

3-D TV : **Where Are We** **Now and Where** **Are Consumers?**

Shawn G.
DuBravac, CFA
and
David B.
Wertheimer



Background/ Methodology

The Consumer Electronics Association (CEA) and ETC set out to gain a baseline understanding of consumer interest in and attitudes towards 3-D, especially as it relates to bringing stereoscopic 3-D into the living room. To date, very little quantitative research has been done on 3-D content – especially as it pertains to 3-D in the home. This study marks one of the first efforts to delve into the opportunity for 3-D from the consumer perspective.

The quantitative results presented in the following paper represent results from a telephone survey conducted among a national probability sample of 1,002 adults during the period of December 18th through December 21st, 2008. Completed interviews are weighted to ensure a reliable and accurate representation of the total US adult population.

As is true with any new technology, studying consumer attitudes toward and interest in 3-D can be difficult for a myriad of reasons. Nascent technologies, with which consumers are largely unfamiliar, are difficult to assess. There is always the risk that consumers' responses will be based on inaccurate misconceptions. As an example, in 1998, as digital TV was just emerging as a viable technology, only 40% of consumers classified themselves as curious and potential buyers. As consumers learned more and personally experienced the technology their interest grew. Today, more than 60 percent of households own a digital TV, and adoption continues to grow at a tremendous clip.

We feel the following results are successful at highlighting and quantifying the significant progress 3-D technology has made in garnering mindshare among consumers as well as providing possible directions 3-D technology may track from here. As consumers continue to learn about and be exposed to 3-D technologies (in the theater and beyond), we will be able to track the trends in interest and understanding. We believe that this study provides a solid baseline on growing consumer interest in 3-D.

- Shawn DuBravac & David Wertheimer

*Shawn DuBravac is the Economist for the Consumer Electronics Association and an Adjunct Professor at the George Mason University School of Business. David Wertheimer is CEO & Executive Director of the Entertainment and Technology Center @ USC.

KC Blake, Director of Business Development at the ETC@USC also contributed to this study.

Coverage of 3D @ CES written by Dennis Kuba and Robert Scott.

Key Insights

Overall awareness of the current state of 3-D is relatively low but is growing, due to the increasing number of 3-D movie releases in theaters. Once given a “taste” of 3-D, consumers show significantly higher interest in viewing additional movies in 3-D and potentially buying and viewing 3-D in their homes. Some of the key findings in this study were:

- 40% of individuals in the top 20 media markets report they've heard or seen information about 3-D content.
- Nearly a third of the people who have heard, read, or seen something about 3-D video in the last year say they've also seen a 3-D movie in the theater.
- 52 percent of consumers who have actually seen a 3-D movie in the theater in the last year say they'll watch another one over the next 24 months.
- More than 26 million households are interested in a 3-D content experience in their home.
- The more experience people have with 3-D, the more interested they are in consuming it. For example, for those who saw a 3-D movie in the last year, 38 percent say they would prefer to watch a 3-D movie in the theater instead of the same movie in 2-D – compared to just 23 percent for US adults who have not seen a 3-D movie in the last twelve months.
- Over half of US adults said having to wear special glasses or holding their heads relatively still while viewing 3-D content would have no impact on the likelihood of them purchasing a 3-D television for their home.
- For those who have seen a 3-D movie in the last year, 60 percent are willing to spend more on a 3-D television for their home and 19 percent are willing to spend up to 25 percent more.
- 18-29 year olds appear to be the prime target, as they are disproportionately familiar with 3D and potentially interested in buying a 3D set for their home.

Overall, 3-D content could be on the cusp of becoming mainstream. Interest in 3-D grows with each release in theaters, and as consumers experience 3-D in theaters, they show increased interest in having 3-D in their home.

