

Evaluation of *Marine Missions* iPad App



Report for
National Geographic Kids
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INTRODUCTION

Produced by National Geographic Kids and Cricket Moon Media with support from the National Science Foundation, *Marine Missions* is a free iPad touch screen application for preschoolers. The app is hosted by Jacques, a hermit crab character who guides pre-readers through six ocean missions and the building of a fantasy sea creature. Players steer Jacques' boat (see screenshot to the right) to three green markers to clean up polluted spots in the ocean and three orange markers to complete different water current challenges in which players rescue Jacques' tools from a whirlpool, run past blowholes, and surf on tidal bores. Completing all six missions earns players rewards to use in the fantasy sea creature builder activity.



As part of the National Science Foundation Pathways grant, Multimedia Research and Knight Williams Inc. implemented an evaluation to gather feedback from five year olds and their parents regarding the app's appeal, usability and learning impact.

METHOD

Child and parent samples

Five year olds who have access to and experience with iPad devices at home were recruited around four national sites: Sacramento, CA; St. Louis, MO; Austin, TX; and Miami, FL. Distributed equally across the four sites, a budget-limited sample of 25 children included equal gender distribution and 44% minority representation. Parents reported that their children had visited an ocean frequently (24%), occasionally (52%), once (16%) or never (8%). Children living in Florida had visited an ocean significantly more frequently than those living in the other states.¹ Moms comprised 84% of the parent sample.

¹ Those whose parents said that they had visited an ocean "frequently" included 71% of FL children; 17% of TX children; and none in CA or MO. A 4x4 chi-square test indicated that the relationship between state and frequency of visiting an ocean was significant, $\chi^2(9, N=25) = 19.40, p = 0.02$.

Procedure

IRB approval and parental consent were obtained for the procedure. Parents downloaded the *Marine Missions* app from the Apple app store to their home iPad and observed their child play the first time through six missions and build a creature. After the initial play with their parent, the children could play as often as they wished or not at all prior to their interview session, which occurred a few days to one week after their initial exposure.

Parents subsequently visited the app's "For Families" section and completed a brief online survey asking about their observations of their child's play, the likelihood of their recommending the app to others, and their reactions to the "For Families" section.

Within a week of completion of the parent survey, a researcher met individually with each child. In the 45-minute session, the researcher observed the child play through the app's six missions and creature building activity for up to 20 minutes. During this play period, usability issues and verbal comments were recorded. After the child completed the app play period, the researcher thanked the child for letting her watch and then asked structured questions about the child's experience. The interview focused on the app's appeal, usability and clarity of game play, and what the child learned about the ocean and ocean animals as a result of playing. To the extent that the children were able to explain their experience and feelings, verbatim quotes are presented in *italics* in the results section. The families each received \$100 in appreciation for participating in the evaluation.

Data analyses

Quantitative data are presented as frequencies in text and charts, and appropriate statistical tests were implemented for all quantitative data. In this report, footnotes present a definition of a statistic when first used and also present the statistical test results. A statistical test that gives a p-value, or probability value, lower than .05 is reported as "statistically significant." This means that a difference between groups is noted as significant only if it has a 5% or smaller likelihood of occurring by coincidence or chance.

Qualitative data were sorted into categories by keyword and meaning in relation to the evaluation issues of appeal, usability and learning. Categories are presented as frequencies in the text, and verbatim quotes from children and parents are presented to illustrate each category and enrich the quantitative data set.

PLAYER RESULTS

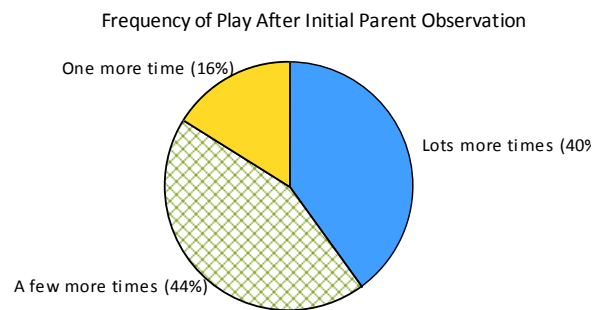
APPEAL

The children spontaneously played *Marine Missions* at least a few times after their initial exposure. Eight of ten children liked the app a lot and seven of ten children were very interested in playing again. A majority of the children gave the highest appeal ratings for each of the activities and the character Jacques.

What children most often liked about the app was playing the whirlpool mission, cleaning up the ocean, and/or playing the tidal bore mission. Only a minority of children identified something they disliked, in particular the cleanup activity because they did not like Jacques telling them repeatedly “we only want to collect trash” when they touched an animal.

Engagement

After the required initial play with their parents, all children reported that they played *Marine Missions* again. The majority of participants reported playing either “lots more times” (40%) or “a few more times” (44%). A small group (16%) of children played only one more time.

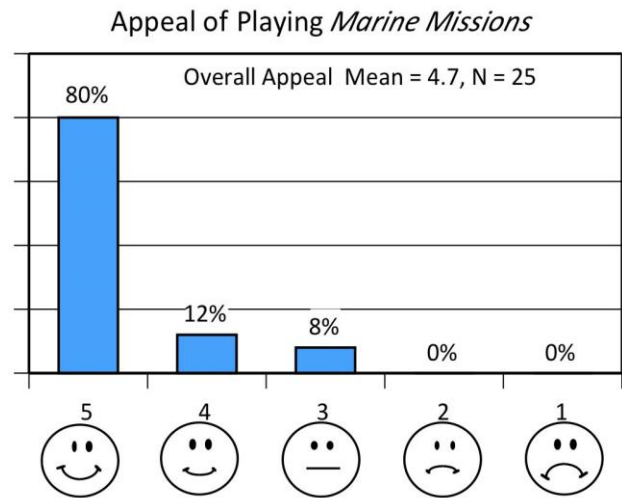


Although the activities of the app appealed greatly to a majority of children (see p. 5-6), how much a child played after the first exposure was strongly associated with how much they liked the whirlpool mission.² Those who reported playing “lots more times” rated the whirlpool mission on average at 4.9 on a 5-point scale; those who played “a few more times” rated the mission at 4.3; and those who played “one more time” rated the whirlpool at 2.3.

² A 3x5 chi-square test indicated that the relationship between frequency of playing again and appeal of the whirlpool mission was significant, $\chi^2(8, N=25) = 18.18, p = 0.02$. Whirlpool appeal ratings are on p. 6.

