of just the snippet of "Starts here, nutrients full circle, you eat."*

***Parent**: We were talking about feces. My family was like, the feces. We didn't realize it was 50 gallons of feces, and it goes into the ecosystem that's in the water there. That was really important. I think you totally get an exhibit or something, especially for kids based on feces and how it affects the whole ocean. And like everyone's kind of grossed out but kind of interested in feces.*

***Parent**: [We discussed] the poop, of course.*

***Parent**: We were just kind of talking about how amazed we were at the self-sustaining balance of the ocean. Like we don't have to go and feed the whales. We don't have to go and feed the fish. We don't have to go and feed the dolphins. They take care of that all on their own, because of the perfect balance that [the ocean] has and seeing the impact that the whales have in that balance and the fact that they're so big and they're so necessary…[disrupting] that balance…not only affects the whales, but it affects everything that's under them.*

Finally, three pairs talked about the features of blue whales, specifically their size, as shown in the comments in Table 30.

Table 30. Youth-parent pair comments about the features of blue whales (n = 3)

***Parent**: How big the blue whales are is discussed and kind of shown, but I still don't have a concept of, if I was standing there, how big is this whale? Except for the one picture, the sad picture where it was on the shore with the men in front of it.*

***Youth**: I wanted to learn more about the size of the whales. Like comparing [it] to something big.*

***Youth**: I never would've guessed that blue whales were bigger than a dinosaur*

1.2 What film topics parents and youth wanted to know more about

Participants were then asked to consider topics from the film they wanted to follow-up on as follows*: If the California Science Center was to host a program or activity to go along with the film, what topics from the film what would you like to hear or see more about?* While answering this question, some of the participants spontaneously suggested ideas for *how* they would like to learn about the topics they recommended – through various programming, activities, apps, or exhibits – as shown in the example quotations below.

Overview

Two topics were mentioned by 14 of the 22 participants: the features of blue whales (with most in this group being interested in their size) and the behaviors of blue whales, such as feeding, mother-calf behavior, communication, migration, sleep, and protection from predators. Other topics were touched upon by smaller groups of participants, including the methods used to study blue whales, the protection of blue whales, the scientists' backgrounds, and blue whales' impact on ocean health. In each case, details and example quotations are below.

Detailed findings

Fourteen (14) of the discussion participants said they would be interested in a program or activity focused on the features of blue whales. This was one of the most frequently mentioned topics for both youth and parents, with most referring to their size and a couple of parents talking about their blow holes. Several participants also gave specific suggestions of how the BWP might illustrate the scale or size of blue whales, through for example a dinosaur graphic or whale projection on a museum wall or comparisons with the Endeavor Space Shuttle, a row of parked school buses, or a floor activity counting the steps it would take to reach the average length. Example comments are in Table 31**.**

Table 31. Youth and parent comments about their interest in the features of blue whales

Youth (n = 5)	Parents (n = 9)
I think that they could compare the size [of the blue whale] to something else, because they're the biggest animal in the world…I read some information like they could be as big as three school buses, something like that.	*[Experiencing] the size and maybe getting like a visual. I know I've been at the zoo and they have these graphics like, this is a gorilla and you can stand in front of it and you can see the size difference. So maybe comparing [a blue whale] to a known building or something where we can see the size. Or even if it was along the wall, I'd be like, okay, this is realistically how long the whale [is. That] could potentially be a good visual...*
I would paint [a blue whale] on the wall, like how big it is, so that you can actually see the full thing… The moment they said that whales were big as dinosaurs, I automatically started thinking, "In comparison, how big is an average whale to the Endeavor Space Shuttle [at the California Science Center]," or something like that.	*[A] picture like on a wall if you had to paint it like the eye of a blue whale in scale, how big that would be compared to someone standing there. Maybe not that big, but maybe just part of their head and especially the eye, like I said, some sense...something like, especially like eye you're looking in.*
You know how basketball players are really tall? I thought you could put like a whale next to [them], like, how many basketball players is a whale?	*Maybe like, you know, [you] start here. This would be the tail, and then you walk the length of a whale…So then you go, "Wow, I started over there and [now] I'm…over here."*
Do different animals…like a stack, one on top of the other and seeing how many tigers [equal a whale], something like that. Yeah. Animals compare.	*[How do they compare in size] to the Endeavor? Also the scale of the whale hole, like it is an interesting thing to know, okay, how big is that hole? And what's the volume that comes out? It was really fascinating to see the perspective above, [to] be able to see how everything was erupting. I've never seen that before.*

Fourteen (14) participants said they would be interested in a program or activity focused on the behaviors of blue whales. This was another of the most frequently mentioned topics for both youth and parents. Specific behaviors mentioned by youth and parents included feeding, mother-calf behavior, communication, sleep or protection from predators (among youth), and migration (among parents). Examples of their comments are in Table 32. Participant responses that mentioned multiple behaviors have been separated and listed by sub-topic to allow for ease of reading and comprehension.

Table 32. Youth and parent comments about their interest in the behaviors of blue whales

Youth (n = 8)	Parents (n =6)
I would really like to know…more about the diet, just different aspects of diet.	*I thought it was amazing how they blow up when they eat. I didn't realize that happened, that they just [expand like that], so maybe something hands on where we can do something in regards to that, so you can kind of see how that works.*
How much krill can a whale eat in one day?	*When you think of nursing, you typically think of attachment [but I don't think whales do it] that way. It's just like extruded into the water and they drink it. So I think that would be interesting, if that information would be shared.*
Do the [blue whales] also feed on the orca?	*I was thinking like the calls…so you can push a little button…like, this is the food call or the mating call or like the different audio effects that you [can play].*
I want to know more about how the whale gives birth. Like in what climates? Do they have to give birth in a warmer climate or a colder climate?	*It would be interesting to have an exhibit that had the sound. And sort of the translation of what each sound means. What are the calls, what's the communication? Because when the film started, there was sort of this almost ominous sound. Mm-hmm. And then there were other sounds throughout the film that were…very different. They sound very different. So maybe something where buttons could be pressed. [You] could listen or match up. [And] where you could feel it.*
How do the baby and the mom feed together? Would they go together or the mother get the food for the baby?	*I have an app on my phone that where you can track great white sharks around the world…So there's like already apps like that. I don't know about for whales, but for sharks there is. I think it's fascinating because you're always connected by going on your phone if you're interested. I find out new information, you can sign up for updates. It's a free app, but I think they have in-app purchases...*
How do whales eat milk?	*[Maybe something] hands-on, the way that there is upstairs in the river room, [where] the kids can stick their hand in water that's the same temperature as what the whales are swimming in. Because they live in so many different climates. Like we went from Antarctic to the Seychelles which is kind of warm, and then California and Baja, like how do they go from these different climates and, and survive?*
I was also wondering…what kind of noise would the whales make if they were in trouble, like if they needed help?	
[There could be an exhibit] where you would hear the noise [of the whales].	
I would like to know like how the whales sleep, if they sleep. And if so at night?	
I [want to] know where they usually sleep and what [their] main home looks like.	
If they were to have an exhibit, I want them to elaborate on how they protect themselves from the predators and how they survive.	

Seven participants expressed interest in learning more about the methods used to study blue whales, with youth being interested in sample collection, tracking the whales, and the logistics of the scientific expeditions and parents being interested in the identification of whales and the challenges of drone photography. Example comments are in Table 33.

Table 33. Youth and parent comments about their interest in the methods used to study of blue whales

Youth (n = 4)	Parents (n = 3)
One activity that I would like to see is like you take [the] blue whale's snot [or the poop] and you put it under a microscope…see what bacteria [is there] and stuff like that.	*I think one activity that would be fun is if they had a picture of a whale and it had the dorsal fin and then [the goal would be] trying to figure out who that is and…their family history, how many calves they had, , things like that. I think that'd be interesting.*
What kind of equipment they use to track the whales, and things they might need on their boat in case of emergency...	*Definitely thought that in the movie when you saw her struggling to catch [the drone], like how probably you lost a bunch them.*
When they were looking for the blue whales, they said they only had 21 days. What happened? Well, I know what happens, they don't do in the 21 days, but, like how much money did they have to spend or do this? How much money do they cost a day? How much are food costs? All the things [like] that.	

Three participants commented on their interest in learning more about the protection of blue whales, with their feedback shared below in Table 34.

Table 34. Youth and parent comments about their interest in the protection of blue whales

Youth (n = 1)	Parents (n = 2)
I was very sad about human hunting, but then maybe elaborating on how we could help.	*For me it was very impactful [hearing], you know, these beautiful sounds …But then [you hear] the devastating effects of the boats and how it stops [the whales] from being able to hear [one another]. So maybe you experience that so you can [hear] how beautiful it is, and then somehow show how the boats disrupt that. And that's like an awakening of, oh my gosh, we need to do something about [this].*
	They're so protected. You have to be a certain distance away from them in the water. You're not allowed to, like if you accidentally are in the water and encounter one in a kayak or something, you're supposed to chill and keep your distance. The whale watching tours are not supposed to go near them at all and scare them or anything. It's a distant experience, as opposed to being immersive.

