Developing a Questionnaire with the Intent of Measuring User Experience in Test Trials of Low-Cost Virtual Reality

by
Andrew McUne

A THESIS

submitted to

Oregon State University

Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Arts in Digital Communication Arts
(Honors Associate)

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AN ABSTRACT OF THE THESIS OF

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Abstract approved:_____

William Loges

This paper details the development and pre-testing of a questionnaire designed for assessing the user experience of a View-Master virtual reality headset, and discusses the theory in the field of user experience used to carry out that effort. A group of eight researchers drafted the questionnaire collectively, with the intent to understand the improvements that could be undertaken on a piece of technology based on either the acclaim or disdain of a user. 51 respondents participated in our trials and survey. Analysis of the resulting data shows significant evidence that those who value interactivity are also more open to using non-native apps in a VR headset, and that men are more willing than women to be seen using the View-Master VR viewer in public.

Key Words: Virtual reality, user experience, survey, questionnaire, sociology

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I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

_____

Andrew McUne, Author

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Thesis Statement

The goal of this thesis is to 1) draft a printed questionnaire, designed for the measurement of user satisfaction, that would be considered both highly valid and highly reliable; 2) to pre-test that questionnaire in an effort to analyze the questionnaire's validity and reliability; 3) to write a report containing that analysis; and 4) to write a follow-up synthesis and evaluation of the questionnaire, and commence the effort to improve it.

Introduction

The medium of virtual reality (VR) has evolved considerably in the past decade, from what many considered to be a gimmick on the fringe of gaming technology to a point of competition between some of the largest technology brands we know. Unveilings and updates of new VR projects are now key features in most technology conventions. Attempts to market VR technology in its early stages to the public were limited in their success due to cost and lack of portability, among other things, but with the recent upswing in VR product development (including social networking company Facebook buying startup Oculus VR for $2 billion) (Solomon, 2014), it is now necessary for numerous questions to be answered. What is it about VR technology that is appealing to consumers? What features or applications would be the most important for corporations to market? What are the potential educational or entertaining uses for the technology that the average person would recognize?

What aspects of a VR experience would some consider to be uncomfortable or awkward? A valid and reliable questionnaire that asks respondents about their experience with VR would be valuable.

This paper details the effort to create that questionnaire, which was undertaken by eight undergraduate researchers under the direction of William E. Loges, PhD. It reviews research standards in drafting questionnaires, descriptions of the intentions of the researchers, the process by which core concepts were decided upon and then defined, the methodology and the materials used in the project, the pre-testing of the questionnaire model, the points of the questionnaire which were considered to be particularly successful and particularly unsuccessful, respectively, and potential improvements and future research. The original project report is also attached to the latter end of this paper, as Appendix C.

Theory and Precedents

Defining User Experience

The evaluation of user experience is essential to successful commerce, and has been since the beginning of the public marketplace. At the most basic level of business, the action of willfully entering into a transaction implies that there is some kind of measurable benefit to be accrued by each party that is involved. If a vendor wishes for such profitable transactions to continue, or for more transactions with other customers to be initiated through the initial customer's referrals, some amount

of satisfaction on the part of the buyer would have to be ensured. However, there is more to selling or marketing a product successfully than can be done by measuring reactive statistics or testimonials. Preliminary investigation into the desires of a potential consumer can answer many questions that follow-up assessment cannot, including some questions or ideas that follow-up assessment or isolated research and development may not even raise. User experience, as discussed by Marc Hassenzahl and Noam Tractinsky (2006), has been considered difficult to define due to its inconspicuousness in academic journals and the general absence of empirical research on the subject. However, in their aggregation of available research, they define user experience as "a user's internal state…, the characteristics of the designed system… and the context within which the interaction occurs" (p. 95). Hassenzahl, in another paper (2011), states that he focuses on *experiences* as "meaningful, personally encountered events," events that gain significance as they are recalled from memory (www.interaction-design.org). That memory should be instructive. What does the user consider to be positive about the experience, and what does he consider not to be? What was enjoyed? What about the experience was unique, that would bring a user back?

Difference in cultural background is one of the variables in one's reception of an object or event, as described by Aaron Marcus in his publication of "Cross-Cultural User-Experience Design" (2006). The way that one perceives details, such as uses of color and script in product design, is greatly influenced by the trends

of the community or country in which one lives. The common connotations of those design colors in a user's home country, for example, may positively or negatively affect a potential user's intent to participate. For example, in a commercial setting, a potential user from Great Britain may choose to purchase a piece of clothing for its purple design, due to the color purple's local association with royalty and great wealth (Melina, 2011). However, another potential user from Thailand might turn away from that same item, due to purple being a color that most Thai citizens don when mourning the loss of a loved one (Girard, 2016). Marcus, basing much of his analysis on the theoretical model of Geert Hofstede (1997), also details other circumstances that have effects on the way that potential users from certain cultures perceive an object or event. These include family makeup, fluidity or rigidity of gender roles, local tendency to avoid uncertainty, and even a country's centralization of power.

An effort to come to a consensus among experts on the definition of user experience was detailed by Effie Law et al. (2008), involving an electronic questionnaire that was administered to participants of a conference. They note one of the most basic problems with finding the correct definition–that user experience is a concept in many different fields, most of them with very little in common. It is also related to a large list of widely varying qualities, "including emotional, affective, experiential, hedonic, and aesthetic variables," some of which are always either deemphasized or ignored in any study focusing on a specific subject (p. 2396).

Various models of theory also exist, which can conflict with each other on basic levels; this was something that Marcus also acknowledged in his treatment of the work of Hofstede. Therein lies much of the issue.

Notably, the government of the United States of America hosts a website that details the importance of investigating usability (www.usability.gov, 2014). Relating the theory presented by Peter Morville (Morville, 2016), an emphasis is placed on what the creator of content can do to make positive reception more likely, or to convince a consumer that an object or event is *valuable*. Morville provides six criteria; a creator must make the content "useful," "usable," "desirable," "findable," "accessible," and "credible" (Morville). These six points were integral to the design of our project. The usability.gov website also lists a number of professional disciplines that have been either adapted to or born from user experience in human-computer interaction, such as information architecture, user interface design, web analytics, and accessibility for the disabled.

In particular, the importance of a user's experience to creators in new media technology has been paramount throughout the past century. Whether the content is visual or aural, analog or digital, creators have been considering the potential reception of their offerings with more intensity in every generation. Building a potential experience for a future user of a technology is so important that John McCarthy and Peter Wright argue in their paper "Technology as Experience" that technology should actually be considered *as* experience itself, and not just as a

catalyst or an instigator (2004). They posit that an experience is woven together from four “threads”; the compositional, the sensual, the emotional, and the spatio-temporal. The compositional thread comprises concepts like structure, narrative, and consequence, and considers how “the elements of an experience fit together to form a coherent whole” (p. 42). The sensual thread is concerned with design, texture, temperature, and other things that are seen or felt at first contact. The emotional thread entails the user’s potential span of judgment of value, as well as prioritization of future experiences. Finally, the spatio-temporal thread is concerned with the user’s perception of space and time while immersed in the experience.

McCarthy and Wright (2004) have also set forth a written series of processes that users engage in each time they encounter an experience, which is additionally useful in drafting a method of user experience investigation. Those six processes include “anticipating” the experience, “connecting” to an experience with initial impressions of it, “interpreting” what is happening mid-experience, “reflecting” on questions and emotions that the experience invokes, “appropriating” how this experience will fit into one’s world view, and “recounting” that experience to oneself or to others at a future time (p. 43). Considering these processes in the mind of a user would be nothing less than intuitive when investigating experience with a technology as visceral as VR, and these themes were present throughout our research.

Virtual Reality

Defining Virtual Reality

VR, at its most basic level, is an immersive artificial environment. It involves placing a user in an illustrated or digitally manipulated space, in a manner that is heavily interactive and typically involves the use of several different media, for both the user's reception and the user's input. The methods of input in each VR experience differ slightly depending on the creator of the system, but a VR headset that completely occupies the user's visual field is a constant throughout the VR market. Thus, a user is not generally able to focus on the objects immediately around him or her in actual reality, because his or her eyesight is being occupied by an encompassing curated environment that commands his or her attention. This distinguishes VR from a similar headset-based technology, called *augmented reality* (AR), which does not establish a completely artificial environment, but instead integrates digital elements and opportunities into the user's actual reality. Today, VR is universally digital, but mechanical forerunners of VR and VR head-mounted displays have existed since the days of penny arcades.

As a doctoral student at Stanford University in 1992, Jonathan Steuer made the case against VR being another "medium," as the radio or the television are often characterized. He argues that VR is not a singularity in technology but rather "a collection of machines" (Steuer, 1992, p. 73). He also points out that creating a strict

technological definition of VR would imply VR systems to be more standardized in their aggregation of input methods and capabilities for interactivity than they are. Thus, he considers the definition of VR to be "a real or simulated environment in which a perceiver experiences *telepresence*" (pp. 76-77). He defines telepresence to be "the experience of presence in an environment by means of a communication medium" (p. 76). (It can be inferred that these definitions were written before the distinction between VR and AR was made.)

Use in Entertainment

The motivation to develop VR technology in recent years can largely be attributed to the entertainment industry. The Oculus Rift headset system, one of the leaders in the recent VR upswing and currently one of the more popular models in the industry, marketed their product specifically to video game developers in their original crowdfund-related press release. A quote in the press release attributed to Palmer Lucky, then the CEO of Oculus VR, reads: "The Oculus Rift is a true game changer that will help make VR the standard for gameplay in the very near future," and later, "We know the gaming community will be as excited as we all are when they get their hands on it" (Schumacher and Redner, 2012). The Sony PlayStation VR was designed to cater to the same demographic of software developers, as was the HTC Vive. However, the connection between virtual reality and entertainment is not a new one; just a few of the electronic game companies competing to develop their

own VR headset projects as early as 1993 include Nintendo, Sega and VictorMaxx (Edwards, 2017; Hill, 2014; Worley and Chamberlain, 1994).

Use in Education

Much like notebook and tablet computers, VR headsets are also being considered for educational use in schools. For young children, virtual field trips are an increasingly popular draw (edu.google.com), allowing them to see world landmarks, marine wildlife, and even bodies of the solar system up close (Krause, 2017). Interactive adaptations of popular children's literature are also possible, as are workspaces for creating digital art projects. Students in some classrooms have been given the freedom to build and structure their own study tools in a virtual setting, and reports from their teachers have indicated great enthusiasm for the exercise (Krause, 2016). One study in Romania tested the use of augmented reality in the teaching of chemistry to children, and the authors described the children as considering the system to be "attractive, stimulating, and exciting" (Pribeanu and Iordache, 2008).

Other Uses

Use of VR technology is also being documented in other fields. Architects have been able to use virtual reality to communicate their designs with a much smaller amount of error than is possible with other media (Corke, 2017). Medical professionals can train others and themselves be trained in a simulated hospital setting

(Powell, 2017). Stroke victims who have taken part in VR-based treatment have been shown in one study to have better improved upper limb motor function compared to those who took part in treatment without VR elements (Turolla et al., 2013). Military exercises are simulated in detail, including combat jumps visualized in headsets and felt with body harnesses built to evoke the same physical stresses expected from real jumps (Nye, 2017). The Institute for Creative Technologies at the University of Southern California has been operating a VR project dedicated to treating post-traumatic stress, guided by professionals, since the year 2005, which is available to any licensed clinicians who wish to use it (Rizzo and Hartholt, 2005). These are just some of the uses that VR has already been put to.

High-End VR vs Accessible VR

Some of the most popular VR systems have already been mentioned in this paper; the HTC Vive, the Sony PlayStation VR and the Oculus Rift are some of the best-selling systems in the industry, in addition to Samsung Gear VR. However, these systems all run their own operating systems, whether they operate alone or attached to another piece of hardware, which means that there is a level of exclusivity to the wares that are available for each system. In addition, popular VR systems are often expensive, with some headset-and-computer combinations approaching the four-digit price range (Leswing, 2017). To provide an alternative to consumers, other technology companies have created VR systems, typically working in tandem with a

smartphone, that cost less money up front. Google Cardboard is one of the most popular kinds of inexpensive VR software. It requires a smartphone to operate, but variants of the headset that would house the smartphone can be purchased for less than $20, and instructions can also be found online for users to craft their own headsets from cardboard and other spare parts. The View-Master Virtual Reality Viewer is an example of a viewer that was built to be compatible with Google Cardboard VR, in addition to its own smartphone applications, and was chosen for this project specifically because it is a type of VR headset that would be easily accessible to a majority of potential respondents.