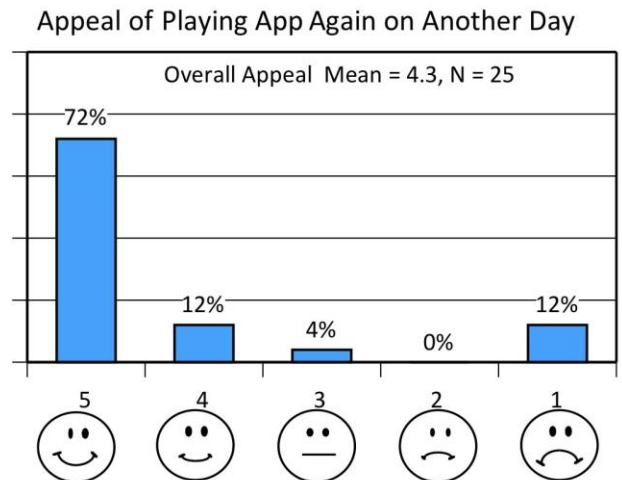
Appeal of playing *Marine Missions*

Most (80%) of the children chose the happiest face on the five-point face scale to describe how much they liked playing *Marine Missions* (see top chart).



Motivation to replay

When asked how much they would like to play the *Marine Missions* game again on a later day, there was a slight drop-off in future playing interest; still nearly three-quarters (72%) of the children were very interested in playing again (see bottom chart).



What was liked most about playing *Marine Missions*

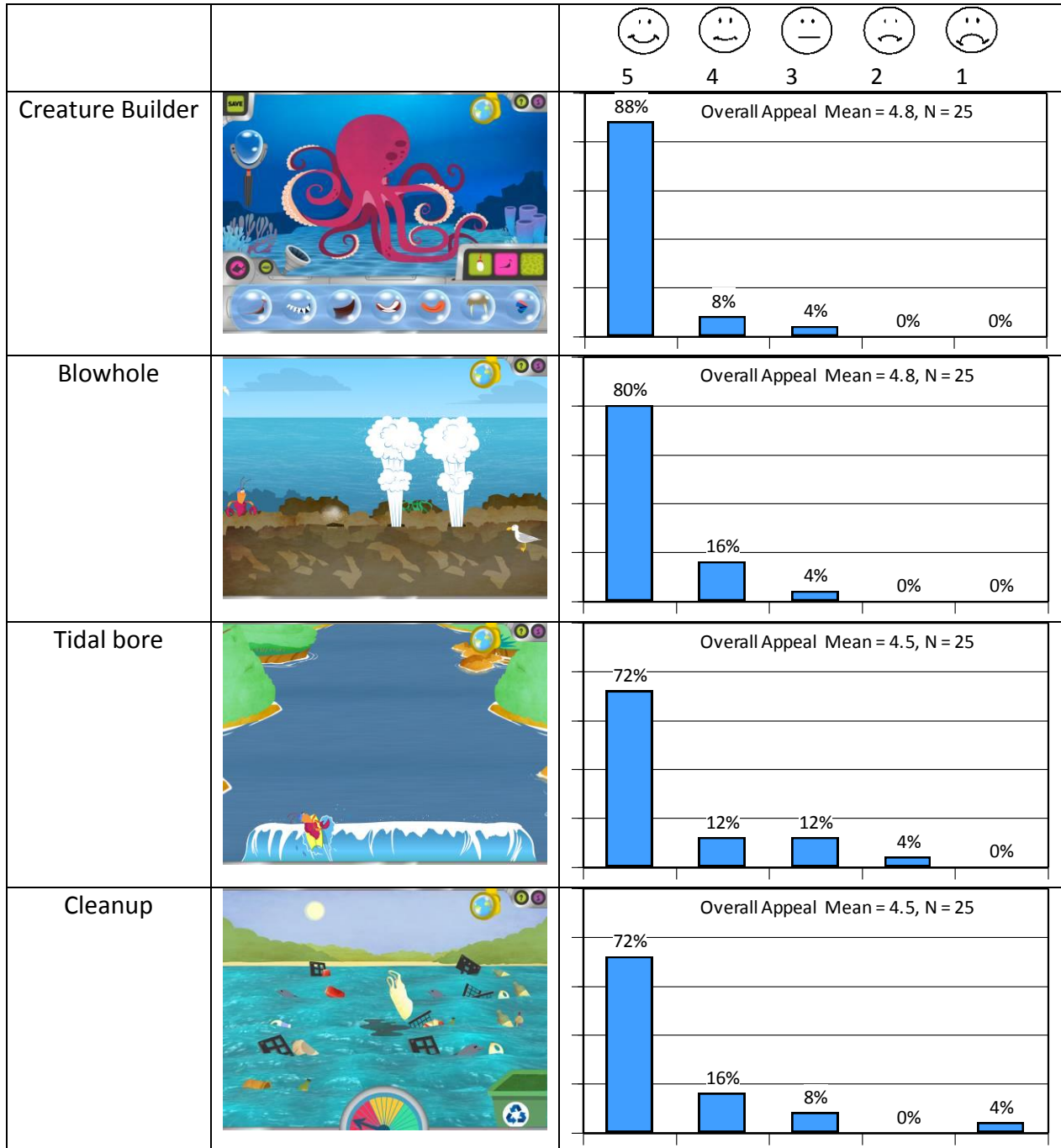
When asked what they liked most about playing *Marine Missions*, the children most often mentioned playing the whirlpool mission (40%) because *you had to do stuff fast* or they liked *getting his stuff*. This group was comprised of children who played the app more than twice. The children also frequently mentioned cleaning up the ocean (28%) because *I want to help the ocean be healthy* or they liked playing the tidal bore mission (24%) because *it was just fun*. Two slightly smaller groups (20% each) liked the blowhole because *hearing him [Jacques] ding into them was fun* or the creature builder because *it was fun to make things the way I want to design them and make them look silly*.