Three participants expressed an interest in learning about the scientists' backgrounds or careers, as shown in the comments in Table 35.

Table 35. Youth and parent comments about their interest in scientists' backgrounds/careers

Youth (n = 2)	Parents (n = 1)
How much do [the scientists] get paid, [and] how long it takes [to receive that education]? Like, what do you have to study? How long does it take to actually get that job in the first place? Are there different ranks in that job? Like, are the teachers in that job okay?	*I would say outreach and education, like, oh, [the scientist has] been doing this 30 years. How? I have a high schooler who's like, I might want to be a marine biologist someday. It's like, how did, how did she get there? How did she start? Who taught her? What kind of education, what kind of training do you have to have to get there and how do you put that in place?*
Maybe they could put the link on and then it shows how Diana got there or her experiences, how did she do this [and for other scientists too], so you can actually see how they got there and stuff.	

Finally, two youth indicated that they would like to learn more about the impact of blue whales on ocean health, although none of the parents mentioned this topic. Youths comments are in Table 36.

Table 36. Youth comments about their interest in the impact of blue whales on ocean health (n = 2)

I kind of want to learn more about the feces and the plankton and the krill, more about that. And does it stink?
I wanted to know more about the impact of blue whales on the health of our ocean. Like whatever they did, how it helped blue whales and the ocean and the krill.

Discussion

The independent evaluation team from Knight Williams Inc. conducted a formative evaluation for the BWP at the California Science Center in two phases. Phase 1 addressed with post-viewing surveys family viewers' experience of the 42-minute *Blue Whales: Return of the Giants 3D* film with respect to the film's appeal and the content goals of increasing viewers' knowledge and interest in featured topics. After survey completion, Phase 2 explored intergenerational conversations about the film and interest in following up on featured topics through discussion groups facilitated with a subset of families.

Phase 1 involved 112 youth and parents, 22 of whom also participated in Phase 2. This discussion first summarizes key findings from both phases related the film's appeal, participants' knowledge of and interest in film topics, youth confusions and curiosities after viewing, and post-viewing intergenerational conversations. The discussion concludes with recommendations that the project team may want to consider to accompany the film.

Film appeal

Overall appeal. Youth and parents found the film very appealing. Additionally, parents rated *Blue Whales* visually exciting, thought the story was interesting, and thought they were likely to recommend the film.

What participants liked about the film. The largest categories of what youth liked about the film included learning about blue whales, seeing blue whales, and/or an aspect of the filmmaking, in particular the 3D effects. In describing what they liked, a majority of parents also pointed to something they learned about blue whales and/or an aspect of the filmmaking, particularly the film's visuals, audio, or 3D effects.

What participants disliked about the film. One-third of parents and two-fifths of youth reported disliking an aspect of the filmmaking including the pacing, the 3D effects, and the volume of the whale calls early in the film.

Learning about film topics

Learning about methods used to study blue whales. A majority of youth could describe as requested two methods used to study blue whales and what scientists learn from those methods. Youth most frequently recalled poop and snot collections and drone photos, from which scientists learned about whales' digestive system, health, and body condition. A majority of parents described three to six methods, most frequently mentioning drone photos, poop collection, and tagging from which scientists learned about body condition, health and digestive system, and migration.

Learning about the calls of blue whales. A majority of youth could describe one thing that they learned from the film about the calls of blue whales, most frequently recalling calls as far-reaching or having a feeding purpose. Although one-third of parents misread the question about whale calls, the other two-thirds could describe the blue whale call with at least one of five descriptors presented in the film. These parents most frequently reported whale calls as having a feeding purpose or a mating purpose.

Learning about ways blue whales impact the health of our oceans. A majority of youth and parents could accurately describe the impact of blue whales on the health of our oceans. Both groups most frequently described part or all of the feeding cycle and/or explained that poop fertilizes the ocean.

Learning about ways people can help blue whales have better lives. A majority of youth and parents were able to describe from the film at least one way to help blue whales have better lives. Youth most frequently described a ban on whaling, whereas parents most frequently responded with suggestions to decrease ship strikes and/or decrease noise pollution.

Interest in film topics

Overall interest. After watching the film, participants indicated a high level of interest in the film's six featured topics, particularly in the importance of protecting blue whales, how blue whales communicate, the impact of blue whales on the health of our oceans, and the size of blue whales. Youth were slightly less interested than parents in the methods used to study blue whales and how blue whales feed, although they still found these topics moderately interesting.

Interest in following up on film topics. During the Phase 2 group discussion session, 11 youth-parent pairs discussed topics from the film they wanted to see or hear more about, if the California Science Center was to host a program or activity to go along with the film. Two topics were mentioned by 14 of the participants: the features of blue whales (with most in this group being interested in their size) and the behaviors of blue whales, such as feeding, mother-calf behavior, communication, migration, sleep, and protection from predators. Other topics were touched upon by smaller groups of participants, including the methods used to study blue whales, the protection of blue whales, the scientists' backgrounds, and blue whales' impact on ocean health. When sharing the topics they found interesting, some participants spontaneously suggested film-related activities or programming that the BWP team might want to consider in their planning, provided in the quotations on pages 34-37.

Youth confusions and curiosities

***Things youth found confusing in the film*.** Small groups of youth, less than a tenth each, described some confusion relating to: scientists or their research; information about blue whales, including about their calves, how they eat, and whether they attack dolphins; whaling; and/or whale poop nutrients.

***Questions youth had about blue whales after viewing*.** A majority of youth shared at least one question they had about blue whales after viewing the film. Questions were wide-ranging, including the study of blue whales; the negative human impact on blue whales; blue whales' feeding and breeding; bodily functions like their blow, poop, and pee; blue whales' communication, size, lifespan, sleeping, swimming, social groups; and their impact on ocean ecosystems.

Intergenerational conversations

What survey participants thought they would talk about from the film. When participants were asked on the post-viewing survey to describe topics from the film they would like to talk about with each other, youth most often pointed to the study of blue whales, while smaller groups thought they would talk about the negative impact of humans on blue whales and calves or reproduction. In comparison, the largest group of parents thought they would talk about conservation with their youth, followed by the whale pump or whale poop, the study of blue whales, and/or the negative impact of humans on blue whales.

What discussion group participants talked about after viewing the film. Of the 11 youth-parent discussion group pairs asked to spend a few minutes talking about the film with one another, more than half each talked about the protection of blue whales, their behaviors, and/or the filmmaking, while just under half each talked about methods to study blue whales and/or the impact of blue whales on ocean health, and a few talked about their size.

Recommendations

A review of participants' responses indicates that the *Blue Whales: Return of the Giants 3D* film has the potential to engage, interest, inform, and motivate families in the ways envisioned by the BWP team. At the same time, caution should be taken in drawing broad implications from the findings given the inherent goals and limitations of formative evaluations, with the evaluation design in this case relying on a budget-limited sample of 112 participants, all of whom were from Southern CA, viewed the film at one science center location in CA, and participated in only post-viewing data collection activities. Moreover, the primary function of the formative evaluation was to provide feedback for the purpose of informing the development of additional (or perhaps positioning of existing) resources to accompany the film, as opposed to providing a full assessment of the film's impact, as is characteristic of a summative evaluation. Below, we look across the findings at themes that emerge in numerous places to suggest a few strategies to enhance the film outcomes.

- **Promote the *Blue Whales* film outreach among prospective parent audiences by emphasizing the opportunity to learn about blue whales and by highlighting aspects of the filmmaking.** More than four-fifths of the parents reported they were very likely to recommend the film. The BWP team could build on this intention by promoting messages among parent networks that reflect what parents and youth indicated most stood out for them about the film. As both parents and youth seemed aligned as to what most appealed to them, the BWP team might consider messaging around the two key film aspects they pointed to: i) information they learned about blue whales and ii) aspects of the filmmaking. Both parents and youth found the blue whales' *facts* and *story* interesting and they variously described the filmmaking, particularly the film's visuals, audio, or 3D effects, as c*aptivating, amazing,* or *immersive*. Other messaging that might be effective to help draw audiences to the film could relate to the film's level of visual excitement and story interest, both of which were highly rated by parents.

  The evaluation findings also suggest the possibility of considering within any film-related messaging the relatively few dislikes raised in the evaluation, which primarily related to filmmaking. These critiques were mainly raised by parents, however, who tended to focus on the film's use of 3D and pace, which some considered slow. While there wasn't sufficient time within the discussion hour to delve deeper, it is possible that these critiques reflected parents' expectations of the film as a 3D presentation being one that harnesses extensive use of special effects, and at a fast pace. Some discussion participants briefly elaborated, for example, that they had this initial expectation but then were pleasantly surprised at how the film's use of 3D and pacing allowed them to experience the film without "*as much of the stuff like thrown at you*." One youth also described the film as *very beautiful and relaxing. It was calm*." Highlighting this (presumably intentional) unique use of 3D may help draw parents to the film and serve to align parental expectations with what is presented onscreen.