Drafting a Questionnaire

What Researchers Must Remember

All elements of a survey should relate to its purpose for being conducted. Arlene Fink, in the Survey Kit manual *How to Ask Survey Questions*, says that "a survey's purpose, surveyors, and respondents… must be fully understood before you begin to write questions," and that a researcher should identify the questionnaire's specific purposes to the respondent first, before any other objective is achieved (Fink, 1995, page 6). Fink also advises researchers to standardize both the surveyor and the response format. For our research team, we had expected since the beginning to undertake individual trials of the VR headset with respondents, with researchers attending to trials in pairs or small groups; that meant it was necessary to plan our

method of conducting trials in a detailed manner, for fear of respondents receiving different instructions from different researchers and having our findings spoiled. The instruction about standardization is in accord with many other instructions from Fink, including avoiding slang and jargon, biasing words, two-edged questions, and negative questions; using complete sentences and avoiding abbreviations; and remembering that "questions are asked in a social, cultural, and economic context" (Fink, p. 17).

Laugwitz, Held, and Schrepp (2008), in "Construction and Evaluation of a User Experience Questionnaire," opine that disseminating questionnaires is a method of research that is used over other methods because of its efficiency, and as such, they emphasize the importance of maintaining that efficiency in questionnaire design. They said:

> The user should be enabled to give his rating about the product as immediately and spontaneously as possible. A deeper rational analysis should be avoided. The questionnaire should not force the user to make abstract statements about the interaction experience or remember details that are likely to be forgotten or had been overlooked in the first place. An explicit evaluation demanded by the user retrospectively is not always reliable… This is supported by results where differently colored UIs affected users' feelings differently (e.g.

> as measured with a mood questionnaire), while this difference was not reflected by users' answers on questions regarding the UI quality.
>
> Experts are able to evaluate user interfaces in detail…. A user questionnaire can lay its emphasis on criteria which are accessible immediately: the user's subjective perception of product features and their immediate impact on the user him/herself. (p. 65)

On the very first written page of another manual from The Survey Kit, *How to Design Surveys*, Arlene Fink described what features made for a successful and direct questionnaire: "Specific, measurable objectives, sound research design (the design of the survey environment), sound choice of population or sample, reliable (consistent) and valid (accurate) instruments, appropriate analysis, and accurate reporting of survey results" (Fink, 1995, p. 1) She subsequently took some pages to describe, as many researchers do, the values of *reliability* and *validity*, and their places in developing research surveys. Both of these values are crucial to the success of a survey, and warrant some basic description before our project is discussed.

Reliability and Validity

Edward G. Carmines and Richard A. Zeller define *reliability* as the "tendency toward consistency found in repeated measurements of the same phenomenon" (Carmines and Zeller, 2008). They note that human measurement completely devoid

of error is nonexistent in science, so they consider reliability not to be a dichotomous attribute describing an experiment's perfection or lack thereof, but rather as a value that allows for variance. Experiments can have high reliability or low reliability–the greater the consistency of the results of repeated trials, the higher the reliability.

There are various types of reliability measures that researchers can undertake in designing their experiments, and Mark S. Litwin describes them in his Survey Kit manual *How to Measure Survey Reliability and Validity*. The first method, test-retest reliability, is measured by testing the same experiment with the same group of respondents at two different times, after which the responses are compared against each other and the correlation coefficients are calculated. Second, alternate-form reliability is the practice of drafting two differently-worded questions that are intended to produce the same answer, or organizing already-existing questions in a different manner, and then applying the two versions of the prompt(s) in separate tests of a questionnaire to ascertain whether the response would still be the same. The third method is called internal consistency reliability, and it involves including multiple items in a questionnaire that measure the same variable and provide a scale of data about that variable; an example might be a series of eight questions about which foods a respondent prefers to eat, rather than a simpler single question that asks whether the responded feels that his or her food preferences are healthy. Finally, interobserver reliability is the practice of multiple trial conductors measuring the

same variable from the same respondent. Litwin asserts this to be common in inquiries such as patient examinations by radiologists and other doctors.

Validity is the measure of how successfully an experiment measures a variable. It is equally as important as reliability. “Once you document that a scale is reliable over time and in alternate forms,” Litwin says, “you must then make sure that it is reliably measuring the truth” (p. 33). Carmines and Zeller (2008) also wrote that “strictly speaking, one does not assess the validity of an indicator but rather the use to which it is being put” (p. 12). Validity is not a value in which a certain question or item on a survey will always be considered appropriate in any situation. Items that are intended to determine a certain kind of variable may work when concerning one type of topic, and may not work when concerning another. Validity also is not dichotomous; like reliability, an item’s measure of validity can vary greatly.

Litwin makes mention of several methods used to measure the validity of surveying tools in *How to Measure Survey Reliability and Validity.* The first of these is face validity, which involves soliciting basic opinions on the potential effectiveness of a questionnaire from persons who are not necessarily professional, and is described by Litwin as “much more casual” (p. 35). Second is content validity, which is measured by persons who possess quantifiable knowledge on a survey’s topic, and consists of their judgments as to whether it is sufficient in its efforts to treat the topic or is in some way incomplete. Concurrent criterion validity consists of comparing one surveying tool to another surveying tool, such as an index or test, which is

well-known and has already been accredited and validated by the research community for investigating the same question. Concurrent predictive validity is the measure of success that a survey instrument has in being able to "forecast" future behaviors, events, or outcomes. (p. 40.) Convergent construct validity, which as Litwin acknowledges is closely related to alternate-form reliability, is validity based in multiple kinds of research processes or inquiries being able to obtain the same information, generally over a long span of time. Lastly, divergent construct validity, which is also demonstrated over a long period of time, is present in surveying tools which show data that is distinctly different from data found through using similar yet different surveying tools.

This concludes the theory and precedents portion of this paper. This description of other works and writings concerning user experience, VR, and drafting questionnaires has been intended to frame the description of our research team's project below, and to assist in judging its merits and success. As researchers, much time was spent in evaluating potential subjects of research, and the study of VR was selected because we perceive it to be meaningful, and do not expect problems or misunderstandings associated with it to go away. We also elected to host the trials of a VR headset with respondents in person, because it is not reasonable to expect people to accurately answer specific questions about this in their home. Researchers need to be present, and the trials need to be controlled.

Discussion of the Project

Framework/Beginning of the Class

The setting for this research was a course at the undergraduate level at Oregon State University, for students receiving a degree in Digital Communication Arts. The course was created to facilitate student development of a collaborative capstone project, and while the type of research project has varied depending on the professor that leads it, the research project for any incarnation of the class must be decided upon, designed, carried out, and reported on within a ten-week time frame. Participation of a certain amount of students is also necessary, in order to have enough researchers to accomplish the tasks required in the ten weeks. Eight students participated in the class, which was less than desirable, but sufficient for a manageable distribution of responsibilities. The idea to develop a questionnaire to determine the user experience of an object or event was presented by Dr. Loges at the beginning of the ten-week term, and then it was given to the students to create the project.

Decision to Work on Mattel's View-Master

The decision to write a survey concerning user experience with Mattel's View-Master Virtual Reality Viewer came quickly. We knew as a research team that if we were able to pretest the questionnaire we would design within the short time we had available, we would have to draw upon the local student population as a source of

respondents. This meant that the technology the survey inquired about would have to be readily available to such a population, and its diversity in geographic and financial background. In addition, the technology would ideally have large potential for future innovation, and by dedicating our project to such an object or event, we would maximize the usefulness of the project. Studying virtual reality was agreed upon, and upon further discussion of accessible variants of virtual reality, we decided to investigate Mattel's View-Master Virtual Reality Viewer. Mattel's VR viewer was new on the market, having been released in the last quarter of 2015, and at its time of release, the viewer hardware could be purchased by a smartphone owner for the price of $30 (Limer, 2015). Notably, by the time our research commenced (a little more than a year after the release date), the price of the viewer hardware had actually been lowered to $20, which if anything would increase its accessibility.

Description of the View-Master

The introductory pages of the original research report that our research team released contains a substantive description of the View-Master Virtual Reality Viewer and its hardware, as well as the brand View-Master and what it has meant to the public up to the present point. Each of these are important to understand when investigating user perception of a technology, and our report sought to describe them as clearly as possible. Herein, I will quote from the report at length.

The View-Master Virtual Reality Viewer is a smartphone-enabled virtual reality (VR) headset, currently sold by the toy manufacturing company Mattel. When used in conjunction with a properly equipped smartphone, it allows for the participation of the user in immersive 3D viewing of VR. The headset is made of hard plastic with a wide tinted visor on the front and hard rubber protruding from the back surrounding the two convex lenses in order to accommodate face shape *(See Fig. 1)*. Sound from the smartphone is able to filter out from the unit via the small slats at the bottom corners of the face of the unit that contains the eyepieces. A clasp on the top unlatches to allow the viewer to swing open, revealing the other side of the lenses, a dedicated three-prong clamp for the user's smartphone, and an additional plastic brace to fit into the clamp if the smartphone has a smaller body *(See Fig. 2)*. The body of the headset is red, and when closed, only features one point of input to manipulate the smartphone inside: a large, orange trigger, which protrudes from unit near the right side of the user's face. A wrist strap is also attached to the unit, on the bottom, near the sound slats.

Fig. 1 - The Mattel View-Master VR Viewer (Closed Unit) Sridhar, S. (2016, March 1). Google Store starts selling View-Master and C1-Glass Cardboard VR Viewers. Retrieved March 23, 2017, from http://www.fonearena.com/blog/176707/google-store-starts-selling-view-master-and-c1-glass-cardboard-vr-viewers.html

Fig. 2 - The Mattel View-Master VR Viewer (Open Unit, Containing Smartphone) G. (2016, February 06). Apple now sells the View-Master VR through its own stores. Retrieved March 23, 2017, from http://www.gsmarena.com/apple_now_sells_the_viewmaster_vr_starter_pack_through_its_own_stores-blog-16483.php

The View-Master is packaged in a cardboard box, with the top of the box extending into an additional cardboard panel that folds over the front, with two attached dog-ear flaps that are inserted into the seams on the sides of the box. When the box is opened, by pulling the panel out and up from the body of the box, the View-Master is immediately visible underneath a thin plastic mold. The cardboard

panel that was also immediately above the View-Master, before it was lifted away, features a graphic that instructs the consumer concerning the enabling of the View-Master's use with a smartphone. When the first plastic mold is discarded and the View-Master unit is removed, a booklet of instructions can be found pressed against the back of the box by remaining plastic. The box also contains a separate object called the Preview Reel, which is a plastic disc with fourteen spaces on its face. This object is intended to be placed on a flat surface near the user of the headset, and then to be a visual reference point for that headset during use; the person using the View-Master can look directly at the Preview Reel laying flat on a table nearby, and the disc will prompt an appropriate menu for the user to navigate, depending on the nature of his current use. (...).

Some consumers are likely to know the name of View-Master from stereoscopic viewers that have been sold in the past, by Mattel and by others. Since the 1930s, View-Master has been the trademarked name of successive models of handheld stereoscopic dual-lens film strip viewers. These viewers accepted native film strips into the main unit via a slot in front of the eyepieces. These film strips being distributed in the form of circular pieces of paperboard containing seven two-panel sets of negatives. These paperboard circles were

called “reels”, and the Preview Reel pays very obvious homage to these reels in both its shape and size.

Description of Software

The VR that is enabled through the View-Master is comprised of both artificial environments made from computer-generated imagery and edited footage of actual environments, the latter of which is more often known as augmented reality. The most heavily advertised uses of the viewer involve dedicated smartphone apps published by Mattel; one app houses a National Geographic-branded environment featuring Earth in the time of dinosaurs, and another app contains an underwater exhibition of sharks and other sea creatures, courtesy of Discovery. More official View-Master apps have been released since the headset’s initial public release, including one sponsored by the Smithsonian Museum, and others of a more immediately fictitious nature, such as *Batman* and Mattel’s own *Masters of the Universe*.