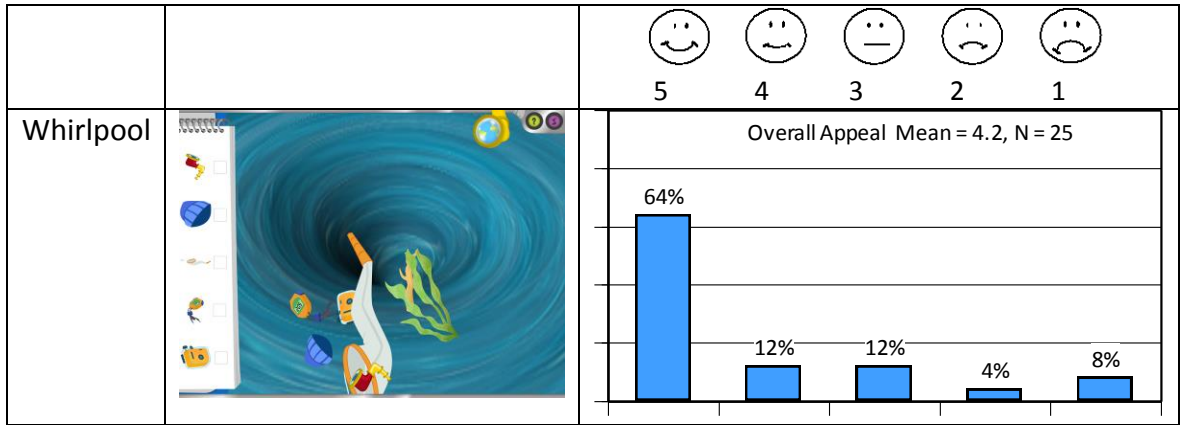
What was not liked about playing *Marine Missions*

The majority of the children liked all of the app, but one-quarter (24%) mentioned disliking the cleanup activities because they did not like Jacques telling them repeatedly “we only want to collect trash” when they touched an animal and/or *because it took so long to do*. The tidal bore was not liked by 8% of the children and the blowhole was not liked by 4%, but these children did not elaborate as to why.

Appeal of activities

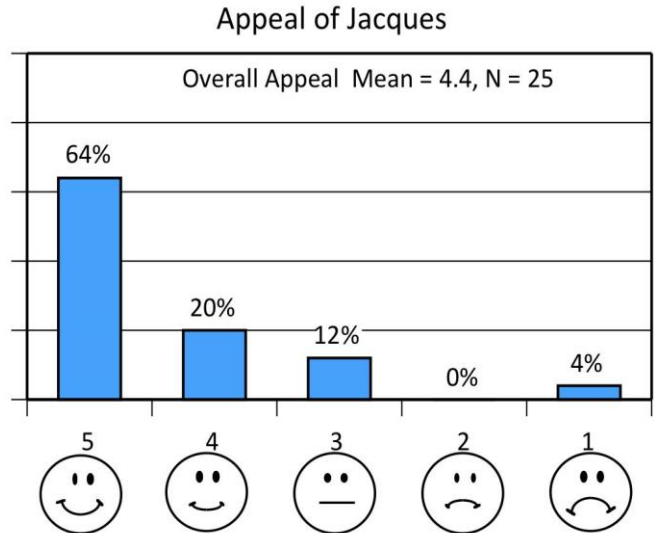
The children were shown individual iPad screen-size pictures of each activity and asked to point to a face on the face scale that told how much they liked playing that part of the game. As the charts below show, a majority of children liked each activity “a lot” (5, on the scale of 1 to 5), with the whirlpool mission showing the most variance (next page).





Appeal of character

The children were shown a larger version of the picture displayed below of Jacques and asked to point to a face that tells how much they liked the character in the game. Two-thirds (64%) liked Jacques a lot, as indicated in the chart below.



Players liked Jacques because he is fun or funny (36%); because of his looks (24%); because of his actions in the game (12%), or as preschoolers are wont to say: 'just because' (20%). For example:

Funny. The way he talks. He says words funny.

He is funny when he is dizzy in the blowhole.

He was fun.

Because he's so funny.

Orange. He is an orange crab.

Jacques! Because I like him. He's a crab.

Because he has things sticking out of his head. I love them. He looks like a crab.

I like the jet pack.

Because he keeps all his stuff in his shell. It is really silly because not all of it fits in his shell. I don't know if he lives in a house or on the boat but he doesn't have enough room on the boat. That he was telling me about creatures. I liked him soooo much, cause he helped me help animals and I could lead him at the blowholes. He's kind of funny and he's nice and he helped me clean up the ocean, he showed me how to do it. I liked him a lot. Because I like him.

A few (8%) were not so positive about Jacques. For example:

*Because he annoyed me when he had to talk and I just wanted to do it already.
Because I don't like him. I just don't like him. Everything about him.*

USABILITY AND CLARITY OF GAME PLAY

All of the children understood what to do to complete the missions. Some players attempted to speed up their completion in some missions with each round of play. Some players showed impatience with Jacques' repeated directions and comments but no one appeared to be aware of the button to skip Jacques' instructions. A few players had difficulty operating the wand in creature builder, finding their saved creature photo, or rubbing the oil spill in the accepted direction in the cleanup mission.

To assess usability and clarity of game play, the researcher observed the child playing through the six missions and the creature builder activity. After completing the game, children were shown pictures of each activity and asked to explain how to play that part of the game.

Overall game play

In the overall game play, none of the children were aware of the <Skip> button to skip over Jacques' instructions, and one-third (32%) showed their frustration at various times by touching the screen repeatedly during Jacques' directions to try to get the boat to move or an activity to start.

Creature Builder

Observation of game play and children's explanations of what a player does in Creature Builder revealed that all of the children understood how to interact with this activity. For example, one child demonstrated for the researcher, as follows:

Those are the bodies. Just touch one you want, then it works. There's these [touches a feature], and if you want to get rid of it, just do that [drags to trash]. See that's how you get the scales and if you want to get a new one, just tap here and save is there [points to save in upper left]. And this is a nice one [sea star]. That's information of it [uses wand], and how you get rid of it [info screen], just touch the x. I don't know what that is or those [music note, question mark, in upper right corner], but I do know what that is [erase whole thing button].

Almost all (88%) children reported using the wand when playing previously and indicated they understood that the wand gives information about the creature; for example: *It will move when you move your finger around. It showed an octopus can squeeze their body through small spaces.*

Most (80%) children also used the wand while being observed by the researcher, but a few were frustrated with its use. The researcher noted, for example:

[Child got frustrated after trying to get the wand to work] *Why won't it [video clip] come up?*
[Child manipulated the various body parts and then passed the wand over, then held it over the new body part. After several tries, the shark clip came up] *I want to make a shark* [Exchanged body for shark body and played with the body parts] *I want sharp teeth. Are these shark teeth? That's a fish tail.* [Exchanged tail.] *This is a shark's tail.* [After several attempts, got the wand to work again. Played shark clip again.] *Why can't they say something new?* [Mother later reported to the researcher that her child had problems closing the video clip box because the "x" is very close to the button that returns user to the map.]