- **Promote the *Blue Whales* website among prospective parent audiences by highlighting topics families want to hear or see more about.** A majority of parents thought they were very likely to visit the film's website. Here again, the findings indicate an opportunity to promote the website

among parents (for example at the theater exit and again in any accompanying exhibits or displays, as suggested by one parent in a discussion group), and to highlight film topics on the website that appear to appeal to parents as well as youth. For example, in the post-viewing discussion groups, the majority of parents, and one of the two largest groups of youth, were interested in learning more about the size of blue whales. In terms of additional topics of interest to youth, the second largest group of youth in the discussion were interested in methods used to study blue whales. Also, when asked in the post-viewing survey if they had any questions about blue whales after viewing the film, three-fifths (58%) shared a question. Although no one theme stood out across their questions, many different questions about blue whales were mentioned, including those related to how they are studied, negative human impacts, feeding, breeding or calves, bodily functions, communication, size, lifespan, swimming, social groups, sleeping, and their impact on ocean ecosystems.

➲ **Develop additional resources or promote existing resources that take into account families' expressed post-viewing interests.** As the current status of BWP outreach programming and resources is unknown, the following general suggestions are provided in the spirit that they may be relevant to ongoing work within the website, planned programming, or educational resources.

- **Extend learning opportunities about blue whale features and behavior.** The film website stated that through the film takes viewers on a journey that explores that world of the blue whale and that by following two featured scientific expeditions, the film *transforms our understanding of the largest animal ever to have lived.* The formative evaluation findings indicate that viewers learned a considerable amount about blue whales and want to learn more, as detailed in the previous bullet about the website.

- **Develop strategies to address potential confusions about the negative impact of humans on blue whales and the study of blue whales.** Although no single topic stood out as being confusing for youth or eliciting further questions, small groups were confused about or had questions about the history of whaling (including why they were hunted and whether they are still hunted) and the study of blue whales (including how and why scientists track them and if they know where they go). To address these areas of confusion, or the other areas detailed in Part 4 about youth confusions and curiosities, the project team might add a Frequently Asked Questions section to the website, providing more information for interested viewers.

- **Highlight science career information**. Parents in the post-viewing survey and youth and parents in the discussion groups expressed interest in learning more about the careers of the scientists featured in the film, as in *[I will talk about these jobs], if he is interested in becoming a marine biologist* and *How much do [the scientists] get paid, [and] how long it takes [to receive that education]? Like, what do you have to study? How long does it take to actually get that job in the first place?* To address this apparent interest, the BWP team might add information about ocean or marine biology careers to the film's website, or link to some of the many YouTube videos on this topic, if any resonant with the project team.

- **Consider a range of topics that youth and parents might be interested in talking about after seeing the film, recognizing there may be generational differences in what most appeals.** More than half of youth-parent pairs in the discussion groups said they talked about the protection of blue whales while just under half focused on methods to study blue whales and/or the impact of blue whales on ocean health. The post-viewing survey findings, however, suggested an apparent mismatch between what youth and parents separately expected to talk about. In this

case, youth most often pointed to the study of blue whales, followed by the negative impact of humans on blue whales, calves/reproduction, or other animals such as orca and dolphins, while the largest group of parents anticipated talking about conservation with their youth, followed by the whale pump or whale poop. The findings may indicate the likelihood that youth and parents will bring different information, interest, and/or motivation to their post-film viewing conversations. Encouraging or highlighting topics that appeal to youth could facilitate their being included in any organized or informal post-film family discussions. It might have come as a surprise, for example, that the parents appeared more likely than the youth to expect to talk about whale poop.

- **Draw on families' local experience to extend the film's impact and illustrate featured topics.** As the evaluation took place at one science center, all of the evaluation participants were from CA and Southern CA in particular. In addition to taking into account this caveat, it is worth considering a place-based perspective of how local audiences might i) resonate with the film based on their experience of their location, and ii) benefit from regional programming or resources designed to extend their film experience at the local level. For example, one youth in a post-viewing survey noted *I liked the fact that part of the film took place in the Gulf of California because it's nearby meaning you could go out to that area.* Similarly, many participants in the discussion groups pointed to local landmarks, aquariums, or other museums they had visited that offered features or activities that might be useful for furthering their understanding of various blue whale features, in particular the size of blue whales (e.g., compared to the Endeavor Space Shuttle at the California Science Center or the replica of a blue whale hanging from the ceiling at the Long Beach Aquarium).

Appendix 1. A pilot study of adults' experience of awe while viewing *Blue Whales*

Introduction

In response to Tangled Bank Studio's interest in viewers' experience of the emotion of awe during the *Blue Whales* 3D giant screen film, Knight Williams Inc. integrated a supplemental awe component into the film's formative evaluation. A pilot study with adult viewers examined the awe-inducing power of the film and the strength of the relationship between viewers' experience of awe and the likelihood of subsequent pro-environmental activities related to whales.

The emotion of awe has religious or spiritual conceptualizations as well as philosophical and psychological definitions. In a foundational paper, Keltner and Haidt (2003) reviewed prior theoretical discussions of awe and concluded with a conceptual approach for the psychological construct of awe. They proposed that stimuli that induce the emotion share two features: (i) perceived vastness, referring to "anything that is experienced as being much larger than the self, or the self's ordinary level of experience or frame of reference" (p. 303); and (ii) a need for accommodation by challenging one to modify current mental structures.

Experimental studies have attempted to manipulate the experience of awe with various types of stimuli including recall of awe-eliciting events (e.g., Shiota et al., 2007); experiencing different physical spaces (e.g., Ballew & Omoto, 2018); spiritual experiences (e.g., Preston & Shin, 2017), virtual reality displays (e.g., Chirico et al., 2017), and brief videos (e.g., Van Cappellen & Saroglou, 2012). The pilot study of awe induced by the *Blue Whales* film builds on recent psychological research about awe and brings the construct to the giant screen arena for the first time.

The effects of awe are wide-ranging. Some of the empirically examined effects include changes in physiological responses (e.g., Shiota et al., 2011); enhancement of prosocial tendencies (e.g., Goldy & Piff, 2020); greater sense of well-being (Anderson et al., 2018); and increased pro-environmental activities (e.g., Skura et al., 2022). Many giant screen films have focused on natural world content, and film evaluations have assessed the effect of films on post-viewing activities that are inspired as a result of viewing. To have the most relevance to the field of giant screen films, this pilot study focuses on the relationship of film-induced awe to the outcome of pro-environmental activities related to the film's whale content.

Only a few studies have been found that looked at awe as it relates to environmental activities. Skura et al. (2022) found that awe induced by short video montages of panoramic nature scenes significantly increased environmentalism in adults compared with a control video and an amusing video. In Yang et al. (2018), adults who viewed a brief awe-inspiring video, compared to those who viewed an amusing or neutral video, were more inclined to behave ecologically. Finally, Zhao et al. (2018) found that exposure to short awe-inspiring nature video clips versus other non-awe-inspiring clips increased viewers' pro-environmental intentions.

With the above literature in mind, the pilot study explored to what extent and how adult viewers experienced awe while watching *Blue Whales* and how that emotion related to what viewers liked about the film and their likelihood to engage in whale-related pro-environmental activities.

Method

Participants

Table 1 shows that the adult participant sample was majority female (68%) with a 60-year age range and a mean age of 42 years. The largest racial or ethnic groups were White (30%), Hispanic or Latino (28%), or Asian (25%). Almost two-thirds (63%) of adults had seen two or more giant screen films prior to watching the *Blue Whales* film.

Table 1. Adult demographic and background information (N = 57)

Demographic/ background factor	Categories	Adult
Gender	Female	68%
	Male	30%
	No response	2%
Age	Age range	23-82
	Mean	42 years
Racial/ethnic group	African American/Black	4%
	Asian	25%
	Hispanic or Latino	28%
	Multiracial	12%
	Native American	2%
	White	30%
Prior giant screen/IMAX experience	Zero	14%
	One	18%
	Two or more	63%
	No response	5%

Procedure

After viewing the 3D version of *Blue Whales* in the California Science Center IMAX theater, adults completed a survey as summarized in the formative evaluation procedure on p. 7. The survey included interspersed questions addressing how the film may have induced the emotion of awe in viewers and what their likelihood was of doing whale-related pro-environmental activities after viewing the film.