The device is not limited to the use of native apps developed by Mattel. The View-Master VR Viewer was created as a joint collaboration between Mattel and the technology company of Google as an implement for Google Cardboard, the company’s virtual reality

> platform. As such, any Cardboard-based applications available in online smartphone markets can be freely used with the viewer, as well as standard smartphone applications that contain Cardboard-dedicated content, such as YouTube.

Values Used to Build the Survey

To compartmentalize the questions in our survey, we set out to define a set of values as an initial guide for writing, and also to organize data when we collected it. Each and every one of these values needed to be meaningful to the user of the View-Master in a distinct and describable way. Most of them do have ties to other values, however, as user experience is itself an interplay among many different sensations and feelings. After reflecting on the twenty values of usability put forth by the usability.gov website (2014), eight distinct values were chosen, either directly from the government list or as an amalgamation of several. These values are: portability, durability, comfort, simplicity, interactivity, desirability, versatility, and emotion. Full definitions were written or cited by the research team in the report, and they can be found on pages 68–72 of Appendix C, but I will also summarize them here.

Portability is a value that has been considered in the development of most handheld electronic games or media. If it is easy or convenient to transport this object from point A to point B, and still be able to use it at point B for what is intended, then

one would consider the device to be portable. That value would also increase if the object could be conveniently used in the very transit between the two points; for example, parents wishing to keep their children occupied during a long car ride would value an object's in-transit portability quite highly.

The proverbial question, "Will it last?" concerns the value of *durability.* What should be the expected lifetime, so to speak, of an object? How sturdy is the construction of this object? Will the material degrade over time? How well would the object handle a drop, or some accidental blunt force? What effects could be expected from extreme temperatures? Might any seams, hinges, or clasps in an object wear down before the rest of it would? At the given market price for this object, and others like it, how long would a user expect the object to last in good condition? Answers to these questions all relate to how much distress an object such as the View-Master VR viewer can endure.

The measure of *comfort* embodies the physical ramifications of using an object. Does it feel satisfying to use? What part of the body of a user, if any, is strained or in danger of being injured during use? What part of the object causes that distress? In our discussions of what would elicit feelings of discomfort with the View-Master VR viewer, some researchers pointed out that the headset has no head strap. A head strap is an integrated feature of most popular VR headset models, so a user could use the headset without having to continuously hold the headset up to his or her face with both hands. The discomfort of holding a headset up to your face for a

long period of time may be a detractor from using the technology for some respondents, and our research team made note of this early in our drafting sessions.

Simplicity is the ability of a user to understand how to use or participate in something with ease. This does not mean that the object should be simple in its construction or in its programming; this value, like the others, is partially dependent on what is in the eye of the beholder. A tablet computer interface is complicated in its build, but also easy to approach because of minimal external buttons and the intuitiveness of a touch-screen. Simplicity tends to appeal to most demographics of customers.

"Interactivity in media refers to the product or service including ways for the user to respond to the media and affect the experience firsthand," according to our research report on page 70. To what degree is a user in control of the experience? What decisions can a user make that enhance or change what is being seen or heard in the VR headset? Accounting for all the potential points of input in a VR-centric system is important in understanding how interactive a program can actually be.

Desirability measures the potential willingness of a user to buy into an object or event. The desirability of a new implementation of technology is not measured from observation of that sole object, but rather from directly or indirectly comparing that technology with an alternative that is also available to the user. Will the View-Master VR viewer appear more desirable than a competing headset to a user who is aware of both? What is this viewer able to do that others cannot? What content

can be used exclusively on it, or used most effectively on it? Financially, how would a user feel about spending the necessary money on this headset instead of a potentially different amount of money for a different headset?

Versatility can be measured by the number of different problems or tasks that the technology in question can assist with or solve. A smartphone is considered quite versatile, for example, because of the many different roles it can play at once, from mobile phone, instant messenger, and email inbox to fitness tracker, video game system, and music player. For a virtual reality headset to also be considered versatile, it should be able to perform multiple tasks or utilize a varied amount of content in a similar manner.

Emotion is the feeling or mood that the user experiences during or after the session of interaction with the object. Feelings that users identify include happiness, satisfaction, frustration, confusion, fear, peace, and a host of others. The emotion can be caused either by the content being conveyed through the technology or by the technology's interface itself. Variance in emotion can also be expected depending on whether the user is participating in the technology alone or with others; the interplay between multiple emotions in a social use of the technology could lessen the intensity of some emotions, and accentuate others.

Drafting and defining these eight values for this research had multiple purposes. It served to ensure that in the research planning stages we would develop a sufficient amount of questions for each aspect of the VR headset and experience that

we wanted to analyze, and that nothing integral would be left out. It also provided a method to organize the data that was collected from the responses to the questionnaires. The resulting codebook can be seen in Appendix B of this paper.

Methods

Respondents were drawn from a class of students in a New Media Communication course at Oregon State University, taught by Daniel Faltesek, PhD. Two of our researchers were allowed to enter the classroom and announced the pending research to the students, at which point a schedule of available trial times (in blocks of 30 minutes) was passed to each student in the room. Students were told that participating in this research would be allowed by the professor as an alternative project to one that would be assigned in class. Those who wished to participate were instructed to sign their name to a spot on the schedule, and told to appear at the appropriate location.

Questions on the survey were organized according to their response type. Questions 1 through 10 are nominal and dichotomous, with the only possible answers to them being “Yes” and “No.” Question 11 is an interval question, with five possible answers. Questions 12 through 24 are also interval questions, which are arranged in a table with their potential responses organized into a five-point Likert scale (McLeod, 2008). Questions 25 through 29 had varying numbers of potential responses, with instructions that tell the respondent to “check all that apply.” Each potential response

for each item was coded as a dichotomous point of data, which amounted to 25 points of data in total from those five questions. Questions 30 through 34 were nominal and dichotomous. Question 35 was open, but coded as dichotomous. Questions 36, 37, and 38 are each nominal, with a varying amount of potential responses. Finally, two additional points of data were entered for each respondent's survey; whether the participant was male or female, and whether the participant was wearing glasses or not.

At the trial location, two researchers sat at one table, and a respondent would be instructed to sit at another table. At the respondent's table, all of the components of a packaged View-Master Virtual Reality Viewer could be found, including the packaging itself. A compatible smartphone owned by one of the researchers would be inserted in the VR viewer, with a free demo version of the View-Master® Discovery Underwater app already loaded on-screen. The respondent would be told to use the application, and to stop either when he or she did not feel inclined to continue or when the demo ended. After indicating that he or she was finished, a researcher would give the respondent a copy of the survey and allow him or her to complete it at the table. Upon finishing the survey, the researcher would receive it from the respondent and give the respondent a final sheet of paper containing a list of prompts for his or her class assignment, from that respondent's professor. The trial would then be considered over, and no further contact would be made with the respondent. The only personal information kept by the researchers about the respondents was a list of

their student ID numbers, to document to their professor that they had indeed completed the task. That list was destroyed upon completion of the research. 20 potential respondents who had signed for trials failed to attend them, but several others who missed their trials contacted us and successfully rescheduled. The data from those rescheduled trials have been included with the data from the rest of the trials.

Data was entered into an online-hosted spreadsheet. The rows of the spreadsheet represented the respondents (respondent 1 through 51), and the columns represented each point of data that could be garnered from the questionnaire. This spreadsheet was then downloaded and imported into SPSS Statistics for data analysis. The choice to use SPSS was made by Dr. Loges; it has been a long-standing program in statistics, and it is the program in which he has experience. SPSS is a predecessor to PASW Statistics 18. It was not a software choice that was made for fear that other statistics software would somehow draw any alternate conclusions from our data. The calculations that were also made in this data analysis were simple, and there should not have been any differences between analyses based in SPSS or analyses from any other statistics calculations program.

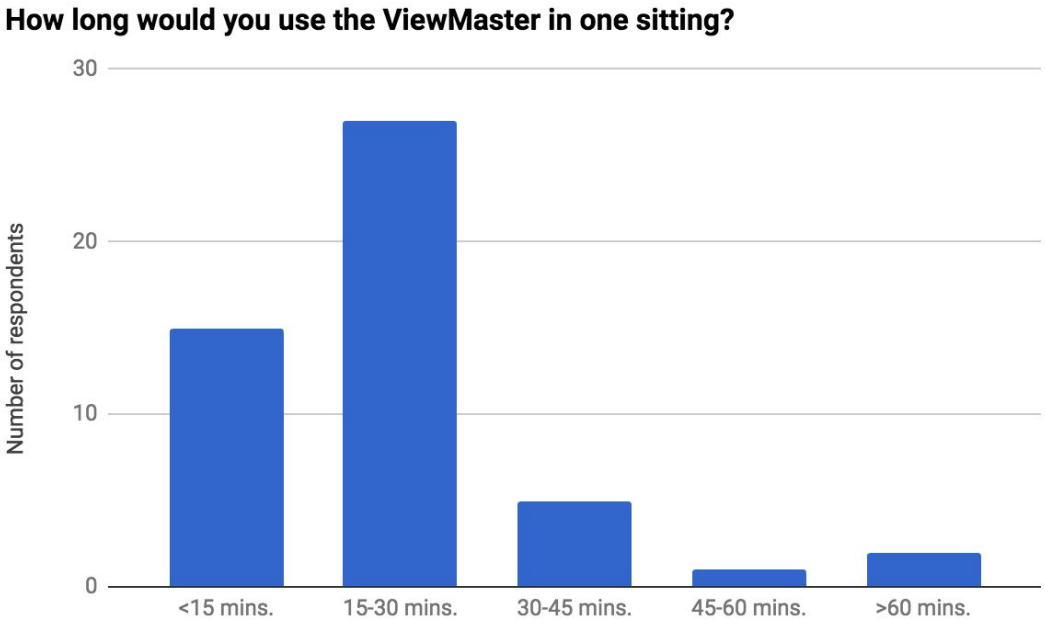
Results

1. Hypothesis: Students who have a higher class standing, and have been in media studies longer, are more open to additional uses of the View-Master.
    a. *VER MoreApps v. Class Standing:* Not statistically significant. Class standing of respondents was found irrelevant when considering their visualization of the View-Master being used for more apps than demonstrated.
    b. *VER TeachMath, TeachEnglish:* **Statistically significant. Upperclassmen are more open.** Of the 49 respondents who indicated their answers appropriately, 12 of 27 upperclassmen said that the View-Master could be used to teach mathematics ($X^2 = 3.8$, d.f. = 1, p. = .05), and 11 of 27 upperclassmen said that it could be used to teach English ($X^2 = 4.4$, d.f. = 1, $p < .05$). In contrast, only 4 of 22 lowerclassmen said that the View-Master could be utilized to teach math, and 3 of 22 lowerclassmen said that it could be used to teach English. It should be noted, however, that all of these respondents who indicated that the View-Master could teach math or English are in the minority of their respective groups. *(See Fig. 3.)*
    c. *VER TeachScience:* Not statistically significant.
    d. *VER TeachHistory:* Not statistically significant.
    e. *VER TeachArt:* Not statistically significant.