All children said that they had saved a creature when playing previously, and most (84%) saved their creature while being observed by the researchers. However, a few children (16%) reported that they did not know where to look for the saved creature; for example: *I knew I could save it, but I don't see the picture, where it goed to after that.*

Blowhole

Children's comments and actions during the blowhole mission showed that the activity was sometimes challenging but they persevered. Children identified the blowhole icon; parroted Jacques' verbal definition of a blowhole and instructions; laughed at Jacques' antics; and crowed when successful; for example:

It's a little scary. This one is a little hard and how do you get him past...the blowhole. Trying to go to the blowhole.
I'm going to the blowhole. This one is difficult to move...Oh I just got it! Mom! Look I got it!
That's a blowhole. [pointing] *...Sometimes he [Jacques] goes whoo whoo sometimes in there.*
Blowholes is one of my favorites. I love when he [Jacques] gets up on the water. It's really silly. And the little pool thing. It goes in a circle. There is something that sometimes happens that's so silly... that! [laughing when Jacques goes up on the water]
I like the blowhole. Splash! Go go! He got in the umbrella. Away I go!
I love this part where he bumps into the blowholes.
Ooh - Ouch! [when Jacques was hit with water].

All children could describe what to do when they played the blowhole mission; for example:

Move and make sure he does not get hit to get his stuff back. When it [the water] goes down you move, when it goes up you stop.
Move him so he doesn't go into any blowholes. Make him get his gear.
This is the same game where you hit the blowholes. How I do it is tip the screen to go that way or this way. He like lost something like his mask, and I am trying to get him to where it is, and you have to get past the blowholes... And it's fun. Then he goes back to the boat.

Tidal Bore

While playing the tidal bore mission, children often reported on their technique for completing the mission; for example:

I can do this...Go!... Look! ...Yay! Stay on the side of the screen.

I can stay here forever and I am going to win. I just keep moving him to the right and stay on the wave.

I can swipe my finger or tilt the pad to avoid the rocks...watch out for the tree branch...[at end] Yay!

I'm so good at this one... [at end] I didn't even hit anything!

My favorite one. [whole upper body moved while tilting iPad] That was easy. When he moves, he has his sunglasses on. That's funny.

This is a hard one but I can do it. See that stick and the wall. You can't get on them. Or the bird. Because there are some birds in there. And how you move it around is do that. [demonstrates moving the iPad].. See there's the bird...That's the end. That's how you do it. In the middle his board gets wiggly. This is the silly part.

This one is THE hardest one... Easy... Don't head for the rock. You're going to get killed... The swans are the easiest to go over... Yikes! [Player mimicked Jacques' eyebrow movements at end of game.]

All children could describe how to play the tidal bore mission; for example:

Skate without getting hit. You can turn on the very side so you don't get hit.

You need to not get hit or hit anything. You can just sit on the side it works.

Move so you don't hit the tree branches, birds, or rocks. Move back and forth with your finger.

I just swipe my finger or tilt the screen back and forth - no wait, side to side and if you see a rock or bird or a tree branch you go the other way -that way or this way.

You make him ride on waves and not hit anything.

Cleanup

During the Cleanup activity children were often observed tapping faster and faster with each repeated cleanup mission; for example:

[Cleanup 1] *You get a prize after you win all of them.* [Cleanup 3: She taps so vigorously that she switches screens to her mother's email] *One time my mom helped me do it so I could be faster. It's hard work to do that, I have to do my hard work again.*

[Cleanup 1] *When you tap the ocean "it" goes into the recycling bin... It just keeps going dink and it keeps falling down and flying down... Gotcha! ...Woo Hoo I cleaned up all the garbage!*

[Cleanup 2] *Pick up the trash [copies Jacques' comments]...woo hoo... squeaky clean... Soda can, spray can, bag.* [Cleanup 3, taps extra fast] *I don't want the music [touches music note in upper right] I just want to hear the sound effects. Soda can... one, two three, four, five, six, seven...[shook bin].*

[Cleanup 1] *I like when I do that one. You have to rub the oil to get it all.* [Cleanup 2] *It's funny when he says squeaky clean.* [exits game accidentally while shaking for recycling bin] [Cleanup

3] *It's not nice when people litter. I don't like when people do that... I can't believe that squid is right there!*

[Cleanup 1] *That's the cleanup one... That tells you how much is full.* [Cleanup 2] *My favorite is this one...The bags come flying and you always clean up the oil mess... Those things [bell buoys] you may think are trash but they are not.*

[Cleanup 1] *Now it will pop back up* [waiting for last trash piece to reappear] [Cleanup 2] [Jacques says, "we only want to collect trash"] *I know. I got it. I only want to collect the trash.* [a little later after Jacques' same instruction] *Okay. Stop it.*

A few children (8%) were observed unsuccessfully swiping the oil spill up and down rather than sideways.

All children could describe what to do in the cleanup mission; for example:

That's where I touch the trash and rub your finger on the oil spill and don't touch the other things; it's ok but try not to. And it goes into the recycling box. Except the oil, that just cleans it up. And this goes like that and it [meter at bottom] tells you how much you cleaned up. The trumpets tell you when it's done.

In this one, how you play it is that [meter at bottom] shows you how much trash you collect, and all the way at the end means not very much and all the way at the other end means pretty much all of it. I usually get to there. How you do it - the oil you rub your finger until it goes away, and you tap tap tap until it all goes into the garbage. And then it says, let's empty our recycling bin, and I lift it up and shake it this way.

You have to pick up the trash. You have to shake the iPad to dump the trash. Pick everything up except the dolphins and creatures.

When I see an oil drop, I give it a nice scrub. I tap the garbage to make it go into the garbage bin. Clean up some things. Don't clean up the trashcan. The fish don't go in the trash.

Try to clean up the water, so then the animals can get a healthy water.

Whirlpool

During the Whirlpool mission, children were often observed tapping to save Jacques' items from the whirlpool, occasionally using both hands to speed up the collection and also waiting for items to disappear and then reappear; for example:

Jacques needs his tools.

If they fall down from here, it comes back. Just pops up.

I was trying to get it to go down, then up. I like it the way it is, you don't have to change it.

I'm really good at that! One of the sticks went all the way down to the bottom of it.

This is the easiest.

I do it so fast, it's easy for me.

That's not his seaweed! ...Done!

All children could describe how to play this mission; for example:

You have to tag the things that are his on the list

You try to get the stuff before it sinks.

Take stuff really quick, but only stuff on the list.

You gotta touch the things in there that's on his list, and then he gets it back. And he sometimes he says the name of them, in fact he usually does.