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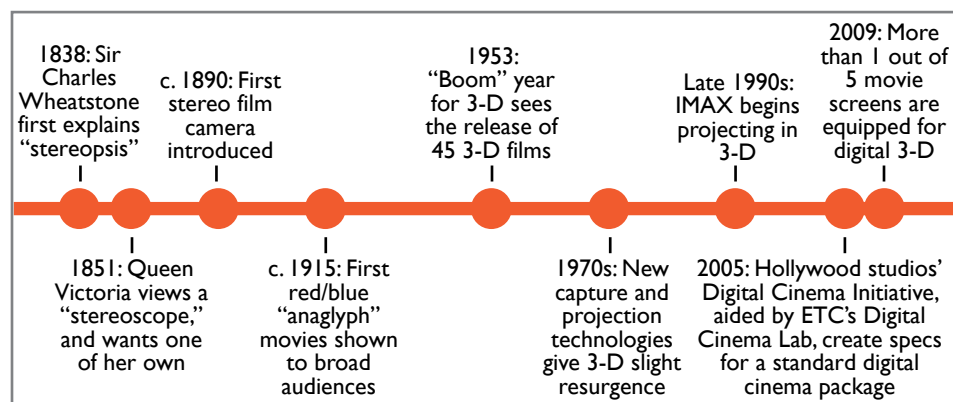
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It is estimated that there were a million stereoscopes in living rooms around the globe by the mid 1850's.

Short History of 3-D

Humans perceive “depth,” or three dimensions, by assimilating a variety of visual cues. The most important of these is the perception of a differential between two slightly offset images when viewed by each of two eyes. By presenting each eye with a slightly offset/different image, a projection system or display can create the illusion of depth, or “3-D.” Sir Charles Wheatstone first explained “stereopsis” -- the perception of depth -- in 1838. When Queen Victoria saw a still-image “stereoscope” in 1851 (and had to have one), 3-D became all the rage. It is estimated that, as a result, there were a million stereoscopes in living rooms around the globe by the mid 1850's. Half a century later, circa 1890, the stereo film camera was first introduced, taking stereo photography to the next level. Around 1915, the first red/blue “anaglyph” movies were shown to broad audiences. However, it wasn't until around one hundred years after the stereoscope, in

the 1950s, that stereo 3-D movies really began to take shape. Color film, as it became mainstream, opened the door to stereoscopic filmmaking and exhibition. By this time, contrary to the mental images that most people today have of 3-D, red/blue anaglyph was mostly relegated to comic books; by contrast, more advanced, polarized light projection (often coming from dual projectors simultaneously) was the norm. In 1953, the boom year for 3-D, 45 films were released in 3-D – the most famous being *Kiss Me Kate*, *Hondo*, *House of Wax*, Hitchcock's *Dial M for Murder*, and of course, *Creature from the Black Lagoon*. A variety of factors – ranging from the creative choices of which films were made in 3-D, to sub-optimal cameras, to limited knowledge in the “art” by crews, to poor quality control in the labs, to the complexity and expense of projector operation and alignment -- combined to strain viewers' eyes and to ring a temporary death knell for 3-D cinema. In the 1970's,



Almost all of the causes for 3-D's failure in the 50's and again in the 70's became moot with the advent of digital technology.

newer capture and projection technologies gave 3-D cinema a slight resurgence, including the making of the film “Jaws 3-D,” but many of the same problems, resulting in eyestrain for the audience, sent 3-D cinema back to the barn.

A new snowball began to form when IMAX started projecting 3-D in the late 90's, primarily in museum-type exhibitions. That snowball got a big push downhill in 2005 when the Hollywood studios' Digital Cinema Initiative, aided by ETC's Digital Cinema Lab in Los Angeles, created a specification for a standard digital cinema package. Through the “Digital Cinema Package,” a purely *digital* copy of a movie could be produced and distributed – and the color and image quality remained consistent from the first showing to the last. In 2005/2006, major theater chains began to replace film projectors with digital equivalents, which opened up new opportunities in the theater for 3-D. The new digital projectors were capable, with fairly nominal additions, of projecting 3-D content using state-of-the-art technologies far superior to anaglyph (red/blue) and previous polarized technologies.

The technical factors that caused

audience eyestrain previously were practically eliminated. In fact, almost all of the causes for 3-D's failure in the 50's and again in the 70's became moot with the advent of digital technology, and so filmmakers began experimenting and re-learning the art of stereo filmmaking. From 2004 to 2008, several major films were released into theaters in 3-D—major films like *Polar Express*, *Chicken Little*, *Monster House*, *Meet the Robinsons*, *Beowulf*, *Journey to the Center of the Earth*, *Bolt*, *My Bloody Valentine 3D*, *Coraline* and even event films such as *U23D* and *Hannah Montana & Miley Cyrus*, which was released *solely in 3-D*.