Measuring awe

The awe-inducing power of *Blue Whales* was established with three questions (see survey in Appendix 2):

1. To assess awe indirectly, adults answered a general question early in the survey about what feelings they experienced while watching the film. This question was intended to produce single word emotions that could be coded by applying two validated dictionaries of feeling words. The awe dictionary of Goldy et al. (2022) includes 26 awe-related words and variations on word stems like "amaze, amazing, amazement." The awe dictionary was developed from analysis and ratings of words in millions of tweets in response to an historic total solar eclipse. Non-awe-related words were categorized using the Whissell Dictionary of Affect in Language (Whissell, 2009). To develop the Whissell dictionary, researchers rated hundreds of thousands of words along the feeling continuum of pleasant to unpleasant.

2. Later in the survey, adults were asked directly if they found themselves experiencing a sense of awe or not during the film, and if so, to describe parts of the film when they felt awe and why each part was awe-inspiring. This question examines if and how the film evokes a personal feeling of awe.

3. At the end of the survey, adults rated on a seven-point scale their level of agreement with statements from the Awe Experience Scale (Yaden et al., 2019). AWE-S asks respondents to reflect on different dimensions of the awe emotion without actually using the word awe. In exploratory factor analysis of AWE-S, six dimensions were revealed (Yaden et al., 2019). Researchers applying AWE-S in their studies have typically not used the entire scale but applied subscales appropriate to their stimulus format and content. The four AWE-S subscales of five statements each chosen for inclusion in the survey are those clearly applicable to a giant screen film experience and the blue whale content, as follows:
    - *Perceived vastness*. Two types of vastness are presumed at play in *Blue Whales*: (i) perceptual vastness because of the "you are there" feeling produced by the cinematography of a 3D giant screen expanse (Knight Williams Inc., 2019) and (ii) conceptual vastness related to the extraordinary pressure on the population's existence, the extreme adaptations of blue whales as long-distance communicators, and the largest animals to ever exist on earth.
    - *Connectedness*. The natural world cinematography of the *Blue Whales* film may heighten viewers' sense of connection to nature or to things beyond themselves.
    - *Physical sensation*. Viewers frequently note that a giant screen film generates feelings of vertigo, goosebumps, or heart pounding (Flagg, 1999).
    - *Self-diminishment*. A "larger than life" experience is often expected and appreciated by viewers of giant screen films (Flagg, 1999). The scale of the giant screen, expanse of the ocean, and the blue whale size is anticipated to encourage a viewer to compare their own smaller body size and to feel perhaps humbled or less significant by the comparison.

Cronbach's alphas for the full sample of 57 adults showed high internal consistency for the composite awe scale (α = .92, 95% CI [0.89, 0.95]) and for each of the four dimensions assessed: Perceived vastness (α = .88, 95% CI [0.83, 0.93]); Connectedness (α = .89, 95% CI [0.84, 0.93]); Physical sensation(α = .83, 95% CI [0.76, 0.91]); and Self-diminishment (α = .88, 95% CI [0.83, 0.93]).

Measuring whale-related pro-environmental activities

Building on measures of the few studies that have looked at awe as it relates to environmental activities (Skura et al., 2022; Yang et al., 2018; Zhao et al., 2018), the survey asked adults to rate how likely they are to engage in seven whale-related activities this year (see survey in Appendix 2). The activities reflect those noted often in online whale conservation sites. Cronbach's alpha for the full sample of 57 adults showed high internal consistency for the pro-environmental activity scale (α = .82, 95% CI [0.75, 0.89]).

Analysis

A few participants failed to complete responses for a few statements in three of the four AWE-S subscales; thus, before analysis, these data sets were subjected to an imputation procedure to fill in missing values and produce an analysis sample size of 57 for the subscales and composite scale.[8]

[8] Power was a consideration in light of the small number of missing data points for the scales. Only 13 data points are missing out of 1,539 data points, therefore simple mean substitution was applied as less than 1% was missing from the dataset. When doing correlations of all scales, without mean substitution, the dataset would drop from 57 participants to 48, as 9 people had at least 1 missing cell and listwise deletion would remove all comparisons if data is not complete.

Applying appropriate statistics, the analysis explores the film's elicitation of awe in adults, how awe relates to the formative evaluation question of what was liked about the film, and examines the strength of the relationship between awe-induction and pro-environmental activities related to the blue whale content.

Findings

Feelings experienced while watching the film

In their response to the question of what feelings they experienced while watching the film, one-third (35%) of adults wrote words appearing in the awe dictionary (Goldy et al., 2022). These words reflecting feelings of awe included *awe, amazed, amazing, amazement, beautiful, dazzled, majestic, wonder, wonderful,* and *mindblowing.* For example, in response to the question about feelings, participants listed "awe, wonder, amazement" and "mindblowing and in awe." Those who produced words reflecting feelings of awe most frequently mentioned filmmaking features when asked what they liked about the film, including the cinematography, sound, and 3D effects.

In addition to the above awe-related words, the adults listed a broad mix of feelings along the continuum of pleasant to unpleasant words as rated in the Whissell Dictionary of Affect in Language (Whissell, 2009). Table 2 presents the percent of adults and feeling words in each category of pleasant, neutral, and unpleasant. The majority (87%) of participants expressed pleasant feelings, whereas half (51%) described unpleasant feelings and a small group (7%) described neutral feelings. Four-tenths (44%) of adults reported both pleasant and unpleasant feelings while watching the film; e.g.: "sadness, happiness" and "happy, scared, concerned, hopeful." The breadth of feelings along the continuum of pleasantness reflects the full narrative arc of the film, progressing from the unpleasant commercial killing of blue whales to more pleasant scientific studies to support blue whale protection and procreation.

Table 2. Pleasant, neutral, and unpleasant feelings experienced while watching the film (n =55)

Pleasant feelings 87%	Neutral feelings 7%	Unpleasant feelings 51%
advocacy, amusement, appreciation	calm, calmness	anger
comfort, curious, curiosity	knowledgeable	concern, concerned, cried
emotion, emotional		disgust
excited, exciting, excitement		frustrating
fascination, free		moving
gratitude		sad, saddened, sadness
happy, happiness		scared
honored		upset
hope, hopeful		worried, worry
inspired, inspiring		
joy, joyful, love		
mesmerized, motivated		
peaceful, relief		
splendor, surprised		
touched, triumph, warm		

Parts of the film that induced awe and why

When asked directly if they found themselves experiencing a sense of awe during the film, almost all (96%) of the participants responded affirmatively. These adults were asked to describe the parts of the film when they felt awe and why each identified part was awe-inspiring. Table 3 presents the most frequently described awe-inducing parts of the film and the variety of reasons why each part elicited the emotion of awe. Example responses are presented to illustrate the parts and the reasons.

Image 1. Mother and calf

Almost half (49%) of participants were awed by the discovery of the baby calf in the Gulf of California (e.g., Image 1), mainly because the sighting promised hope for a recovery of the population. Other reasons included the pleasure at seeing scientists happy with the discovery and the novelty of never having seen a whale calf before.

Image 2. Blue whale and scientists' boat

Almost one-third (31%) of participants felt awe in response to the cinematography that revealed the extreme size of blue whales in comparison to the researchers' boats and other ocean life (e.g., Image 2). Those who described such footage as awe-inspiring were significantly more likely than other participants to write that they liked learning about blue whales, Fisher Exact test, $p = 0.03$.

Table 3. Parts of film most frequently described as awe-inducing and reasons why (n = 55)

Awe-inducing parts	Example reasons for awe
Footage and discovery of baby calf (49%)	
Seeing new calves.	*Seeing new calves after many years of not seeing them inspired awe and hope for their species.*
The baby calf whale.	*Never seen a baby whale.*
When the mother whale was shown with her calf.	*It was beautiful to see the scientist so happy to find a calf after 5 years without seeing one.*
Footage indicating adult whale size (31%)	
Scenes filming the whales underwater and filming the researchers with the whales.	*The size of the whales and the proportion/size in relation to the boats.*
Seeing the three dolphins swim in front of the whale.	*It really drives home how massive they are.*
First views of whales.	*Sheer size of whale when it first appeared on the huge IMAX screen.*

Table 4 presents awe-inducing parts of the film described by 20-30% of participants and the reasons why each part elicited the emotion of awe. Example responses illustrate the parts and the reasons.

Three-tenths (29%) of participants were in awe of the scenes of whales feeding on krill (e.g., Image 3). They were impressed by the novelty of never having seen whales eat, the smallness of the krill, the amount that a whale eats, and the mammoth size of the whale's mouth.

One-quarter (25%) of participants noted the awe-inspiring sounds of the blue whales, and one-fifth (22%) of adults were awed by visuals of other ocean life (e.g., Image 4).