Tap it and it goes there [points to list]. The camera, hat and measuring tape. The leaf and branch go in the hole.

I tap stuff that's on his list and it appears there.

I had to touch the things that he needed and watched out for the things he didn't need.

LEARNING

Most of the children learned something new from the game about the ocean and ocean animals. A majority of the children learned that a trash-free ocean is a healthy ocean for animals. On the other hand, only a minority of the children concluded that the oceans are connected to each other, making one big ocean.

A majority of the children could describe the activity of the three water phenomena when shown a screen shot. Approximately half or more of the children could recall the names “blowhole” and “whirlpool” when asked to name these water features, but “tidal bore” was less memorable, with less than one-fifth recalling this name.

During the interview, the children were asked to describe what they learned from the game about the ocean and about ocean animals. Looking at pictures of the three water challenges (blowhole, whirlpool, and tidal bore) the children were also asked to describe what the water does in that part of the game and to name the water feature.

Learning about the ocean

Most children (84%) were able to describe something that they learned about the ocean. The majority of children (60%) explained that the ocean needs to be cleaned of trash to be healthy; for example:

- We need to clean it up. It needs to be healthy for the animals.*
- I learned that if you don't clean the ocean then it is not a healthy life.*
- We need to keep the garbage out for healthy animals.*
- If you have a clean ocean, it is healthy life.*
- We throw trash in it and it is not healthy for them.*
- Helping the ocean get clean.*
- Cleaning it up and helping it.*
- Has lots of garbage and you have to clean them.*
- I learned that you need to keep the place clean.*

Smaller groups described one or more of the water phenomena (12%) or said they learned names of the oceans (8%).

One of the learning goals of *Marine Missions* is that a trash-free ocean is an ocean healthy for animals. All of the children could explain why we should keep trash out of the ocean; for example:

- Or else fish could die. Stuff could trap them, then they can't breathe.*
- So all the animals can have a clean home.*
- So the animals can stay healthy.*
- Because the animals need a healthy place to live.*
- Because it makes other animals come in when it's clean. Other animals come into the ocean that got cleaned up.*
- Because the animals will get sick if we don't.*
- Because it is not safe for the creatures.*

*Because it needs to be clean so the dolphins and all of the fish in the ocean don't get sick.
So the animals can keep healthy.*

Another goal of the app is to communicate that the oceans are connected to each other as one big ocean. However, three-quarters (72%) of the preschoolers reported that there is more than one ocean. When asked if the oceans are connected to each other, making one big ocean, half (50%) of these participants said yes and half said no, explaining for example:

It doesn't say there is one big ocean so I don't think so.

It says they are all separate.

It's about four oceans.

Five oceans. They are not connected because they say each ocean.

There's a hundred oceans. Even the Mississippi ocean.

Learning about ocean animals

Players were asked what they learned about the animals in the ocean from playing *Marine Missions*. One-fifth (20%) of the children could not think of anything they learned about ocean animals, but most (80%) reported picking up some information, as follows:

- 28% reported learning that animals need a clean healthy ocean to live in; for example:
I learned about helping them and how I help them in the game, I clean up their home.
I learned that they needed a healthy place to live.
That they need healthy water.
- 20% recalled specific facts about animals from the Creature Builder activity:
The eel is not a snake, they are fish. One of the fish can eat a fish half its size. A starfish when its hand breaks, it gets to come to life again.
When a sea star loses an arm, it can grow a new one.
About the eels. The eels are not snakes they are fish.
I learned that when seahorses rest they wrapped their tails around something to stay.
Sharks eat a lot.
- 20% mentioned ocean animals more generally:
Fish, jellyfish, octopus, and shark. I learned about them, just stuff about them.
There is a dolphin and a octopus and a shark and a jellyfish and that is all.
I learned about turtles.
Some of them swim under water and some above.
They can swim.
- 12% noted from the Cleanup mission that you cannot “recycle” the animals:
I learned that you can't clean them. You can't recycle the animals. You can take the garbage out but you can't take out the fish.

Learning about water phenomena

Jacques describes each of the three water phenomena before a player starts the mission. In the interview, the children were shown pictures of each of the missions and asked to describe what the water does in that part of the game and to name that type of water.

Blowhole. Jacques describes blowholes as “caused by ocean water and air getting trapped in underground caves. The pressure builds and then splash!” The majority (60%) of the children could recall the term “blowhole” in response to the mission screen shot and could describe the action of the water as *blowing up, popping up, exploding, or shooting up*. One-quarter (24%) of the children demonstrated some recall of ocean water trapped in caves being pushed up:

Blowholes can take with water and air that get trapped in underground caves. The pressure will build and then splash.

It blows up, well it's like kind of there's a cave underneath and it kind of gets like...stuffed up and then shh there it goes!

It explodes because it gets stuck in the ocean.

It gets trapped in underground caves.

It puts the water in underground caves.

Whirlpool. Jacques describes a whirlpool as “where currents meet and swirl in a circle.” About half (48%) of the children recalled the term “whirlpool,” and almost all (92%) described the water’s action as a *whirl or swirl or spin in circles like a tornado*; for example:

Whirlpools swirl in a circle.

It swirls up in a big circle.

It swirls and in circles.

It goes in a circle, really fast.

This makes a little tornado of water.

It whirls around.

It's sucking the things in.

It goes around and around.

Tidal bore. Jacques notes that a tidal bore “is where the ocean’s waves travel up a river.” Only 16% of the children could recall “tidal bore” as the name of this type of water. Most (76%) described the water action as a wave or waves; for example:

High waves.

It just makes waves that keep on coming.

It goes up and makes a big wave.

Makes waves.

PARENT RESULTS

When playing the app for the first time, a majority of the preschool parents felt that their child was very engaged and found the app moderately easy to play. A majority noted that their children had low or no familiarity with the app's topics. Most parents felt that their children learned mainly about recycling and cleaning up trash in the ocean.

A majority of parents were very or moderately likely to recommend the app to other parents, most often praising the app as fun and informative. Parents' recommendation of the app was significantly influenced by their child's gender, as the majority of parents, mostly parents of girls, were either very or moderately likely to recommend it.

With respect to the "For Families" section of the app, the majority of parents rated each of the three features as very or moderately valuable.