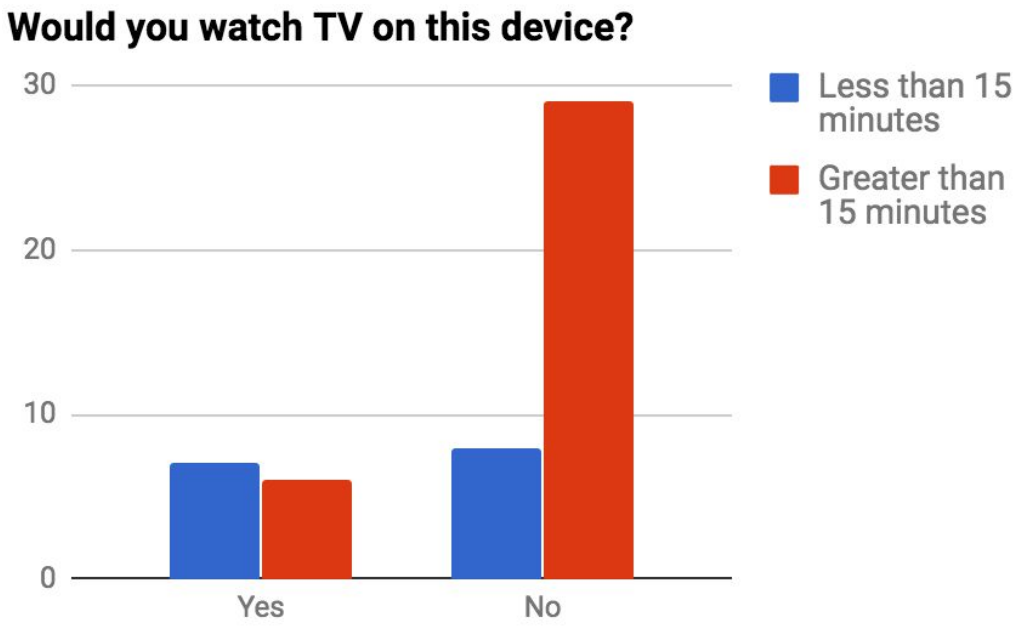
f. *VER Useful, VER Effective:* Not statistically significant.

2. *Durability:* The team of researchers also desired to learn how durable respondents thought the View-Master VR Viewer appeared to be. 76.5% of respondents answered "Yes" to at least one of the items that question durability, which at face value indicates generally low expectations for the View-Master's endurance.
3. *Portability vs. Durability:* The comparison between the values of portability and durability to the respondent is not statistically significant, but evidence exists for a mutually positive relationship between the two. We believe that the lack of real significance in our data is due to our small pool of respondents, and that this relationship should be investigated further with a bigger sample.
4. *The Value of Interactivity v. "Would you use this for more than the included apps?":* **Statistically significant. There is a mutually positive relationship between these two (F = 5.3, d.f. = 1, p. < .05)**.
5. *Gender v. The Value of Desirability:* Not statistically significant.
6. *Gender v. Fad:* Close to statistically significant. Equal numbers of women answered yes and no to the question of whether VR was a fad (12 and 12), but nearly three-fourths of men answered the question in the negative (20 vs. 7).
7. *Sitting Binary v. Watching YouTube:* Not significant.

8. *Sitting Binary v. Watching TV:* **Statistically significant. Those who said that they could sit for longer periods of time also said that they would *not* use the View-Master to watch TV ($X^2 = 4.8$, d.f. = 1, p. < .05)**. 29 of the 35 respondents who indicated that they would use the View-Master for at least 15 minutes at a time also said that they would not use it to watch television. By contrast, 8 of the 15 respondents who would only use the View-Master for bouts smaller than 15 minutes indicated that they would not watch TV on it. This seems to mean that, when considering the 13 respondents who would watch an episode of television on a View-Master, half of them would only watch a fraction of a desired episode before turning the system off. *(See figs. 4-5.)*

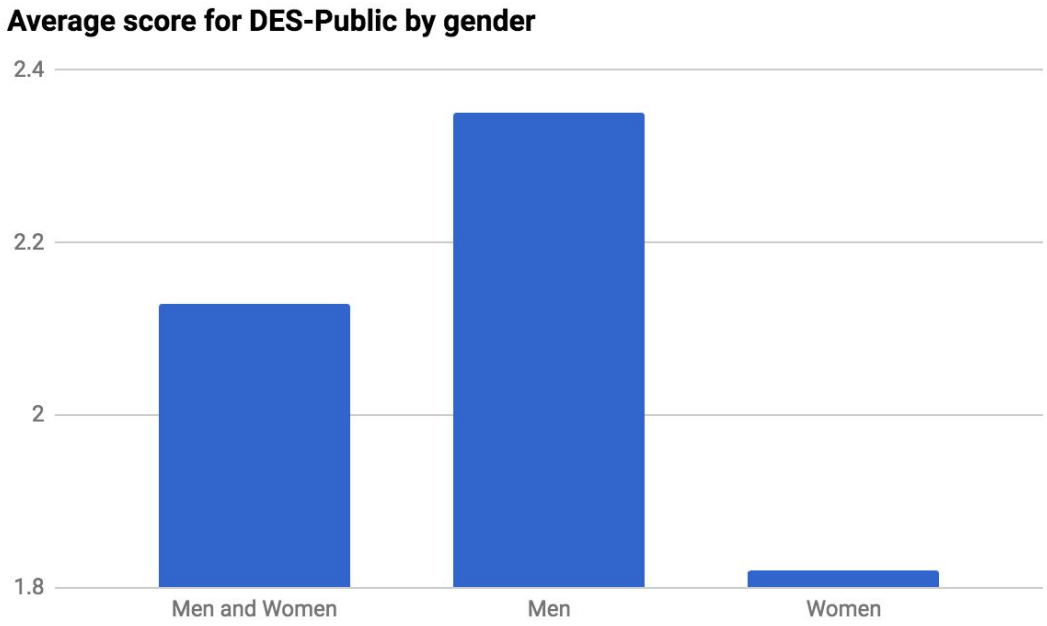


"How long would you use the View-Master in one sitting?" Fig. 4.



"Would you watch TV on this device?" Fig. 5.

9. *Sitting Binary v. Watching a Movie:* Not statistically significant, but trends in the same way as the comparison between sitting and TV.
10. *DES-Public v. Gender:* **Statistically significant. Men are more willing to be seen with this in public than women (F = 4.7, d.f. = 1, p. < .05)**. *(See Fig. 6.)*



Gender of respondents v. willingness to be seen with the View-Master in public. Fig. 6.

Analysis of Project's Level of Success

Effectiveness in Addressing Questionnaire Values

Several questions in the questionnaire asked about the value of portability, and the results of the related data were varied. 23 of the 51 respondents disagreed with the sentiment that the View-Master is easy to carry, which would form the plurality opinion when compared to the 13 respondents who agreed with the sentiment and the 15 who chose neither to agree nor disagree. 26 of 50 measurable respondents indicated that the View-Master would be easy to travel with, which is a bare majority, while 11 disagreed and 13 chose neither to agree nor disagree. A question was also

asked of the respondents as to where they would be willing to take the View-Master. Of 49 respondents, 57% said they would bring it on a road trip and nearly 80% said they would bring it to a friend's house, but only 16% of respondents would bring it to work, 8% would take it to the park, and 6% would bring it to school. 10% of respondents would not take the View-Master anywhere. The results provide an instructive picture of what sorts of places a user would be inclined to use the headset, and by extension, what kind of a social perception they expect peers in those locations to have of their View-Master use.

Many points of data from the trials contribute to our understanding of users' perception of the View-Master's durability. That perception is mixed to negative. Less than 4% thought that the smartphone used with the View-Master was loose inside the headset, but 70% of respondents thought that the headset would break if dropped, and 26% of respondents worried about packing the headset in luggage when traveling. 43% of respondents thought that it was a sturdy unit, with 20% disagreeing and 37% expressing no opinion. However, only 10 of the 51 respondents indicated that either the latch, the interaction, or the smartphone mount were not secure. These durability-related questions provided information that was useful, but also rather basic. Different questions that could be pursued include those about how a user feels the View-Master would handle a specific kind of physical distress, such as excessive or concentrated heat.

Our comfort questions provided the information that was being sought. We

wanted to learn the amount of time for which a user would be willing to use the device, and that was accomplished. We also learned much of the physical strain that can be felt while using the View-Master VR viewer, some of which we did not expect to be as prevalent among users as it was; 26% of the respondents reported feeling dizzy while using the View-Master, and 48% indicated that they had experienced eye strain. With such a high rate of eye strain, especially given that the respondents were using the View-Master for a five-minute timed demonstration, this would be another phenomenon to investigate further, and one for development teams and engineers to address in their designs of future hardware and software as well.

With regards to simplicity, it was asked in the survey whether the user required the instruction manual to successfully use the device, how easy the app(s) were to use, and how confident the user felt in his or her use of the device. Only 8% of users required the manual, and only 6% disagreed with the sentiment of the app(s) being easy to use, compared to the 82% of respondents who agreed. Through these findings, it is evident that navigating the software is not an issue for college students. Testing use of the View-Master with a younger audience would be an ideal next step in the continued research of virtual reality development, especially considering the View-Master's intended demographic of children at an elementary school age.

Levels of response to the questions with a basis in the value of interactivity were positive. Two-thirds of respondents stated that they felt in control of the experience, and 86% agreed or strongly agreed with the statement, "The View-Master

tracked my head movements perfectly." 56% of respondents also found the View-Master Preview Reel helpful in their use of the headset, which is notable for an item which, as far as the demonstration was concerned, was used primarily for menu functions. The trial itself, however, was limited in exploring the potential interactivity available in the View-Master and in Cardboard-native software. Conducting a longer-lasting trial with a deeper application experience, perhaps one oriented in gaming, may provide added perspective for respondents and enrich their feedback to future researchers.

The data concerning the desirability of the View-Master as found from our trials may not be of great import to the company that created it, for the same reason that our measure of simplicity was limited–this product was designed for a different age demographic. Objects of desire that elementary schoolers and undergraduate college students have in common are few and far between. It should be of interest that 65% of respondents indicated that they liked the way the View-Master headset looked, and only 14% indicated that they did not. However, 57% of respondents said that they would not use the View-Master in public. One theory for this is that the respondents for these trials were practically all students of digital communications, and that they would consider this technology to appeal to them more than it would to those in different fields of study. Further investigation of desirability, and of these two figures, would be benefited by a larger sample of respondents who are not all of a discipline relating to digital communications.

Respondents were asked about the versatility of the View-Master specifically because we researchers were seeking their feedback concerning the headset's potential use in education. The mixed responses from our trial participants are reflected in the previous results section. In general, the data from the versatility questions imply that, to our respondents, the idea of using the View-Master to teach students works with some academic subjects, but not with others. 78% of respondents said that the View-Master could be used to teach history, for example, but only 29% said that it could be used to teach mathematics. Our research team foreseeing this kind of opinion is why the specific response options were drafted. An ideal continuation of this value's investigation would involve inquiring about other subjects or more specific subject disciplines, such as microbiology or Greek history.

The number of survey questions that dealt with the value of emotion were minimal in retrospect. Only three questions were asked, all of them were dichotomous, and two of them dealt with nostalgia, which means that the scope of our understanding of a user's emotions that are experienced while using the View-Master may be incomplete. Indeed, nothing was directly asked about the emotions being felt by the user. To address this in a future incarnation of the survey, one might choose to draft an appropriate multi-optional question about the user's emotional experience while using VR ("How did you feel during this experience?" Happy, sad, confused, annoyed, etc.).

Analysis of Questionnaire's Reliability and Validity

In order to test the reliability of the responses provided by those who participated in our research, questions were asked at different points in the questionnaire that should have elicited similar responses, in an effort to demonstrate alternate-form reliability. An example of this is the relationship between questions 13 and 27.

13. I would use the View-Master in public. (choose one)

- ❑ 1 (Strongly Disagree)
- ❑ 2 (Disagree)
- ❑ 3 (Neither Agree Nor Disagree)
- ❑ 4 (Agree)
- ❑ 5 (Strongly Agree)

27. Where would you take this device? (choose all that apply)

- ❑ Road trip
- ❑ Friend's house
- ❑ Work Break
- ❑ School
- ❑ Park
- ❑ Nowhere

These two items are both framed differently–one is a statement, and the other is a question. Their response options also contrast. Possible responses to the statement in item 13 are offered in a Likert scale and are limited to one choice, while response options to item 27 include unique answers to a direct question and feature the ability to choose multiple answers. However, there still should be some consistency found in the responses to these two items. Someone who strongly disagrees with the statement

in item 13 should likely answer “None” for item 27, or perhaps pick only one of the several responses. Someone who strongly agrees with the statement in item 13 should also choose multiple responses in item 27, to manifest which places in public that user would indeed be willing to go to with the View-Master. When referencing the data, this designed relationship between the two questions seems to hold up; all five of the respondents who chose “None” for item 27 indicated that they either disagreed or strongly disagreed with the statement in item 13. This is not the only example of reliability testing in this questionnaire–items 10 and 15 also have an alternate-form reliability relationship with each other.