Images 3 and 4. Blue whale lunge feeding on krill and other ocean life

Table 4. Parts of film less frequently described as awe-inducing and reasons why (n = 55)

Awe-inducing parts	Example reasons for awe
Footage of whale feeding on krill (29%)	
Small shrimp.	*It's so tiny yet very filling for the whale.*
Seeing them eat.	*Because they ate so much.*
Surface feeding segments -when their mouth was fully "inflated.	*How large their mouth gets.*
Sounds of whales (25%)	
The sounds.	*I've never heard or felt it before.*
Hearing the blue's calls.	*Physically feeling their strength in IMAX.*
Audio portions - mating call.	*Powerful, disorienting, amazement at how far the sound travels.*
Footage of other ocean life (22%)	
When after several days at sea, the team saw over 20 species of whales/dolphins.	*It was amazing to see so much sea life!*
The amazing undersea footage was so engrossing in 3D.	*Inspiring footage! I was moved. Felt the vastness of the sea.*

Table 5 presents awe-inducing parts of the film described by less than 10% of participants and the variety of reasons why each part elicited the emotion of awe. Example responses are presented to illustrate the parts and the reasons.

One-tenth (9%) of participants felt awe related to the methods used to study blue whales like the unique snot collector (e.g., Image 5). Other awe-inducing parts noted by fewer participants included whale poop (7%, e.g., Image 6), the discovery of blue whales in Seychelles (5%), and the discussion of whale extinction (5%).

Images 5 and 6. Assembling snot collector on drone and blue whale pooping

Table 5. Parts of film least frequently described as awe-inducing and reasons why (n = 55)

Awe-inducing parts	Example reasons for awe
Methods to study whales (9%)	
The drone device that Diane created to collect whale's snot.	*A brilliant idea using simple tools.*
Whale poop (7%)	
Whale poop [is] red.	*I have never seen whale poop and it is just amazing to get to know that is very important for plankton.*
Discovery of blue whales in Seychelles (5%)	
Two blues in the Seychelles	*Hope for future blue whale populations.*
Discussion of whale extinction (5%)	
When they were almost extinct and that there was not a safe place for them.	*I felt that humans were destroying them and that there is a lot to do as humans..*

Awe-inducing power of the film

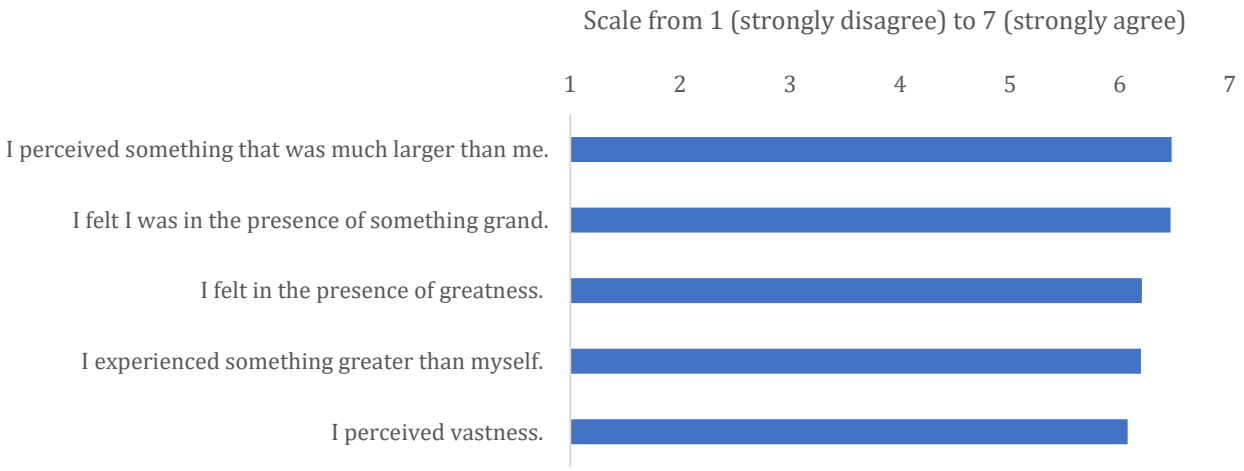
Composite awe

To estimate the awe-inducing power of the *Blue Whales* 3D film, adult participants used a seven-point scale from *strongly disagree* to *strongly agree* to rate their level of agreement with 20 total statements from four subscales of the AWE-S instrument (Yaden et al., 2019). Higher scores indicate a higher intensity of the awe emotion. The adults experienced a high level of awe while viewing the film. The composite of the four subscales yielded a mean of 5.5 and median of 5.5 on the seven-point scale.

Perceived vastness dimension of awe

Figure 1 presents the mean results for five statements making up the perceived vastness dimension of the AWE-S instrument. On average, adult participants showed a high level of perceived vastness while watching *Blue Whales*. Mean scores of individual statements ranged from 6.1 to 6.5, with an overall mean of 6.3 and median of 6.4.

Figure 1. Adults' mean ratings of perceived vastness statements (N = 57)
Overall mean rating (*M* = 6.3, *SD* = 0.83)

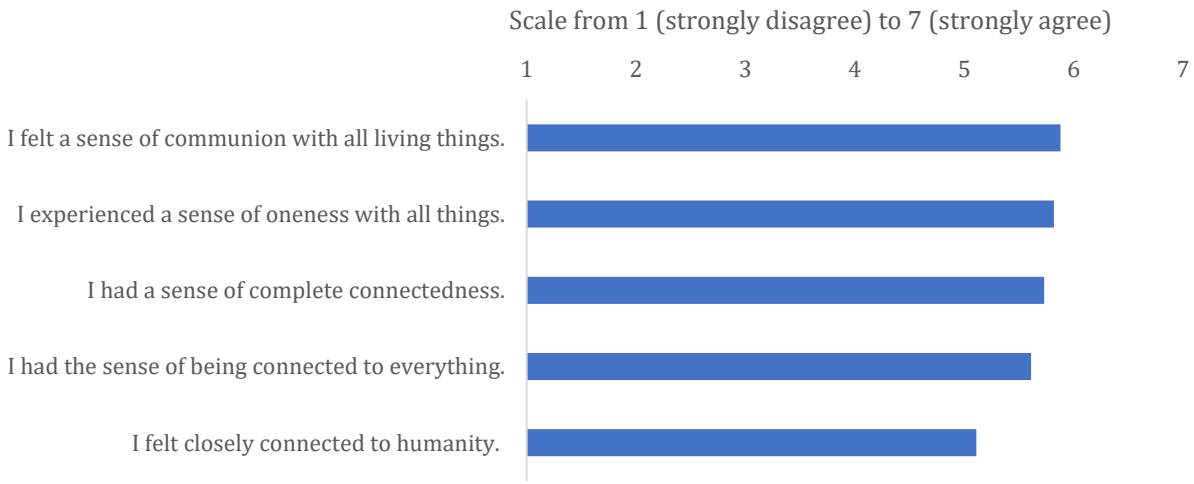


When asked in the formative evaluation survey what they liked about the film, one-quarter (21%) of adults noted liking the 3D or immersive quality; e.g., "*The spray looking like it was coming at us was a nice interactive touc*h," "*I love the 3D feature*," "*I felt like I was there*," "*I felt like I was part of it*." This group of adults rated their mean level of perceived vastness significantly higher (*M* = 6.6) than those who did not spontaneously mention liking the film's immersive quality in their open-ended appeal responses (*M* = 6.2), $t(27) = 2.15$, $p = 0.04$.

Connectedness dimension of awe

Figure 2 shows the mean results for five statements making up the connectedness dimension of the AWE-S instrument. On average, adults showed a high level of connectedness while watching *Blue Whales*. Mean scores for individual statements ranged from 5.1 to 5.9, with an overall mean of 5.6 and median of 5.8.

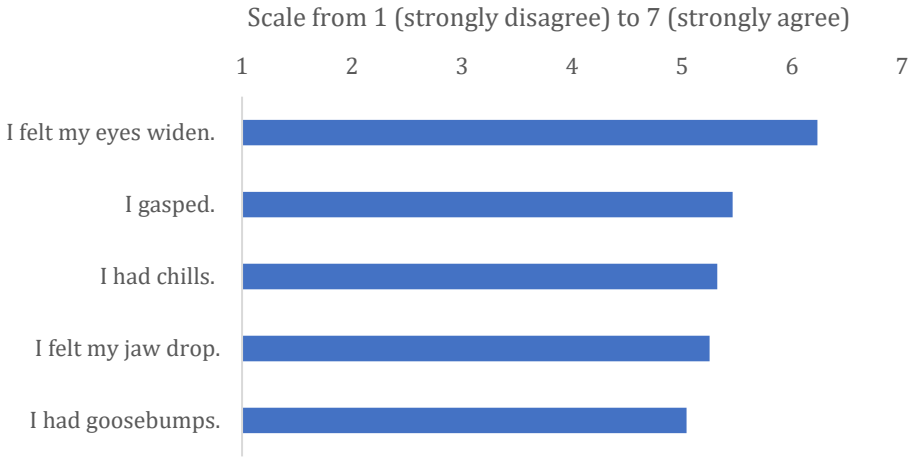
Figure 2. Adults' mean ratings of connectedness statements (N = 57)
Overall mean rating (*M* = 5.6, *SD* = 1.0)



Physical sensation dimension of awe

Figure 3 presents the mean results for five statements making up the physical sensation dimension of the AWE-S instrument. On average, adult participants showed a high level of physical sensation while watching *Blue Whales*. The mean scores of individual statements ranged from 5.0 to 6.2, with an overall mean of 5.5 and median of 5.8.