Engagement

Parents at home watched their child play the app's six missions and creature building for the first required game play. The more engagement perceived by the parent during the first exposure, the higher the child rated the appeal of the app when later interviewed (p. 4).³

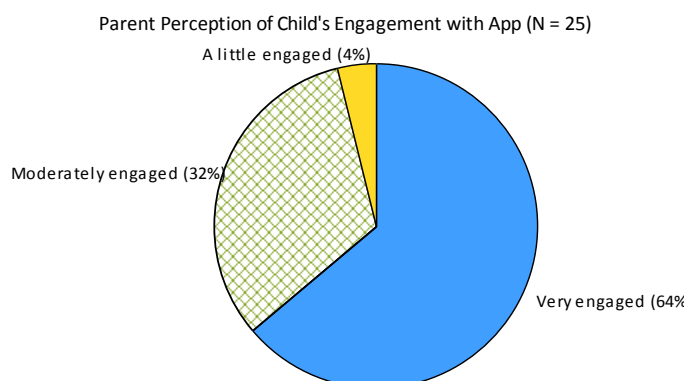
Two-thirds (64%) of parents felt their child was "very engaged" in playing *Marine Missions* the first time (see pie chart). Of these parents, some commented further about the app's appeal, tending to point to features or activities that their children most enjoyed or describing app voiceovers or volume as loud or annoying; for example:

His favorite thing to do was create the creature. There were a lot of options and he really got into it.

My daughter played it several times and really liked that she had to shake or move the tablet to get things to happen. She was disappointed that there were no info boxes for the fish in the creature builder and only one info box for the other creatures.

My daughter liked the games/adventures, but wasn't all that interested in building a creature. I thought the voiceovers became annoying after a little bit, but my daughter didn't mind. She immediately wanted to play again, so she likes the app!

He seemed to be most engaged with the litter recycling game. The ocean current games were a



³ $r_s(23) = .52, p = .008$ two-tailed. The nonparametric Spearman rank-order correlation coefficient, r_s , assesses the strength of association between two ranked variables and ranges from -1.0 to +1.0.

little tough for him.
Way too loud, annoying for adults.
The app is a little over the top with the amount and volume of the music and narration. At times, it seems to try too hard to connect with the child.
The integration of actual ocean videos would enhance the experience.

Of the third (32%) of parents who perceived that their child was “moderately engaged” in their first exposure with the app, a few (12%) commented further about the app as follows:

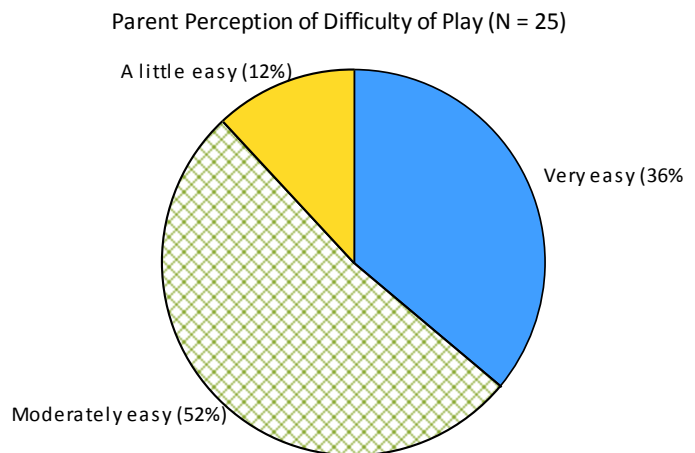
She thought it was a little boring. It should have some reward points to keep the children excited. The first time through was great, but then it was boring. The game play did not get harder, and so the game ends up being boring and repetitive. Limited in diverse play. There is no learning about the animals, which was surprising. We liked the oceans and the narration. The creature creator was cool but overwhelming. There was too much and it was too hard to navigate. It would be cool if all the creatures could be together in an aquarium.
I wish there was more information given in short spurts. The surfing was basic to avoid things in the water, but trying to get something or save animals would be more entertaining. The whirlpool section was too fast and too short lived. The clean up section was good but happened three times. Maybe info on how/why the things he was cleaning up were harmful. Build a character was definitely the most captivating for both my 5 and 3 year old while at times a bit frustrating for lack of "accessories" to add to the chosen body. My son wanted to build a shark that looked like a shark but didn't have the right add ons (fins, eyes).

User friendliness

Half (52%) of parents felt that the first time through the game was “moderately easy” for their child, with 36% saying it was “very easy” and 12% saying it was “a little easy” (see pie chart).

Some parents commented further on the app’s usability, as follows:

Some of the instructions seem to be given a little too fast.
Initially, the app was a little hard to navigate while holding the iPad. He figured it out though and then made his way to all the locations.
My daughter sometimes had a hard time navigating to adventures.
The ocean current games were a little tough for him.
The creature builder was the least preferred, would have been easier if he could model one after another. Better verbal instructions on how to build the sea creatures, as well as some examples of how to design creatures.
The info magnifying glass in the create a creature section was difficult for my child to manipulate, my child loved it though.



Familiarity with topics

Parents estimated that their children were only “a little” familiar (36%) or “not” familiar (32%) with the topics featured in the app (see pie chart). A minority of children were reported as being “very” (20%) or “moderately” (12%) familiar. The topics that were described as most familiar to their children were recycling and not littering; for example:

She understands about keeping everything clean and not polluting.

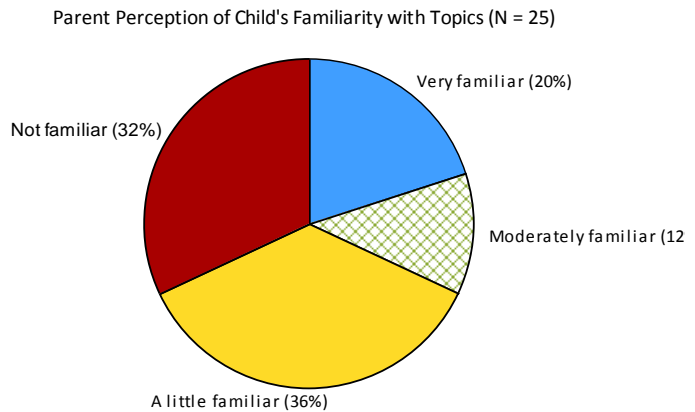
Recycling is something that we do. Each of our children are responsible for helping with recycling in our home in some form or fashion.

He knows the importance of not littering and the importance of caring for the earth.

He's very familiar with animals and very familiar with recycling.

He's familiar w/cleaning up litter, recycling and sea creatures but doesn't know much about the ocean in general.

She knew that littering was bad. She knew there are several oceans in the world.



Gains from playing app

Parents were asked what they thought their child gained from playing *Marine Missions*. Three-quarters (75%) of parents felt that their children learned about recycling and cleaning up trash in the ocean; for example:

Greater appreciation for environmental cleanliness - he's especially interested in the cleaning-up portion of the game.