As this report goes to press, there are approximately 5,000 digital cinema screens, and about 1,700 of those are equipped for digital 3-D – the majority of which are in the major markets of the United States. Moviegoers, at least in the large cities, are slowly beginning to become aware of stereoscopic films.

There is excitement in the movie industry surrounding 3-D as well, because audiences appear to be flocking to the 3-D screens (and paying more to do so) when given the option – and that makes for good business for the cinemas

Broadcasters have also started to experiment with 3-D and have performed several tests -- looking at the issues and opportunities for bringing new kinds of 3-D content to consumers in their homes.

and the studios. For example, it is estimated in the press that the movie *Bolt* saw 50% of its admissions come from 3-D screens, even though those venues represented only 32% of the total screens the movie played on. *Journey to the Center of the Earth* reportedly saw *four times* the revenue come from 3-D theaters versus 2-D. And while early results showed that 3-D versions of a film could draw approximately double the traffic compared to 2-D versions of same film, all other factors being equal, those statistics appear to be growing. *My Bloody Valentine*, as an example, blew those statistics out of the water, with 3-D screens reportedly out-performing 2-D screens *six-to-one*.

However, once the films leave the theaters, the options for consumers to enjoy the 3-D version of the film, which may have cost the producers an incremental 10-15% of the budget to create, are limited. In 2008, as a stop-gap strategy, several studios chose (perhaps reluctantly) to ship Blu-ray discs with anaglyph versions of their 3-D films to satisfy some of the demand for 3-D. Consumers were able to see a High Definition picture with red/blue paper glasses from the box -- resulting in all the same issues

(eye strain, poor color representation, etc.) that made anaglyph inadequate for movies before. Not surprisingly, there's an interest on the part of the industry to have a significantly higher-quality secondary market for stereoscopic 3-D content.

In addition to the movie studios, broadcasters have also started to experiment with 3-D and have performed several tests -- looking at the issues and opportunities for bringing new kinds of 3-D content to consumers in their homes. A few high-profile examples:

- *The NBA experimented with shooting and distributing the all-star game in 3-D in 2007 (and again in 2009).*
- *BS11, a Japanese broadcaster, has been broadcasting 20 minutes a day of 3-D content since March, 2008.*
- *Fox Sports shot several 3-D tests -- NASCAR, boxing, football, etc. in 2008.*
- *The NFL, 3ality and Technicolor performed a broadcast test of an NFL football game in December, 2008.*
- *Sky Broadcasting did a test 3-D broadcast of a boxing match in December, 2008.*
- *Fox, Sony, 3ality, Cinedigm, et.*

For home displays, there are several new technologies currently in development; of these, there are three that are generally regarded as alternatives in the next several years: active shutter glasses-based displays, polarized glasses-based displays, and autostereoscopic displays.

al broadcast the college football, BCS championship game to 80 theaters across the USA and CES, in January of 2008.

- *Dreamworks bought a 120 second advertisement in the 2009 Super Bowl, broadcasting the trailer for Monsters vs. Aliens in 3-D; NBC followed that up with an episode of Chuck on the following night.*

That said, linear content is not the only story in the 3-D world -- nVidia, in 2009, began a big push with 3-D games on 3-D TVs and monitors. Many people feel that 3-D games may actually be the tip of the spear, bringing 3-D TVs into homes while the various industries work out the standards issues in terms of delivering 3-D into the home on disc, via broadcast, or digital delivery.

Fortunately, many of the technologies that make digital cinema possible are also potential options in the home, and so many of the major consumer electronics manufacturers have been producing or researching new ways of delivering 3-D experiences. In 2007/2008, Mitsubishi and Samsung were both shipping DLP-based High Definition TV's that were 3-D capable. A user could purchase a stereo glass-

es kit and infrared emitter, and turn an otherwise normal HDTV into a 3-D TV. Samsung has since started shipping 3-D capable Plasma Display Panel TVs. It is estimated that there will be over three million 3-D-capable TV sets in consumer homes by the end of 2009.

To understand some of the potential issues and barriers to adoption, following is a quick overview of the predominant short-term technologies for stereoscopic 3-D. These technologies are presented at a high-level, from a consumer point of view, in order for readers unfamiliar with 3-D to understand some of the questions and results of this consumer-based survey.