Figure 3. Adults' mean ratings of physical sensation statements (N = 57)
Overall mean rating (*M* = 5.5, *SD* = 1.2)

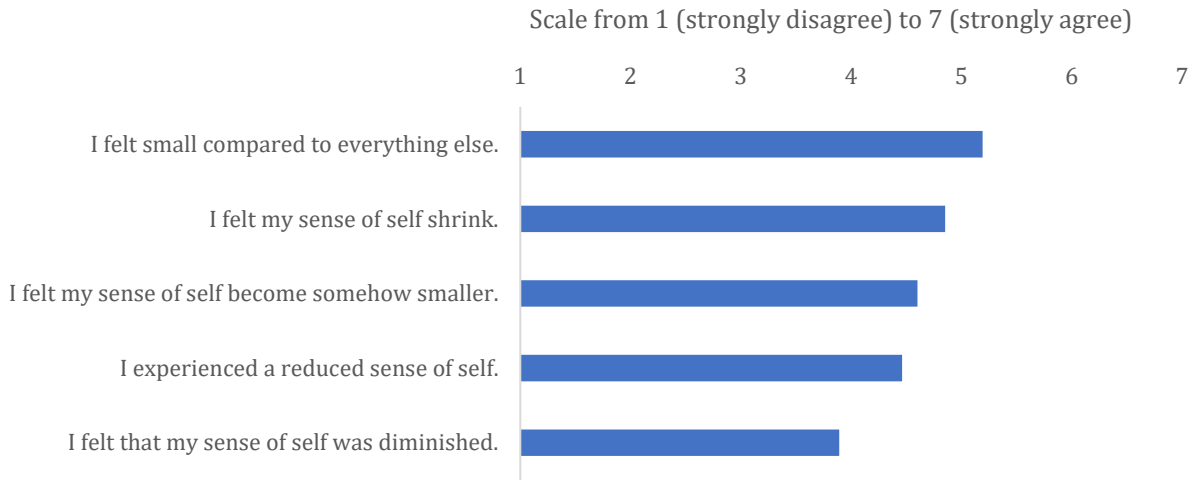


A small group of adults noted the scientists' methods as awe-inspiring parts of the film because of "*the sheer lengths and methods to which the marine biologists will go to learn about the whales*." This group rated their mean level of physical sensation significantly higher (M = 6.3) than those who mentioned other awe-inspiring parts of the film (M = 5.4), $t(10) = 3.33$, $p = 0.008$.

Self-diminishment dimension of awe

Figure 4 presents the mean results for five statements making up the self-diminishment dimension of the AWE-S instrument. On average, adult participants showed a moderate level of self-diminishment while watching *Blue Whales*. Mean scores of individual statements ranged from 3.9 to 5.2, with an overall mean of 4.6 and median of 4.4.

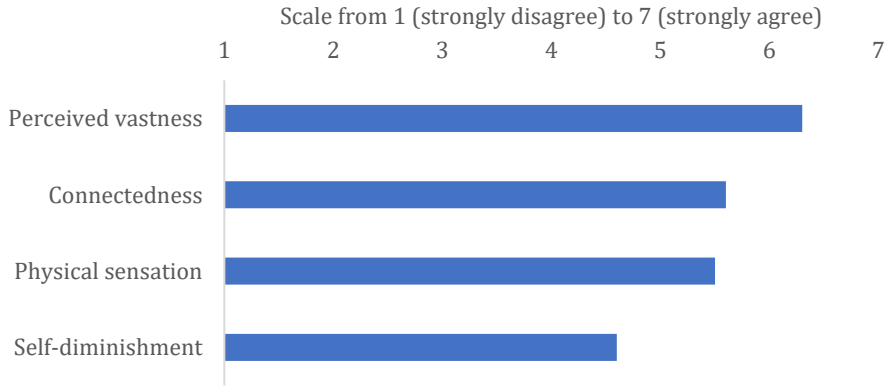
Figure 4. Adults' mean ratings of self-diminishment statements (N = 57)
Overall mean rating (*M* = 4.6, *SD* = 1.4)



Relationships among awe dimensions

Figure 5 presents a visual comparison of the mean ratings for the four awe subscales.

Figure 5. Adults' mean ratings of dimensions of awe (N = 57)



Since the same participants completed each of the four awe subscales, a repeated measures ANOVA[9] was performed and revealed a significant difference between at least two dimensions, $F(2.56, 143.26) = 40.48$, $p < .001$, $\eta^2 = .219$. To determine which of the four awe dimensions differed significantly, post hoc pairwise comparisons were implemented, as displayed in Table 6 on the next page. The mean differences

[9] Greenhouse-Geisser correction ($\varepsilon = .85$) was applied to address that the variances of the differences between dimensions are significantly different, violating the assumption of sphericity. The correction increases the accuracy of the ANOVA by adjusting the degrees of freedom for the F test. Subsequently, post hoc pairwise tests with the Holm correction to adjust *p* were conducted to determine which comparisons showed significant differences.

between perceived vastness and each of the three other dimensions of connectedness, physical sensation, and self-diminishment were statistically significant ($p < .001$). In addition, mean differences between each of the dimensions of connectedness and physical sensation with self-diminishment were statistically significant ($p < .001$). There was no significant difference between dimensions of connectedness and physical sensation.

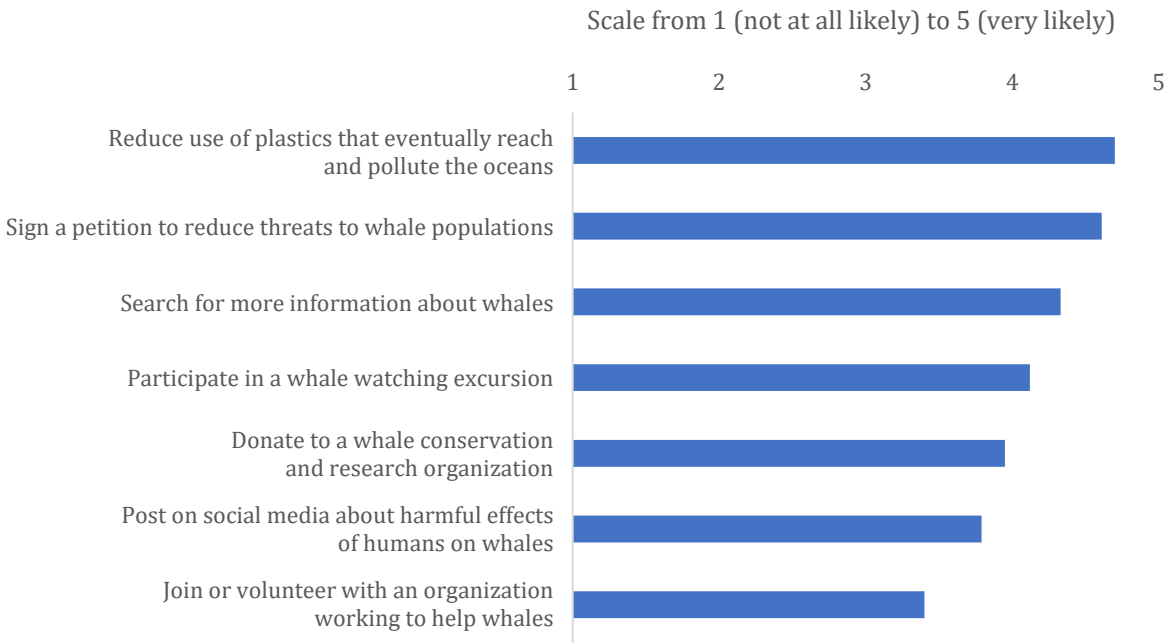
Table 6. Post hoc comparisons of awe dimensions

Test	Mean difference	Adjusted p-value
Vastness – connectedness	0.646	$p < .001$
Vastness – physical sensation	0.821	$p < .001$
Vastness – self-diminishment	1.681	$p < .001$
Connectedness –self-diminishment	1.035	$p < .001$
Physical sensation – self diminishment	0.86	$p < .001$
Connectedness -physical sensation	1.035	$p = .22$

Likelihood to engage in pro-environmental activities

Mean ratings for participant likelihood to engage in pro-environmental activities related to whales this year are presented in Figure 6. On average, adult participants reported a high likelihood of engaging in whale-related pro-environmental activities. The mean individual activity ratings ranged from 3.4 to 4.7, with an overall mean of 4.1 and median of 4.0.