Littering has a negative effect on the oceans.

An understanding of the importance of keeping our oceans clean.

Improved awareness of trash contaminating land and sea.

The idea of recycling and keeping trash in its place is important.

She gets a great exposure to the importance of clean waters for marine life.

She really enjoyed the clean up games and said several times "I want to help clean the ocean!"

Four of ten parents (40%) also commented that their children learned about ocean terms and phenomena; for example:

Names of several Oceans. Natural aquatic phenomenon.

She gained a familiarity with different types of water phenomenon.

He learned about different currents, whirlpools, blowholes, tidal bores and sea creatures. I think it's an amazing app, it was educational and I can see he's gaining knowledge and new words, like whirlpool and blowholes. We didn't know this terminology before.

She knows more about marine life, currents, tides, tidal bores, whirlpools, blowholes. I am amazed

at how much information she has retained.

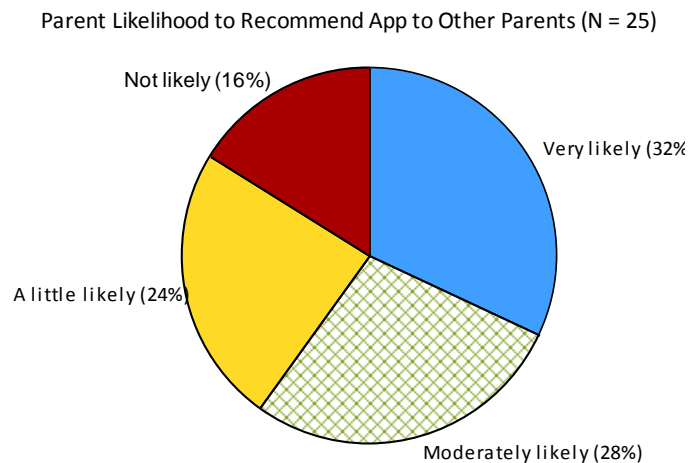
One-third (32%) of parents mentioned that their child learned about sea creatures; for example:
She was very engaged and especially liked learning the different facts about sea creatures in the creature-builder section. She was particularly impressed that an octopus has no bones!
In the creature creator he learns some information about the animals he is creating.
My child learns about the ocean creatures.
Basic understanding of ocean creatures.
Body-parts and usage of marine life.

Two of ten parents (20%) wrote of improving motor skills by playing the app; for example:
She practiced motor skills.
Fine motor skills.
He learns some motor skills (very basic).
Hand-eye coordination.

Likelihood to recommend app

Parents' recommendation of the app was significantly influenced by their child's gender. The majority of parents (60%), mostly parents of girls, were either "very" or "moderately" likely to recommend the free iPad app to other parents (see pie chart).⁴

Another 28% of parents were "a little" likely and 16% were "not" likely to recommend the app. The latter were all parents of boys.



Those who would recommend the app felt that it was fun and informative; for example:

I think it's great to teach children about the oceans and that we need to keep them clean. He learns that it's not good to have trash in the ocean. That it needs to be cleaned up. He learns about the ocean names. It exposes him to the ocean life.

Very fun, informative, instructional vs. other apps. He will play this over other games. Every time I want the iPad we fight over it. Now we have a clock so each can have it for a half an hour. The creature builder was the least preferred, would have been easier if he could model one after another. Overall it's my favorite app! and my 2 1/2 year old likes to play it too, quietly, but he plays.

⁴ A 2x4 chi-square test indicated that the relationship between child gender and parent recommendation level was significant, $\chi^2(3, N=25) = 8.211, p = 0.04$.

The app is engaging as a game. She knew about beach cleanups, but not about topics like tidal bores and blowholes. Some video at each site would be a neat addition perhaps. She also loved the creature creation segment, which she did spend considerable time on. She enjoys finding the trash and knowing when it is marine life hiding behind the rock, not a milk carton. She enjoys the surfing screen and likes that she can now maneuver the geysers more easily than her first few times.

Those less likely to recommend the app felt that it was not sufficiently engaging for repeat play or was geared to children younger than five; for example:

It was fun the first couple of times she played it, but then not as exciting. Could have a question and answer game with multiple choice to make it fun for the kids to learn. Improved hand-eye coordination.

I'm fairly certain that my daughter would get tired of it after a day or two - perhaps because she mastered all the games pretty quickly.

I'm not sure he gained too much from the game. He was already aware of recycling and ocean animals, but knowledge of whirlpools and currents might have been over his head. Maybe the vocabulary and information integrated more within the game. The game seems to be geared to a younger audience than a 5 yr. old.

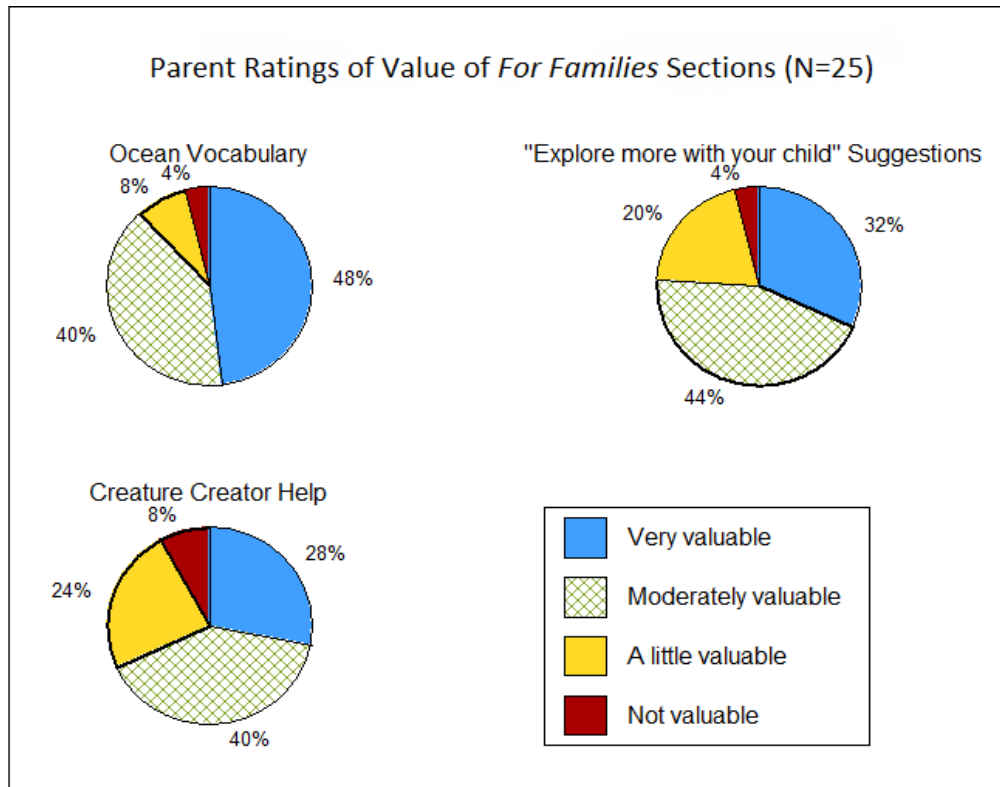
I would probably recommend the app to friends who have children that are a little younger than my 5 year old. My 3 1/2 year old was quite engaged with the game.