As implied by the name, face validity of the questionnaire is taken at face value. Does it seem to address what it intends to? Is the questionnaire coherent? Are there any basic errors? Are the items in the questionnaire good ones? In the case of this questionnaire, there were a few basic errors that could have distracted respondents, and those errors are described in the “What were some problems?” section below. The items which featured these errors should be classified as less valid than they could have been. Generally, however, we received very few questions about the structure of the survey from our respondents, which was good. Few or no questions about a survey which one is given with no preparation and a few sentences of instruction is a positive note for the survey’s validity.

What went particularly well?

Participation was a standout success in this research. 71 students accepted the invitation to participate and were scheduled for individual trials, while the most we had expected to volunteer was around 30. 19 of the 71 who signed up for a trial failed to arrive and failed to reschedule, which meant that 51 total respondents participated in the survey and provided data for analysis. As a team of researchers, we agreed on why we believe this happened; participation in the survey was incentivized by Daniel Faltesek, PhD., for his students. He offered students in his course two choices for an assignment–participate in the survey and then submit a response to a series of questions about it directly to him, or develop and complete a unique and original project. Many of the students likely perceived participation in the survey as less work, and volunteered themselves accordingly. Incentivization such as this is a key element in many successful surveys. Eleanor Singer and Cong Ye aggregated information from many studies in their paper "The Use and Effects of Incentives in Surveys," and they posit that, among other things, incentives have an effect on nearly every kind of survey, whether it be carried out in person, by mail, or by phone. It should be noted, however, that most studies of incentive success typically concern incentives that are fiscal.

What were some problems?

Upon review of the survey itself, one glaring error was noticed; potential responses to Question 11 were written incorrectly. The question reads:

> **11. How long could you use this in one sitting? (Please select only one option)**
> ❏ Less than 15 min.
> ❏ 15 to 30 min.
> ❏ 30 to 45 min.
> ❏ 45 to 60 min.
> ❏ Greater than 60 min.

The central three responses overlap each other. This likely did not provide a difficulty for every respondent, but it was still not appropriate. If a respondent, for example, felt that she could use the View-Master for exactly 30 minutes, which response would she choose? She would be at an impasse between the second and third response options. Even if she elected to choose one of them to be her response, it still would not be taken by the researchers exactly as it would have been intended.

Too much time was scheduled for each interaction. We estimated that it would take an average respondent at least five minutes to use the View-Master VR viewer, and about ten minutes to fill in the survey. This was incorrect; most respondents stopped using the View-Master within two minutes, and filled out the survey in less than five. In nearly every trial, the researchers present were left with over two-thirds of their scheduled time to do next to nothing.

Use of time over the ten-week period that we had available could also have been better utilized. Due to an initial lack of researchers and a consequent uncertainty

about whether or not the project and its course would even continue, not much in the way of planning was accomplished during the first two weeks, let alone researching or drafting. Several of the researchers were also unavailable for varying amounts of time throughout the period, which made coordination and in-person discussions difficult and sometimes close to impossible. The final report written by the team ended up being rushed in order to publish on time, and still could have been formatted more before it was printed. As mentioned by Kelley et al., "researchers must prepare to spend substantial time on the data analysis phase of a survey (and this should be built into the project plan). When analysis is rushed, often important aspects of the data are missed and sometimes the wrong analyses are conducted, leading to both inaccurate results and misleading conclusions" (p. 265). Kelley et al. also note, however, that those conducting research "must not engage in data dredging, a practice that can arise especially in studies in which large numbers of dependent variables can be related to large numbers of independent variables (outcomes)" (p. 265). There is a plethora of ways to spend either too little or too much time on data collection and analysis, and researchers should be careful with time spent in each project they pursue. When considering the use of time with trials, needing to conduct the administration of the survey in person also took much longer than it would have taken to conduct a similarly written survey by mail, email, or potentially even over the phone, although it still took less time than a face-to-face interview with no written survey would have required. Data analysis was not very deep, as a result. However, as

the test was a pre-test, it should not be said that the exercise and analysis was incomplete; it should be considered appropriate for what the project was intended to be. These issues with time constraints are common in similarly structured research.

Other difficulties were encountered. We had one View-Master VR viewer to use for the entire project. This was sufficient during product development, with only nine research participants, but when more than two researchers would have been available to conduct trials at one time, it would have been beneficial to use more than one View-Master VR viewer and more than one smartphone. A related problem: the trial was also a lonely one. Each respondent was required to use the View-Master VR viewer by himself or herself, in a practically non-social setting. Testing the one person's use of a View-Master in the midst of a social gathering or testing the use of multiple View-Masters being used by friends in the same room are both paths of research that may yield different results than those found here. This desire to understand how the View-Master is perceived in social settings may lead market research in the direction of other types of investigation, such as utilizing focus groups.

Conclusion

This project was meant to be an execution of typical preliminary research that one would find in studying user experience. It should not be considered a complete research project. Continuing this research would involve editing the questionnaire,

drawing out a larger sample, amassing more stock View-Master VR viewers, and testing user experience with virtual reality on a much larger scale, with several finite hypotheses to drive the editing and testing. Time management is even more necessary in a project of that size than it was in this one. This project does, however, provide adequate direction for further investigation into the phenomena considered significant in our data analysis. Men being more willing to be seen in public using the View-Master, people being willing to use VR for long periods of time but not for watching television, and people who rate the View-Master highly for interactivity also happening to be more open to other applications of VR are all intriguing findings that should be explored.

Appendix A: Survey

Appendix A: Survey

In this survey we will be asking your thoughts on the View-Master that you had the opportunity to use. The survey will take approximately 10 minutes to complete with 38 questions.

1. I remember using something similar this when I was younger.
- ❑ Yes
- ❑ No

2. Have you ever seen a product like this before?
- ❑ Yes
- ❑ No

3. Is virtual reality a fad?
- ❑ Yes
- ❑ No

4. Reading the instruction manual was required for me to understand this device.
- ❑ Yes
- ❑ No

5. I felt in control of the experience.
- ❑ Yes
- ❑ No

6. One button was enough to operate the View-Master.
- ❑ Yes
- ❑ No

7. The View-Master needs a head strap.
- ❑ Yes
- ❑ No

8. The phone was loose in the device.
- ❑ Yes
- ❑ No

9. The device will break if I drop it.
- ❑ Yes
- ❑ No

10. I would worry about packing this in my things when traveling.
- ❑ Yes
- ❑ No

11. How long could you use this in one sitting? (Please select only one option)

- ❏ Less than 15 min.
- ❏ 15 to 30 min.
- ❏ 30 to 45 min.
- ❏ 45 to 60 min.
- ❏ Greater than 60 min.

For the next section rate the following statements by circling a number between 1 to 5. With 1 being Strongly Disagree and 5 being Strongly Agree.

Questions	Strongly Disagree	Disagree	Neither Agree or disagree	Agree	Strongly Agree
12. I like how the View-Master looks.	1	2	3	4	5
13. I would use the View-Master in public.	1	2	3	4	5
14.The device is convenient to carry around.	1	2	3	4	5
15. This device is easy to travel with.	1	2	3	4	5
16. The View-Master is sturdy.	1	2	3	4	5
17. The Preview Reel is easy to lose.	1	2	3	4	5
18. The View-Master tracked my head movements perfectly.	1	2	3	4	5
19. The apps were easy to use.	1	2	3	4	5

20. The Preview Reel was helpful in the use of the app.	1	2	3	4	5
21. This device lets me do things I would not normally do.	1	2	3	4	5
22. This is more useful for Entertainment than Education.	1	2	3	4	5
23. I felt very confident using the device.	1	2	3	4	5
24. This device enhances the effectiveness of education.	1	2	3	4	5

<u>In the next section select all the options that apply</u>

25. How many of the following did you experience using the View-Master?

- ❑ Eye Strain
- ❑ Tired arms
- ❑ Sore neck
- ❑ Dizziness
- ❑ I didn't experience anything listed

26. I felt the View-Master's _____ was not secure.

- ❑ Latch
- ❑ Interaction button
- ❑ Cell phone mount
- ❑ None

27. Where would you take this device?

- ❏ Road trip
- ❏ Friend's house
- ❏ Work Break
- ❏ School
- ❏ Park
- ❏ Nowhere

28. I would watch the following on this device:

- ❏ A YouTube video
- ❏ A TV Episode
- ❏ A movie
- ❏ None of the above

29. The apps in this device could be used to teach…

- ❏ Math
- ❏ English
- ❏ Science
- ❏ History
- ❏ Art
- ❏ None

<u>For the final questions select one response per question.</u>

30. Do you see this being used for more than the predetermined apps?

- ❏ Yes
- ❏ No

31. Do you think VR is more capable of communicating emotions than traditional forms of media?

- ❏ Yes

- ❑ No

32. Could you teach my parents how to use this?

- ❑ Yes
- ❑ No

33. Would you recommend the View-Master to a friend?

- ❑ Yes
- ❑ No

34. I know someone that I would give the View-Master to as a gift.

- ❑ Yes
- ❑ No

Demographic Questions

35. What is your current major at Oregon State University?

_____

36. What is your current class standing?

- ❑ Frosh
- ❑ Sophomore
- ❑ Junior
- ❑ Senior

37. Are you a full-time (greater than 12 credits) or part-time student (less than 12 credits)?

- ❑ Full-time
- ❑ Part-time

38. Are you Currently Employed?

- ❑ Full-Time
- ❑ Part-Time
- ❑ No

Appendix B: Codebook

Appendix B: Codebook

View-Master Usability Study Survey Codebook

In this survey we will be asking your thoughts on the View-Master that you had the opportunity to use. The survey will take approximately 10 minutes to complete with 38 questions.

For Questions 1-10:

No	0
Yes	1
Missing	9

1. I remember using something similar this when I was younger. EMO - Younger
- ❑ Yes
- ❑ No

2. Have you ever seen a product like this before? EMO - SeenBefore
- ❑ Yes
- ❑ No

3. Is virtual reality a fad? DES - Fad
- ❑ Yes
- ❑ No

4. Reading the instruction manual was required for me to understand this device. SIM - Manual
- ❑ Yes
- ❑ No

5. I felt in control of the experience. INT - Control
- ❑ Yes
- ❑ No

6. One button was enough to operate the View-Master. DES - Button
- ❑ Yes
- ❑ No

7. The View-Master needs a head strap. COMF - Strap
- ❑ Yes
- ❑ No

8. The phone was loose in the device. DUR - LoosePhone

- ❏ Yes
- ❏ No

9. The device will break if I drop it. DUR - Drop

- ❏ Yes
- ❏ No

10. I would worry about packing this in my things when traveling. DUR - Packing

- ❏ Yes
- ❏ No

For Question 11:

Less than 15	1
15-30	2
30-45	3
45-60	4
Greater than 60	5
Missing	9

11. How long could you use this in one sitting? (Please select only one option) COMF - Sitting

- ❏ Less than 15 min.
- ❏ 15 to 30 min.
- ❏ 30 to 45 min.
- ❏ 45 to 60 min.
- ❏ Greater than 60 min.

For 12-24 (NOTE "NEITHER AGREE/DISAGREE" IS 8):

Strongly Disagree	1
Disagree	2
Neither Agree/Disagree	8
Agree	3

Strongly Agree	4
Missing	9

For the next section rate the following statements by circling a number between 1 to 5. With 1 being Strongly Disagree and 5 being Strongly Agree.