Figure 6. Adults' mean ratings of pro-environmental activities (N = 57)
Overall mean rating (*M* = 4.1, *SD* = 0.7)



Relationship of awe to pro-environmental activities

Spearman rank correlational analysis assessed the relationship of composite awe and the four subscales with the likelihood of engaging in pro-environmental activities. Table 7 shows that composite awe and the awe dimensions of connectedness, vastness, and physical sensation were significantly and strongly associated with the activity scale, and self-diminishment was significantly and moderately associated.

Table 7. Correlations between awe and pro-environmental activity (N = 57)

Awe	Pro-environmental activity
Composite awe	.60***
Connectedness dimension	.66***
Perceived vastness dimension	.61***
Physical sensation dimension	.51***
Self-diminishment dimension	.36*

*(p value significance levels are reported as follows: *.05, **.01, ***.001).*

Simple linear regression analysis was used to test if composite awe predicted adults' ratings of their future engagement with pro-environmental activities related to whales. The regression results showed that composite awe significantly predicted pro-environmental activity ratings, $\beta = .46$, 95% CI [0.28, 0.63], $p < .001$. Composite awe explained a significant 34% of the variation in the pro-environmental activity scale, $R^2 = .34$, $F(1,55) = 28.32$, $p < .0001$.

Discussion

Within the formative evaluation procedure of *Blue Whales* was implemented a pilot study of the awe-inducing power of the film. The pilot study explored whether participants experienced awe while watching the giant screen film; which parts of the film were awe-inducing and why; which dimensions of awe were experienced and to what extent; and to what extent awe related to what adults liked about the film and to their likelihood of following up with pro-environmental activities.

The experience of awe in response to *Blue Whales* was assessed indirectly, directly, and with ratings of four dimensions of the AWE-S instrument. When explaining their feelings experienced while watching *Blue Whales*, one-third of adult viewers spontaneously wrote words within the awe emotional category (e.g., awe, amazement, dazzled, wonderful). This group most frequently mentioned filmmaking features when asked what they liked about the film, echoing one of the top features noted by viewers of other giant screen nature films (Flagg, 1999). When adult participants were asked directly if they experienced a sense of awe during the film, almost all responded affirmatively, describing a wide variety of awe-inducing parts of the film. Finally, AWE-S ratings revealed that adults experienced a high level of awe while viewing the film, with significantly higher mean ratings for the perceived vastness dimension compared with the dimensions of connectedness, physical sensation, and self-diminishment.

Perceived vastness, both conceptual and physical, appears to play a significant role in eliciting the emotion of awe while watching *Blue Whales.* When asked to describe awe-inspiring parts of *Blue Whales,* the largest group of adults, almost half, mentioned the discovery of a baby calf in the Gulf of California, explaining that the sighting gave hope that the population might recover from historical decimation of blue whales. The choice of the baby calf story as awe-inspiring reflects conceptual vastness "as in hearing an idea with enormous implications" (Yaden et al., 2019, p. 2). The moral complexity of the blue whale population being killed by man and then new life being discovered by man is an awe-inspiring narrative.

Reflecting the induction of awe by physical vastness, almost one-third of participants described as awe-inspiring the scenes that revealed the extreme size of blue whales, and three-tenths of participants were in awe of seeing mammoth mouths feeding on huge schools of tiny krill. In addition, adults who spontaneously mentioned liking the film's immersive quality in their open-ended appeal responses rated their mean level of perceived vastness significantly higher than those not noting this quality. The "you are there" feeling and the size of the giant screen effectively elicits feelings of awe.

The efficacy of perceived vastness in eliciting awe in *Blue Whales* corroborates experimental studies of other stimulus types with the AWE-S instrument. Employing brief experiences of 360° virtual reality videos of high and low awe-inducing nature scenes, Boer (2022) and Rohr (2022) both found that the AWE-S subscale of perceived vastness was the only dimension significantly affected by the main effect of stimulus. Comparing science text stories, rated by journalists as awe-inspiring, with control "business-as-usual" science stories, Landrum et al. (2022) found that only the perceived vastness subscale revealed a difference between the story types. Even an actual physical experience like scuba-diving elicited a higher mean score on the perceived vastness scale compared with the other AWE-S subscales (Eisen, 2021).

Finally, the emotion of awe induced by watching *Blue Whales* was found to significantly predict adults' ratings of their likelihood to engage in seven whale-related pro-environmental activities this year. Adults indicated a high likelihood of engaging in the activities, but intention to engage in an activity appeared to be conditional upon the ease of participating. For example, adults were more likely to reduce plastic pollution, sign a petition, or search for more information and less likely to volunteer with or donate to a whale-related organization. The results of the pilot study agree with the few studies that have found that awe-inducing stimuli increase environmentalism more than control stimuli (Skura et al., 2022; Yang et al., 2018; Zhao et al., 2018).

A large portion of studies of awe have elicited this emotion via nature stimuli using video clips or virtual reality experiences of only a few minutes or less in duration. In contrast, *Blue Whales* is a 42-minute film with two complementary narratives of scientists studying the status of blue whale populations in different parts of the world. The complexity of the giant screen film narratives and duration of the experience make conclusions more difficult than in controlled experimental studies comparing short experiences of high and low awe-inducing stimuli. However, even with this film's complexity, the pilot study shows that *Blue Whales* elicits a high intensity of the emotion of awe mainly through the perception of physical and conceptual vastness, induced by scenes of the extreme size and extreme eating behavior of blue whales as well as by the narrative of past whaling and present births. Finally, awe appears to have a significant and strong relationship with participants' intention in the future to engage in pro-environmental activities.

In closing, it is worth noting the limitations of the pilot study given that the questions were incorporated as a supplemental component of the film formative evaluation. In addition to the study questions being

exploratory in nature, the study relied on a one-group posttest-only design and a small convenience sample. Acknowledging the pilot study's limitations, the findings from this exploratory study make a promising contribution to the field of informal science education as they support the conclusions that a giant screen nature film can effectively induce the emotion of awe, which can significantly affect post-viewing activities related to the film content.

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Appendix 2. *Blue Whales* film survey for adults

Breakdown of formative evaluation survey questions and their anticipated use in the summative evaluation

The table below presents the post-survey questions for adults in the *Blue Whales* formative evaluation. The table also shows questions the evaluation team anticipated for use (included or adapted) for the summative evaluation (pre-survey, post-survey, and delayed post-survey). In addition, the table and the survey incorporate the study of awe into this evaluation.

***Blue Whales* evaluation outcomes and questions**				
Outcome	**Formative evaluation**	**Summative evaluation**		
	Post only	**Pre**	**Post**	**Delayed**
Q1: Appeal General	1. What did you like about the film and why?	NA	Same	NA
Q1: Appeal General	2. What did you not like about the film and why?	NA	Same	NA
Awe General	3. What feelings did you experience while watching the film?	NA	NA	NA
Q1: Appeal Ratings	4. How do you feel about the film as a whole? [Rating of Like, Visualization, Story]	NA	Same	NA
Q4: Conversation	5. What topics from the film do you think you will talk about with your 4th to 6th grader(s), if any?	NA	Same	Modified for delay
Q2: Knowledge General	6. What were the most interesting things you learned about blue whales from this film?	NA	Same	NA
Q2: Knowledge Specific	7. Based on what you learned from the film, how can people help blue whales have better lives?	Film phrase deleted	Same	NA
Awe General	8. Did you find yourself experiencing a sense of awe during the film? (Options for Yes, No) If yes, please describe the part(s) of the film when you felt awe and why each part was awe-inspiring.	NA	NA	NA
Q3: Interest Specific	9. After watching the film, how interested are you in the topics listed below... [size, feeding, communication, protection, impact on health of our oceans, methods]	Film phrase deleted	Same	Same
AWE-related Pro-environmental activities	10. After watching the film, how likely are you to engage in the following activities this year?	NA	NA	NA
Q1: Appeal General	Part of 10 format: How likely are you to recommend the *Blue Whales* film to others?	NA	Same	NA

Q2: Knowledge Specific	11. Please describe in as much detail as you can how blue whales impact the health of our oceans.	Same	Same	NA
Q2: Knowledge Specific	12. Please list as many methods as you can that scientists use to study blue whales and describe what they hope to learn from each method that you list.	Same	Same	NA
Awe-S: 5 statements for each dimension of Physical Sensation and Self-diminishment	13. The following statements describe things you may or may not have experienced while watching the film. Please choose the extent to which you agree or disagree with each statement on a scale from 1 to 7.	NA	NA	NA
Q2: Knowledge Specific	14. Please describe as many things as you can recall from the film about the calls of blue whales.	Film phrase deleted	Same	NA
Awe-S: 5 statements for each dimension of Connectedness and Perceived Vastness	15. The following statements describe things you may or may not have experienced while watching the film. Please choose the extent to which you agree or disagree with each statement on a scale from 1 to 7.	NA	NA	NA
Demographics/background	16. Age; 17. Gender; 18. Race/ethnicity; 19. Relationship to child with whom they attended the screening; 20. Previous IMAX experience	Same	Same	Same

ADULT SURVEY

Thank you for answering questions about the *Blue Whales* film. We appreciate your frank and honest answers and remind you that your responses are confidential. Our independent evaluation team will combine your responses with those from other viewers and report all findings together.