Almost seems geared towards younger ages. My three year old plays with it easily as well. Once they have played the game a few times, they have it easily mastered and become bored.

Good for 3-4 year old.

For Families section

The pie charts below display the distribution of parent ratings of the value of the three features in the For Families section of the app. A majority of parents considered each feature “very” or “moderately” valuable, with Ocean Vocabulary most valued by 88%, “Explore more with your child” Suggestions most valued by 76%, and Creature Creator Help most valued by 68%.



Those who were more positive about their potential recommendation of the app also valued more highly the ocean vocabulary⁵ and exploration activities.⁶ Those with a weaker recommendation valued less highly the vocabulary and exploration activities.

The following are other features parents suggested for this section:

Ideas for games and at home activities to reinforce the concepts learned in the app would be nice.

The questions asked were not very relevant to us at home.

Perhaps some links to other apps or websites where the child and parents can explore the topics on a deeper level.

⁵ $r_s(23) = .54, p = .006$ two-tailed. Parents' ratings of recommending the app and value of ocean vocabulary are significantly correlated.

⁶ $r_s(23) = .55, p = .004$ two-tailed. Parents' ratings of recommending the app and value of exploration activities are significantly correlated.

More links to information about specific creatures or ocean vocabulary? Suggestions of games to play with my child that are related to the content. Suggested books to read re: specific animals or ocean features.

I would like to see links to the websites of the best marine laboratories and/or marine wildlife sanctuaries in the world -Mote Marine Sanctuary comes to mind - give families a sense of where they can take their children to see ecologically sound/responsible aquariums/sanctuaries/laboratories.

Perhaps some video; the link to the National Geographic for Little Kids site did not offer much interactivity or engaging user experience. We clicked on the link, then clicked on one, the dolphin maze, expecting interactivity. She was a little frustrated to find none.

Follow the outline of external resources provided by the Magic Tree House Companion Research Guides, which list Books, Museums, Videos, CDs, Websites and ways that parents can use the resources.

Child parent quiz game with pictures and video integrated.

Animations that illustrate the creation of the various concepts described in the "Ocean vocabulary."

I think there should be more graphics.

Better defined goals.

I don't usually read these sections in apps, so I can't think of anything that I would add to it.

DISCUSSION

National Geographic Kids' app, *Marine Missions*, was very appealing to the 25 five-year old evaluation participants. After playing under the eye of a parent, most children spontaneously played the app at least a few more times at home. Eight of ten children liked the app "a lot," and a majority of children gave the highest appeal ratings for each of the activities and the character Jacques.

Players liked the crab Jacques because he is funny or fun or because of the way he looks and acts; however, they sometimes were impatient and frustrated when his instructions held up their game play. No child or parent noticed that touching the <skip> button would eliminate Jacques' verbal instructions. Some players also became annoyed by Jacques' repetitious comments during the cleanup missions.

Creature builder was a very popular activity, with almost nine out of ten children indicating they liked it a lot. All children understood the functionality of the creature builder activity, although a few players had difficulty successfully holding the wand over an item long enough to activate the info box. All children had saved a creature that they had built, but a few children reported not knowing where to look on the iPad for the saved photo. Almost all children reported using the wand that gave animal facts, and one-fifth of the sample recalled specific facts when asked what

they learned about ocean animals. Parents also valued the wand's information, with one-third noting that their children had learned about sea creatures from playing *Marine Missions*.

Eight of ten children liked the blowhole mission a lot. Although a bit physically challenging for some players, all children understood how to play. Many imitated Jacques' comments while playing and laughed at his behavior. A majority recalled the term "blowhole" and could describe the water shooting up, with an additional quarter of players recalling that the water is trapped in underground caves.

Seven of ten children also liked the tidal bore mission a lot. The children understood how to play, and with repeated play, they tended to develop their own technique for moving Jacques to avoid obstacles. Most children could describe the water action of the tidal bore as a wave or waves but only 16% recalled the name for this type of water.

Similarly, seven of ten children liked the cleanup mission a lot. The children understood how to play the game and often tried to increase their cleanup speed with each repetition. The children did not have difficulty playing the game, although a few swiped the oil spill vertically rather than horizontally. A few players also expressed irritation with Jacques' recurring instruction to collect only trash. The cleanup missions, of which there were three, showed the strongest influence on learning: asked what they learned about the ocean from playing *Marine Missions*, a majority explained that the ocean needs to be cleaned of trash to be healthy; asked what they learned about animals in the ocean, three of ten children reported that animals need a clean healthy ocean to live in. A large majority of parents also reported that their child gained knowledge about recycling and cleaning up trash in the ocean.

The whirlpool mission was enjoyed a lot by two-thirds of the children and was rated more highly by those who played the app more frequently after their initial exposure with their parent. All children understood how to play the game. Almost all of the children could describe the water action in this mission, and half recalled the whirlpool name.

Although visually the app map and Jacques' boat movement implies that all oceans are connected to each other as one big ocean, Jacques' verbal naming of oceans gives support to the idea that there is more than one ocean. Three-quarters of the children reported that there is more than one ocean, and one-quarter concluded that the oceans are connected to each other, making one big ocean.

Two-thirds of parents felt that their child was "very" engaged when playing the app the first time through. Six of ten parents were "very" or "moderately" likely to recommend *Marine Missions* to other parents. Those who most strongly recommended the app felt it was fun and informative. Those with a weaker recommendation felt the app was not sufficiently engaging for repeat play or was geared to children younger than their five-year old. Finally, parents' recommendation of the app was significantly influenced by their child's gender, as the majority of parents, mostly parents of girls, were either "very" or "moderately" likely to recommend the free iPad app to other parents.