Questions	Strongly Disagree	Disagree	Neither Agree or disagree	Agree	Strongly Agree
12. I like how the View-Master looks. **DES - Looks**	1	2	3	4	5
13. I would use the View-Master in public. **DES - Public**	1	2	3	4	5
14.The device is convenient to carry around. **PORT - Carry**	1	2	3	4	5
15. This device is easy to travel with. **PORT - Travel**	1	2	3	4	5
16. The View-Master is sturdy. **DUR - Sturdy**	1	2	3	4	5
17. The Preview Reel is easy to lose. **PORT - ReelLoss**	1	2	3	4	5
18. The View-Master tracked my head movements perfectly. **INT - Tracking**	1	2	3	4	5
19. The apps were easy to use. **SIM - AppEasy**	1	2	3	4	5
20. The Preview Reel was helpful in the use of the app.	1	2	3	4	5

INT - ReelUse					
21. This device lets me do things I would not normally do. **INT - Normally**	1	2	3	4	5
22. This is more useful for Entertainment than Education. **VER - Useful**	1	2	3	4	5
23. I felt very confident using the device. **SIM - Confident**	1	2	3	4	5
24. This device enhances the effectiveness of education. **VER - Effective**	1	2	3	4	5

In the next section select all the options that apply

For 25-29

No	0
Yes	1
Ambiguous	8
Missing	9

25. How many of the following did you experience using the View-Master?

- ❑ Eye Strain COMF - PainEyes
- ❑ Tired arms COMF - PainArms
- ❑ Sore neck COMF - PainNeck
- ❑ Dizziness COMF - PainDizzy

- ❏ I didn't experience anything listed COMF - PainNone

26. I felt the View-Master's _____ was not secure.

- ❏ Latch DUR - SecureLatch
- ❏ Interaction button DUR - SecureButton
- ❏ Cell phone mount DUR - SecurePhone
- ❏ None DUR - SecureNone

27. Where would you take this device?

- ❏ Road trip PORT - TakeTrip
- ❏ Friend's house PORT - TakeHouse
- ❏ Work Break PORT - TakeWork
- ❏ School PORT - TakeSchool
- ❏ Park PORT - TakePark
- ❏ Nowhere PORT - TakeNowhere

28. I would watch the following on this device:

- ❏ A YouTube video COMF - WatchYT
- ❏ A TV Episode COMF - WatchTV
- ❏ A movie COMF - WatchMovie
- ❏ None of the above COMF - WatchNone

29. The apps in this device could be used to teach…

- ❏ Math VER - TeachMath
- ❏ English VER - TeachEnglish
- ❏ Science VER - TeachScience
- ❏ History VER - TeachHistory
- ❏ Art VER - TeachArt
- ❏ None VER - TeachNone

For the final questions select one response per question.

For 30-34

No	0
Yes	1
Ambiguous	8
Missing	9

30. Do you see this being used for more than the predetermined apps? VER - MoreApps

- ❑ Yes
- ❑ No

31. Do you think VR is more capable of communicating emotions than traditional forms of media? EMO - Emotions

- ❑ Yes
- ❑ No

32. Could you teach my parents how to use this? SIM - Parents

- ❑ Yes
- ❑ No

33. Would you recommend the View-Master to a friend? DES - Recommend

- ❑ Yes
- ❑ No

34. I know someone that I would give the View-Master to as a gift. DES - Gift

- ❑ Yes
- ❑ No

Demographic Questions

For 35: 1 for DCA/NMC
0 for Any other Major
9 for missing

35. What is your current major at Oregon State University? Major

_____

36. What is your current class standing? Standing

- ❑ Frosh - 1
- ❑ Sophomore - 2
- ❑ Junior - 3
- ❑ Senior - 4

37. Are you a full-time (greater than 12 credits) or part-time student (less than 12 credits)? Student

- ❑ Full-time - 1
- ❑ Part-time - 2

Missing Data - 9

38. Are you Currently Employed? Employed

- ❑ Full-Time - 1
- ❑ Part-Time - 2
- ❑ No - 3

Missing Data - 9

39: Gender Gender

Male - 1
Female - 2
Missing - 9

40: Glasses Glasses

No Glasses - 0
Glasses - 1

Appendix C: Original Report

Questionnaire Design and Evaluation of the View-Master VR Viewer

Performed by William E. Loges, Ph.D. and:

Tim Andrade

Makenzie Bittinger

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Andrew McUne

Aaron Meche

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Josh Worden

Oregon State University, 2017

Executive Summary

What do today's college students think about virtual reality (VR)? As to its nature and longevity, do they consider it to be a passing fad? Or do they, the next generation of educators and entrepreneurs, consider it to be a potential vehicle for education? And what of preference based upon sex? Does one's gender seem to implicate a difference in deciding what one would use this device for? These are some of the questions that were answered in this demonstration of a questionnaire concerning VR usability.

The experiment began by first finding a proper VR headset to use for our observations. Considering that limited financial resources were available, it was ultimately decided to use one of the more simple VR headsets, known as the View-Master. The View-Master headset works by using a View-Master app on a smartphone. While the app is open, the smartphone is placed inside the View-Master headset, and a user can look through the headset to reveal a 3-dimensional world. We used our personal smartphones for this experiment; and in order to make the experience relatively similar for every participant, we had each individual use the same app - which was an underwater experience. Next, it was necessary to find a test group that would be able to participate in the experiment. Dan Faltesek's New Media Futures class ultimately became that test group; and from that group, 51 total participants were obtained for our working sample. After that, a 38-question survey was created. We started creating these items through usability concepts that can be

found on usability.gov. We began with about 20 concepts, then narrowed it down to eight: portability, durability, comfort, simplicity, interactivity, desirability, versatility, and emotion; and each of these eight concepts will be described in more detail, later in the report. We created roughly 5 items per concept, and from there, edited the questionnaire down to 38 total items that accurately test the usability of this device.

Finally, our testing began. One student came into the gamelab at a time, every 30 minutes, to be tested. They were asked to sit down, then were handed the View-Master and were left on their own for the next 5 minutes to have an authentic experience. Because there were in-app purchases for the View-Master, we were limited to only using one demo video for testing. However, that 5 minute trial video was enough for a participant to have an accurate virtual reality experience.

After completing the video on the View-Master, each participant was asked to answer the questionnaire. It took roughly ten minutes to complete, and each student was given class credit for agreeing to participate in our experiment. Once all 51 participants were tested, we gathered the data and began our analysis. Many different variables and relationships between the data points were gathered and tested, and we found a few that were statistically significant. Men tested significantly higher than women in overall desirability. Also, notably more men had seen the device before, where women had not. More men tested that virtual reality is not a fad, where women were split evenly between thinking it is and isn't. Surprisingly, although we had the students test the View-Master using a science-related app, we ended up with

results stating that VR would be better for teaching the subjects of Math and English than Science and History.

Introduction

The View-Master Virtual Reality Viewer is a smartphone-enabled virtual reality (VR) headset, currently sold by the toy manufacturing company Mattel. When used in conjunction with a properly equipped smartphone, it allows for the participation of the user in immersive 3D viewing of VR. The headset is made of hard plastic with a wide tinted visor on the front and hard rubber protruding from the back surrounding the two convex lenses in order to accommodate face shape. *(See Fig. 1.)* Sound from the smartphone is able to filter out from the unit via the small slats at the bottom corners of the face of the unit that contains the eyepieces. A clasp on the top unlatches to allow the viewer to swing open, revealing the other side of the lenses, a dedicated three-prong clamp for the user's smartphone, and an additional plastic brace to fit into the clamp if the smartphone has a smaller body. *(See Fig. 2.)* The body of the headset is red, and when closed, only features one point of input to manipulate the smartphone inside: a large, orange trigger, which protrudes from unit near the right side of the user's face. A wrist strap is also attached to the unit, on the bottom, near the sound slats.

Fig. 1 - The Mattel View-Master VR Viewer (Closed Unit)[1]

[1]Sridhar, S. (2016, March 1). Google Store starts selling View-Master and C1-Glass Cardboard VR Viewers. Retrieved March 23, 2017, from http://www.fonearena.com/blog/176707/google-store-starts-selling-view-master-and-c1-glass-cardboard-vr-viewers.html

Fig. 2 - The Mattel View-Master VR Viewer (Open Unit, Containing Smartphone)[2]

The View-Master is packaged in a cardboard box, with the top of the box extending into an additional cardboard panel that folds over the front, with two attached dog-ear flaps that are inserted into the seams on the sides of the box. When the box is opened, by pulling the panel out and up from the body of the box, the View-Master is immediately visible underneath a thin plastic mold. The cardboard panel that was also immediately above the View-Master, before it was lifted away, features a graphic that instructs the consumer concerning the enabling of the View-Master's use with a smartphone. When the first plastic mold is discarded and the View-Master unit is removed, a booklet of instructions can be found pressed against the back of the box by remaining plastic. The box also contains a separate object called the Preview Reel, which is a plastic disc with fourteen spaces on its face. This object is intended to be placed on a flat surface near the user of the headset, and then to be a visual reference point for that headset during use; the person using the View-Master can look directly at the Preview Reel laying flat on a table nearby, and the disc will prompt an appropriate menu for the user to navigate, depending on the nature of his current use.

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[2]G. (2016, February 06). Apple now sells the View-Master VR through its own stores. Retrieved March 23, 2017, from http://www.gsmarena.com/apple_now_sells_the_viewmaster_vr_starter_pack_through_its_own_stores-blog-16483.php

The VR that is enabled through the View-Master is comprised of both artificial environments made from computer-generated imagery and edited footage of actual environments, the latter of which is more often known as augmented reality. The most heavily advertised uses of the viewer involve dedicated smartphone apps published by Mattel; one app houses a National Geographic-branded environment featuring Earth in the time of dinosaurs, and another app contains an underwater exhibition of sharks and other sea creatures, courtesy of Discovery. More official View-Master apps have been released since the headset's initial public release, including one sponsored by the Smithsonian Museum, and others of a more immediately fictitious nature, such as *Batman* and Mattel's own *Masters of the Universe*.

The device is not limited to the use of native apps developed by Mattel. The View-Master VR Viewer was created as a joint collaboration between Mattel and the technology company of Google as an implement for Google Cardboard, the company's virtual reality platform. As such, any Cardboard-based applications available in online smartphone markets can be freely used with the viewer, as well as standard smartphone applications that contain Cardboard-dedicated content, such as YouTube.

Some consumers are likely to know the name of View-Master from stereoscopic viewers that have been sold in the past, by Mattel and by others. Since the 1930s, View-Master has been the trademarked name of successive models of

handheld stereoscopic dual-lens film strip viewers. These viewers accepted native film strips into the main unit via a slot in front of the eyepieces. These film strips being distributed in the form of circular pieces of paperboard containing seven two-panel sets of negatives. These paperboard circles were called “reels”, and the Preview Reel pays very obvious homage to these reels in both its shape and size. No mention of these previous iterations of the View-Master is made in the questionnaire, but incidentally, the value of nostalgia that this fosters is addressed within the questionnaire.

Concepts and Definitions

Twenty values were found on the usability.gov website, and from these values, eight individual concepts were derived that then served as the organizational values for the tabulation of our research data. The eight concepts that were found to be most appropriate for evaluating this experiment are *portability, durability, comfort, desirability, simplicity, versatility, emotion,* and *interactivity.* The concepts are defined herein.

Portability:

Portability in media products is based on a product’s capability of being transportable and still being generally capable of accomplishing the same tasks in different environments. Is a product easy to move from one location to another, and

does it remain effective in that new environment? Then, by definition, it's portable. There is such a thing as software portability, such as if an app can be used on different devices or operating systems with the same effectiveness. For the purposes of this project, we primarily are concerned with hardware portability, which refers to how portable a media product is physically. For instance, a laptop computer should be more physically portable than a desktop computer since its hardware is lighter, slimmer and has a battery.

Related concepts include durability (more durable products will be more capable of being transported and in transitioning environments), desirability, and versatility.

Durability:

Durability is essentially the assurance that a media product will be able to sustain a relatively long, continuous and useful life without an inordinate amount of repairs or maintenance. Basically, a media product is durable if it can be used often while consistently providing the expected result or service over an extended lifetime. How long this "lifetime" is would depend on the product — the life of headphones would likely be measured in months, while a desktop computer would be in years. Regardless, the relative durability of a media product is how well it can withstand wear and tear over time with normal usage amounts.

Related concepts include portability (durable products could withstand being transported more easily if designed for it) and desirability (durable products would require less maintenance and thus more desirability).