1. What did you like about the film and why?

2. What did you not like about the film and why?

3. What feelings did you experience while watching the film?

4. How do you feel about the film as a whole? Please circle one number on the scale from 1 to 7 for each pair of descriptions below, with 4 being "neutral."

Disliked	1	2	3	4	5	6	7	Liked
Visually dull	1	2	3	4	5	6	7	Visually exciting
Boring story	1	2	3	4	5	6	7	Interesting story

5. What topics from the film do you think you will talk about with your 4th to 6th grader(s), if any?

6. What were the most interesting things you learned about blue whales from this film?

7. Based on what you learned from the film, how can people help blue whales have better lives?

8. Did you find yourself experiencing a sense of awe during the film? ❍Yes ❍ No
If yes, please describe the part(s) of the film when you felt awe and why each part was awe-inspiring.

Describe parts that caused you to feel awe	Explain why each part was awe-inspiring

9. After watching the film, how interested are you in each topic below, on a scale from 1 (not at all) to 5 (very)?					
	Not at all interested	Slightly interested	Somewhat interested	Moderately interested	Very interested
Importance of protecting blue whales	1	2	3	4	5
How blue whales feed	1	2	3	4	5
The size of blue whales	1	2	3	4	5
How blue whales communicate	1	2	3	4	5
Impact of blue whales on the health of our oceans	1	2	3	4	5
Methods to study blue whales	1	2	3	4	5

10. After watching the film, how likely are you to engage in the following activities this year, on a scale from 1 (not at all likely) to 5 (very likely)?					
How likely are you to...	Not at all likely	A little likely	Somewhat likely	Moderately likely	Very likely
recommend the *Blue Whales* film to others?	1	2	3	4	5
visit the *Blue Whales* website?	1	2	3	4	5
participate in a whale watching excursion?	1	2	3	4	5
sign a petition to reduce threats to whale populations?	1	2	3	4	5
reduce use of plastics that eventually reach and pollute the oceans?	1	2	3	4	5
donate to a whale conservation and research organization?	1	2	3	4	5
join or volunteer with an organization working to help whales?	1	2	3	4	5
search for more information about whales?	1	2	3	4	5
post on social media about harmful effects of humans on whales?	1	2	3	4	5

11. Please describe in as much detail as you can how blue whales impact the health of our oceans.

_____

_____

_____

12. Please list as many methods as you can that scientists use to study blue whales and describe what they hope to learn from each method that you list.

Methods used	What scientists hope to learn from each method you listed

13. The following statements describe things you may or may not have experienced while watching the film. Please choose the extent to which you disagree or agree with each statement on a scale from 1 to 7.

While watching the film,	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
I felt my eyes widen.	1	2	3	4	5	6	7
I had chills.	1	2	3	4	5	6	7
I had goosebumps.	1	2	3	4	5	6	7
I felt my jaw drop.	1	2	3	4	5	6	7
I gasped.	1	2	3	4	5	6	7
I felt my sense of self shrink.	1	2	3	4	5	6	7
I experienced a reduced sense of self.	1	2	3	4	5	6	7
I felt that my sense of self was diminished.	1	2	3	4	5	6	7
I felt small compared to everything else.	1	2	3	4	5	6	7
I felt my sense of self become somehow smaller.	1	2	3	4	5	6	7

14. Please describe as many things as you can recall from the film about the calls of blue whales.

_____

_____

_____

15. The following statements describe things you may or may not have experienced while watching the film. Please choose the extent to which you disagree or agree with each statement on a scale from 1 to 7.							
While watching the film,	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
I had a sense of complete connectedness.	1	2	3	4	5	6	7
I felt a sense of communion with all living things.	1	2	3	4	5	6	7
I experienced a sense of oneness with all things.	1	2	3	4	5	6	7
I had the sense of being connected to everything.	1	2	3	4	5	6	7
I felt closely connected to humanity.	1	2	3	4	5	6	7
I felt I was in the presence of something grand.	1	2	3	4	5	6	7
I perceived vastness.	1	2	3	4	5	6	7
I experienced something greater than myself.	1	2	3	4	5	6	7
I felt in the presence of greatness.	1	2	3	4	5	6	7
I perceived something that was much larger than me.	1	2	3	4	5	6	7

The final few questions will help us learn about the diversity of participants answering this survey. Thank you for helping us to learn about you!

16. How old are you? _____ 17. What is your gender? _____

18. Please check one or more boxes to describe your racial/ethnic background:

- ❑ African-American/Black
- ❑ Asian (e.g., Asian Indian, Chinese, Japanese, other)
- ❑ Hispanic, Latino, or Spanish origin
- ❑ Native American Indian or Alaskan Native
- ❑ Native Hawaiian or Pacific Islander
- ❑ White
- ❑ Other: Please describe:_____

19. What is your relationship to the child who attended the screening with you today (e.g., parent, grandparent)

_____

20. Not counting today's film, how many giant screen/IMAX films have you seen? ❍ 0 ❍ 1 ❍ 2 or more

Appendix 3. *Blue Whales* film survey for youth

The table below presents the post-survey questions for youth in the *Blue Whales* formative evaluation. The youth survey focuses on the same short-term outcome questions as the adults, with the removal of questions about awe and with the addition of open-ended questions (#13, #14) to help guide development of outreach materials.

***Blue Whales* evaluation outcomes and questions**	
Outcome	**Formative evaluation**
Demographics/background	1. Grade 2. Gender
Appeal Ratings	3. Put a checkmark ✓on one face that shows how much you liked or did not like the film.
Conversation	4. You watched the film with an adult. What topics from the film do you want to talk about with that adult?
Appeal General	5. Describe what you liked about the film and explain why by completing the sentence below.
Appeal General	6. Describe what you did not like about the film and explain why by completing the sentence below.
Knowledge General	7. What was the most interesting thing you learned about blue whales from this film?
Knowledge Specific	8. Scientists study blue whales in different ways. Tell us about two methods that scientists in the film use to study blue whales and what they learn from those methods. Complete the sentences below.
Knowledge Specific	9. Complete the sentence below to tell us one thing you learned from the film about the calls of blue whales.
Knowledge Specific	10. Complete the sentence below to tell us one way that blue whales impact the health of our oceans.
Interest Specific	11. Put a checkmark ✓on the face that shows how interested you are in each of the listed topics. [size, feeding, communication, protection, impact on health of our oceans, methods]
Knowledge Specific	12. Complete the sentence below to tell us one way people can help blue whales have better lives.
Knowledge Confusion	13. Was there anything confusing in the film that you want explained further?
Knowledge Curiosity	14. What questions do you have about blue whales after seeing the film?

STUDENT SURVEY. PLEASE ANSWER AS MANY QUESTIONS AS YOU CAN. THANK YOU!

1. **What is your school grade?** _____ 2. **What is your gender (e.g., girl, boy)?** _____

3. **Put a checkmark ✓ on one face that shows how much you liked or did not like the film.**

4. **You watched the film with an adult. What topics from the film do you want to talk about with that adult?**

_____

_____

5. **Describe what you liked about the film and explain why by completing the sentence below.**

I liked _____

because _____

6. **Describe what you did not like about the film and explain why by completing the sentence below.**

I did not like _____

because _____

7. **What was the most interesting thing that you learned about blue whales from this film?**

_____

8. **Scientists study blue whales in different ways. Tell us about two methods scientists in the film use to study blue whales and what they learn from those methods. Complete the sentences below.**

One method that scientists use to study blue whales is _____

Using this method, scientists can learn _____

A second method that scientists use to study blue whales is _____

Using this second method, scientists can learn _____

9. **Complete the sentence below to tell us one thing you learned from the film about the calls of blue whales**

One thing I learned about the calls of blue whales is _____

_____

10. Complete the sentence below to tell us <u>one way</u> that blue whales impact the <u>health of our oceans</u>.

One way that blue whales impact the health of our oceans is _____

_____

11. Put a checkmark ✓ on the face that shows <u>how interested you are</u> in each of the listed topics.

How interested are you in	**Not at all interested** **Very interested**
the importance of protecting blue whales	
how blue whales feed	
the size of blue whales	
how blue whales communicate	
the impact of blue whales on the health of our oceans	
methods to study blue whales	

12. Complete the sentence below to tell us <u>one way</u> people can <u>help blue whales</u> have better lives.

One way that people can help blue whales is by _____

_____

13. Was there anything <u>confusing</u> in the film that you want explained further?

_____

_____

14. What <u>questions</u> do you have about <u>blue whales</u> after seeing the film?

_____

_____