Comfort:

Media products are defined as comfortable if they do not cause the user undue or excessive pain due to normal usage of the media product, and if the product allows a certain element of ease or relaxation during usage. Just like a misshapen chair would be uncomfortable to sit in, a pair of awkwardly shaped headphones would cause ear pain and thus wouldn't be a comfortable media product. Comfortable media products are designed ergonomically so that normal usage will be easy to perform, both because the product is physically designed for efficient usage but also the software is comfortable — the interface is understandable, instructions are clear, input methods are coherent, etc.

Related concepts include desirability, emotion, and simplicity.

Simplicity:

While complexity is easy, simplicity is hard. Simplicity in media consists of many components working together in an easy to use and understandable way. Though simplicity can be measured through user experience (how the user interacts or feels), it also can be measured through user interface (what the user sees). In order

to understand the user's interaction with the View-Master's simplicity, we must gather information in which the experience was clear, understandable, and useable in direction and design.

Related concepts include usability, interactivity, and emotion.

Interactivity:

Interactivity in media refers to the product or service including ways for the user to respond to the media and affect the experience firsthand. In other words, the output from the media is affected by the input of the users. Does the user have any control over what's happening, like playing a videogame with a controller, or does the user simply observe, like watching a movie?

Related concepts include desirability (users could possibly want a media product that allows them to influence the content) or versatility (a truly interactive product provides as many different experiences as the user creates themselves, whereas a movie has only one narrative or experience).

Desirability:

Desirability puts emphasis on the quality of technology and if it's worth having. Today's society allows for the ability of choice between similar products at similar costs, so what makes a consumer buy the View-Master over another similar product? In order to be a leader in the media world, products must be desirable; this

means how high the product ranks is in brand recognition, usability, and essentialness. The higher the product ranks, the more likely of product success.

Related concepts include usability, comfort, portability, and durability.

Versatility:

Media versatility is essentially one product's ability to adapt to and allow for different functions to perform at the same time. Modern media allows multiple functions to be completed through one item which allows the ability to do more with less. How much versatility does the View-Master have? How many different tasks can be completed? Do you need multiple apps to be considered versatile or can that be achieved through one app?

Related concepts include interactivity and desirability.

Emotion:

Emotion is the state of consciousness in which joy, sorrow, fear, or any other feelings are experienced. How are they feeling about this? Does this make them feel happy? Does this make them feel frustrated? The essential question is, how does this product make you feel?

Related concepts include desirability, interactivity, comfort, and simplicity.

Methods and Administration

The survey was announced solely to Dan Faltesek's New Media Futures Class and signups were passed around in class, with 71 students enlisting to partake in the usability study. Due to students who signed up but never actually showed, 51 students ultimately took part in the survey. Students who participated in the study were able to receive participation points for their class project after completing a one-page reflection.

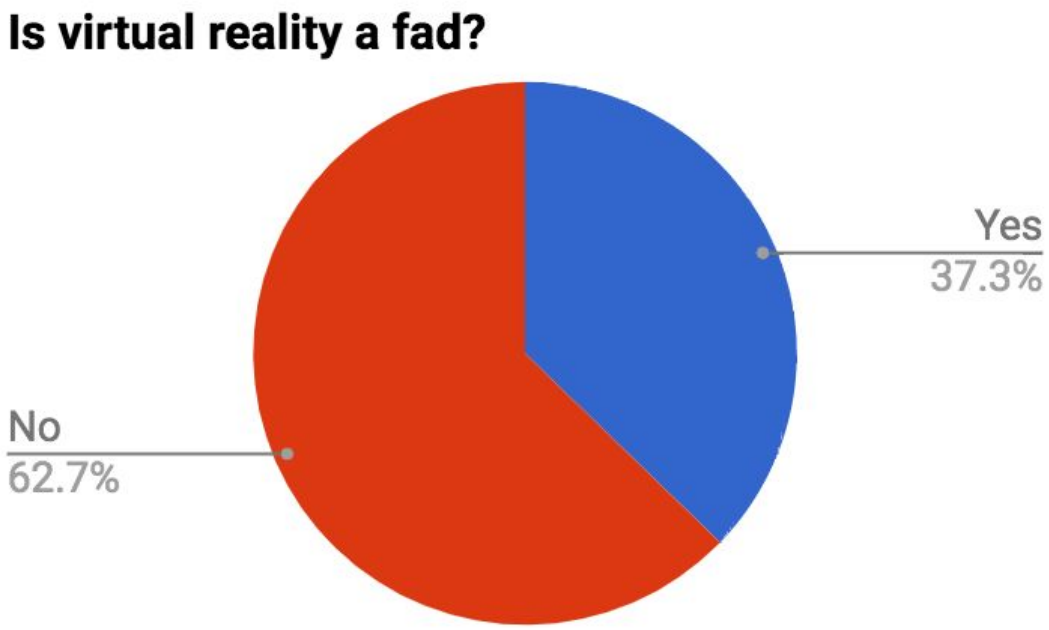
Once the questionnaire design was finished and the signups were completed, the tests were conducted over a 10-day period in 30-minute slots for each subject. Two test administrators were present in the previously determined time slots in the Game Lab in Snell Hall, where the study took place.

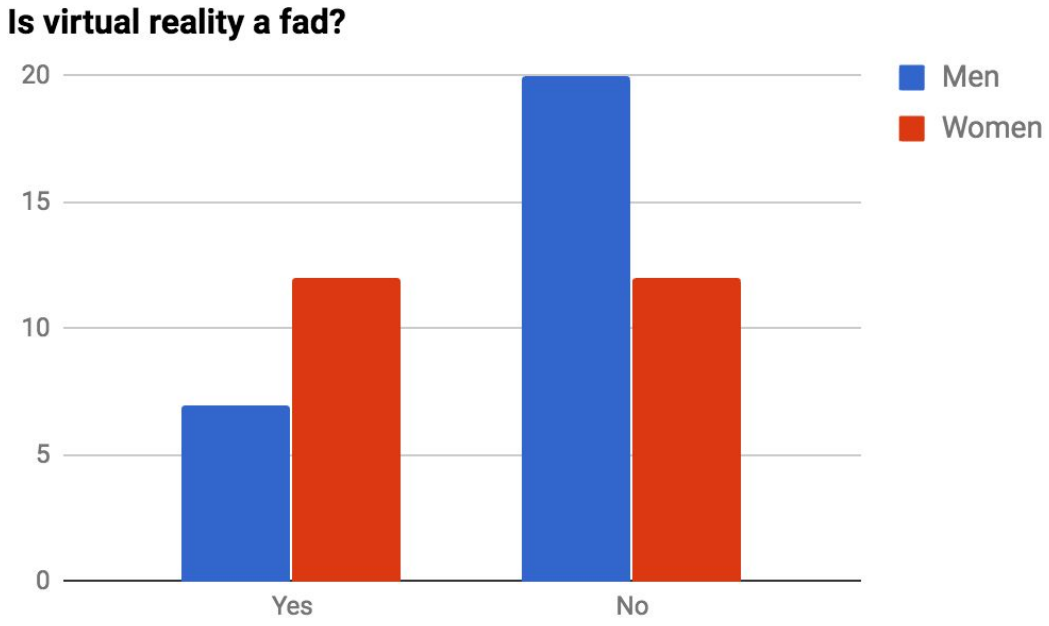
Once the subject arrived, the introduction was brief. The subject was shown the View-Master, informed they would use the product for a short time and take a roughly 10-minute questionnaire afterwards. The administrators put their personal phone in the View-Master with the application loaded, handed over the View-Master and let the subject know they could use it standing up or sitting down. The administrators didn't explain what the demo actually was about or what the subject should do, in order to make the experience more like a real world situation when administrators wouldn't be present. The administrators did, however, make sure the subject was able to start using the View-Master without problems so they could at least experience the app. Also, the administrators generally refrained from answering

questions during the subject's use of the product unless they were unable to continue by themselves. For instance, one subject had some problems with the app and got stuck on a screen without being able to move forward. The administrators helped fix the problem briefly and returned the View-Master to the subject. Other than that, the administrators let the participants experience the app and View-Master without interruption.

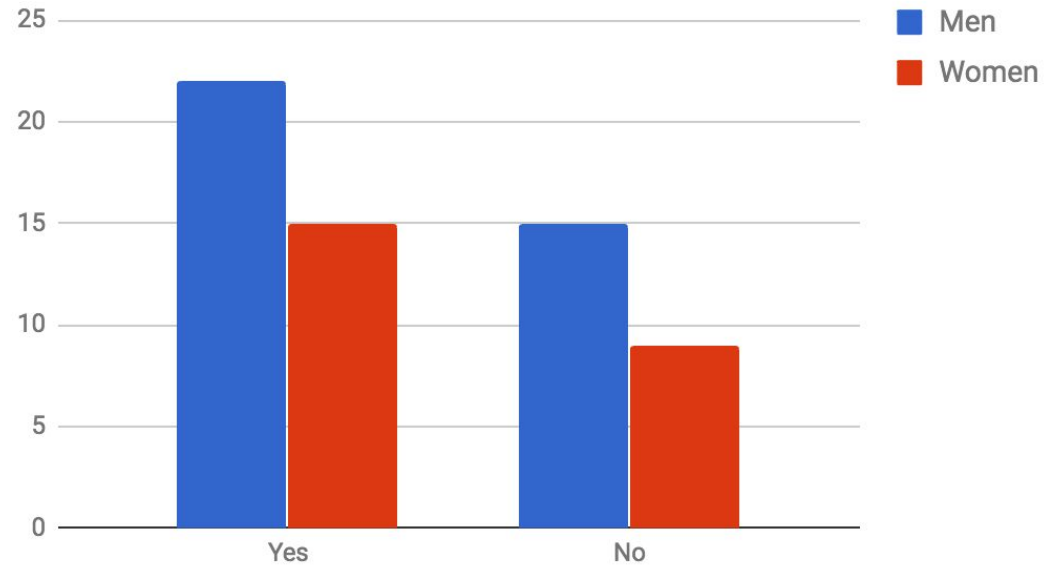
The app used in the test experience was a demo of the View-Master Discovery Underwater app. The demo immersed the user in a 5-minute sequence of underwater visuals, which automatically ended the demo after that period. Once the subject was finished, they were given the questionnaire and told to complete it in the same room, being told it would take about 10 minutes. Similar to during the usage of the View-Master, the administrators refrained from answering questions about the survey in order that someone who asked a question about the survey wouldn't get a different or additional explanation about an item that someone who didn't ask a question would get. Once the subject was done with the questionnaire, they returned it to the administrators and no more contact was made between the two parties afterwards.

Results:

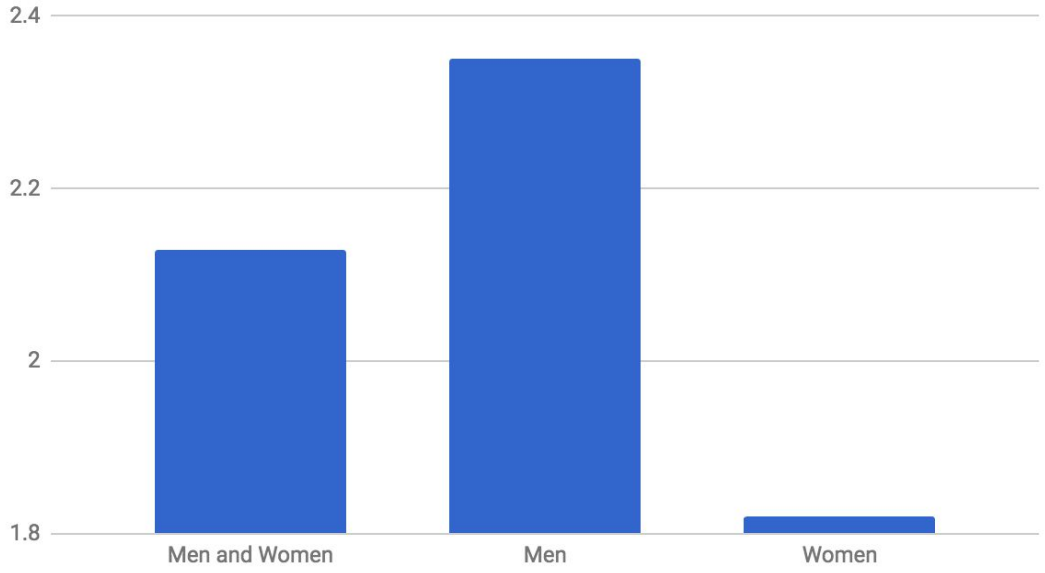

Is virtual reality a fad?
Yes
37.3%
No
62.7%

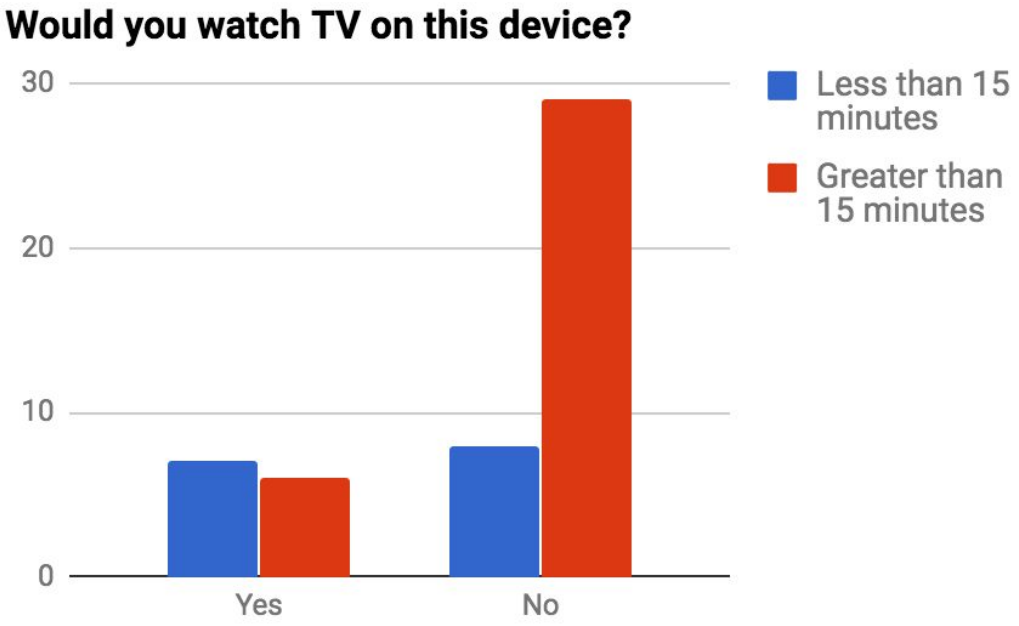

Is virtual reality a fad?
20
15
10
5
0
Yes
No
Men
Women

Have you seen a product like this before?

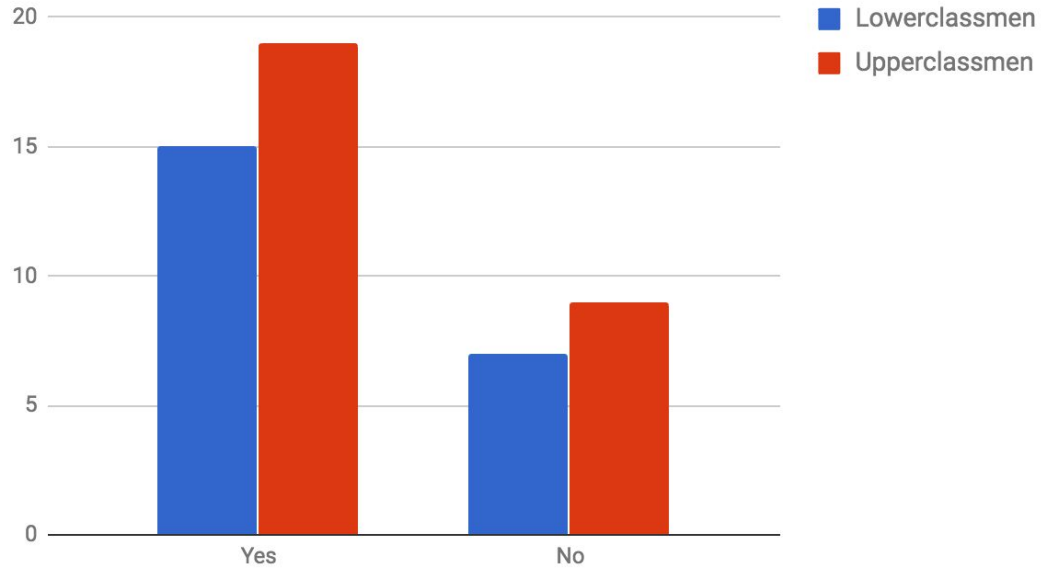


Average score for DES-Public by gender

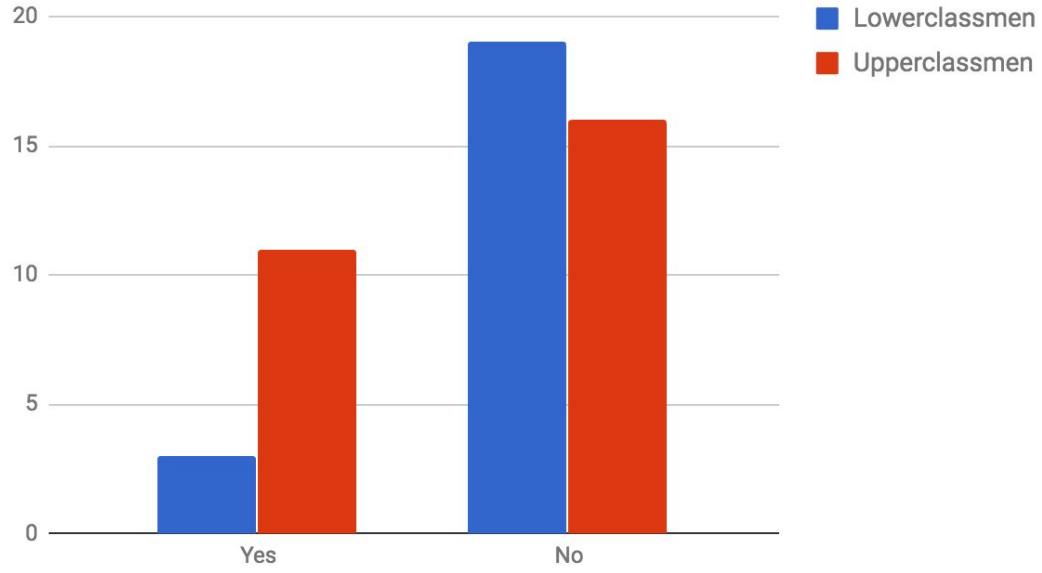


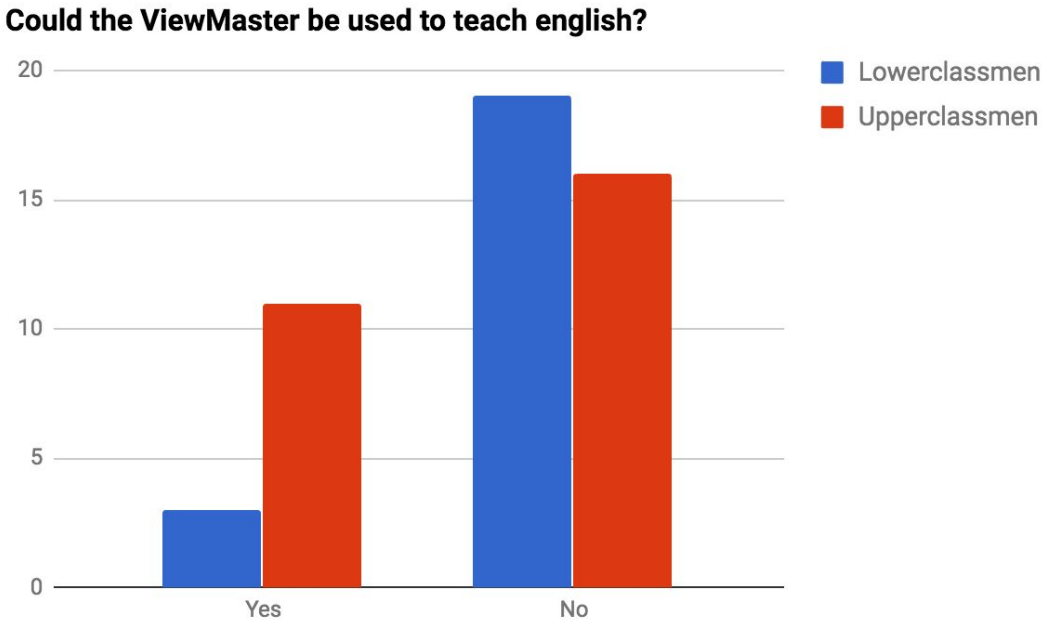

Would you watch TV on this device?
30
20
10
0
Yes
No
Less than 15 minutes
Greater than 15 minutes

Could the ViewMaster be used to teach science?



Could the ViewMaster be used to teach english?





Relationships Between Data

Overall we didn't have a high variance between our data, and a significant part of this was a result of the low number of participants in the surveying process. Despite these drawbacks, we were able to ascertain a few relationships between our data. One such relationship is that women were more likely than men to think of virtual reality as being a fad. There were three times as many men who believed it wasn't a fad than those who thought of it as one. Seventy-three percent of participants would not like to be seen using this device in public. Of the people that were willing to use the device in a public place more men chose they would use the device in public than women. A naturally occurring hypothesis was upperclassmen, those who

are media majors, would find more purposes to use this device; their responses reflected it could be used for Math and English, but Science and Art was not as significant.

Several of the data points provided results that were contrary to our initial hypothesis. One unexpected data point came from individuals who experienced discomfort whether it be eyestrain, sore arms, dizziness, and/or sore neck, in relation to whether they would recommend the View-Master to a friend. Our initial hypothesis suggested these items to have direct correlation though our data provided the opposite. Another result that had no correlation was between how long respondents would use the View-Master and what they would use it for. Individuals who said they were willing to use the device for a limited amount of time, five to ten minutes, also claimed they were willing to watch an episode of tv or a movie.

The questionnaire was constructed with four desirability questions which were meant to separate positive and negative attitudes toward the product. Using this we were able to see how our participants felt about the desirability of the View-Master. We found that sixty-five percent of respondents had a mostly favorable attitude toward the View-Master, twenty-four percent had a slightly negative or neutral view, and ten percent had a purely negative view.

Conclusion and Future Research

The final results of this test study suggest a definitive need to follow up with a larger study. Several data points had a slight statistical significance that would be solidly affirmed either way with a larger population. This study appealed to a single New Media Communications (NMC) class of approximately 150 students. 71 students showed initial interest in participating and 51 students arrived to participate in the study. This gives the study a 70% response rate. Therefore, there is reasonable expectation that future studies will have an excellent response rate. The next iteration of the study will have to expand its reach to more than just a single NMC class on campus to ensure a larger pool of respondents. To support an increase in population size for the study, the time allocated to each participant's experience should be revised as well. Due to unfamiliarity with the product, a large block of time was allocated to the subject for each participant. The application came with a set appointment time and the survey was simple and easy for the participant to fill out. After several meetings it was determined that instead of a 30 minute block a ten minute block would have been all that was necessary for each meeting time.

To increase the validity of the survey experience and accommodate new questions, the study would benefit from the inclusion of more variety and also other types of VR and AR experiences, e.g, 360 video. The eight concepts used were very successful in obtaining insight into perceptions and opinions of the View-Master; and we found that other user research surveys used similar concepts.

Other virtual reality headsets are also available for evaluation, at varying levels of cost and accessibility to the common consumer. Some headsets that are considered to have higher price ranges and run on their own respective native softwares include the Oculus Rift, the HTC Vive, Sony's PlayStation VR, and Samsung Gear VR. Many other headsets with a lower cost use Google Cardboard software as their operating system, and these viewers, besides the View-Master VR viewer, include dozens of iterations, with some produced by Google and other licensed companies literally being made of cardboard, in order to maximize accessibility. These options would provide many vehicles for additional questionnaires and general research, especially when concerning questions detailing the influence of cost and market.

Overall, discovering some of the relationships that were found was surprising. We think this experiment could be improved with a bigger sample size and more variety in apps and hardware.

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