Relevant 3-D Home Display Types

For home displays, there are several new technologies currently in development; of these, there are three that are generally regarded as alternatives in the next several years:

- 1. active shutter glasses-based displays*** – *These TVs have electronic glasses that open and close each eye in sequence with different images on the screen. The switch is done at a speed which is faster than the human*

Roughly 49% of individuals who have seen a 3-D movie in the last 12 months live in one of top 20 DMAs.

visual system can discern, so even though only one eye is actually seeing at any given time, each eye gets what the brain believes is a sustained image. One complaint is that every person gets the same 3-D image regardless of their position to the screen, but that's true in the theater as well. Active shutter glasses are more expensive on a per-pair basis than polarized glasses.

2. polarized glasses-based

displays – In these displays, both eye images are projected simultaneously on the screen; however, the images for each eye are run through polarizing filters so that glasses with the appropriate lenses will see only the image that is intended for that particular eye. Again, this is a stereo (2-eye-view) experience, so everyone sees the same image. Polarized glasses are relatively inexpensive as compared to active shutter glasses.

3. autostereoscopic displays – In “autostereo” or multi-view displays, two separate images are presented to each viewer's eyes without the need for glasses, because the display creates various vertical “barriers” between pixels or lenticular lenses that allow one eye to

see a different image from the other eye. Drawbacks to these displays are that they generally force a viewer to be in one of the “sweet spots” to see the image, there are a limited number of viewpoints, and users generally find that moving their heads creates problems with the 3-D effect. The upside, beyond not needing glasses, is that each viewer could potentially get a more correct image relative to where he or she is seated. However, currently, the image resolution of autostereoscopic displays is somewhat lower than the stereoscopic displays that use glasses, and the costs are significantly higher.

All of these technologies continue to be developed and perfected by their proponents, and some of the liabilities will be minimized over time. This paper is not intended to be a technological or marketing treatise on the aforementioned technologies. There are many sources on the Web for deeper understanding of the pros and cons of each. The brief descriptions above exist solely to illustrate that all technologies are not created equal when it comes to moving 3-D into the home. And there are emerging technologies that are in develop-

Roughly 49% of individuals who have seen a 3-D movie in the last 12 months live in one of top 20 DMAs.

	% of Total Population	Have watched a 3-D movie at a movie theater in the last 12 months
Age		
18-29	20%	27%**
30-49	38%	19%
50-64	24%	12%**
65+	16%	10%**
Race		
White (non Hispanic)	68%	13%**
Black	12%	23%
Hispanic	13%	31%**
Other	8%	25%
Education		
Less than High School	7%	29%
High School	25%	12%
Some College	27%	17%
College +	41%	20%
Household Income		
Less than \$30K	21%	16%
\$30K-\$50K	23%	19%
\$50K-\$75K	23%	19%
Greater than \$75K	33%	20%
Children	50%	24%**
Region		
Urban	52%	18%
Suburban	26%	20%
Rural	22%	13%
Top 10 DMA	27%	36%**
Top 20 DMA	39%	49%**

Table I: Demographics of those who have seen a 3-D movie in the last 12 months

** Statistically significant at the 5% level

Nearly 26 percent of consumers say they would prefer to watch a movie at the movie theater in 3-D over watching the same movie at the movie theater in 2-D

ment that are not mentioned here for the sake of brevity.

In the Eyes of the Consumer: Understanding the Current State of 3-D

Most consumers are familiar with the concept of 3-D technology, and over 17 percent of US adults – nearly 41 million adults – even say they have watched a 3-D movie at a movie theater in the last 12 months. As Table I highlights, this trend is especially pronounced for young adults between the ages of 18 and 29, with greater than one in four of these individuals saying they have seen a 3-D movie in the theater in the last year.

Beyond age, there are minimal demographic differences between those who have seen a 3-D movie in the last 12 months and those who have not. For example, when it comes to income or education background, there is no statistical relationship - suggesting 3-D movies are an attractive entertainment

option for a wide breadth of individuals. Caucasians are less likely than the overall population to have seen a 3-D movie in the last year, while Hispanics are more likely to have done the same. Adults with children in the household are also more likely to have seen a 3-D movie in the theater in the last 12 months than adults in households without children – quite understandable given that the majority of recent 3-D releases have been oriented towards younger audiences.

While living in urban or suburban areas does not appear to impact if consumers have or have not seen a 3-D movie in the theater in the last year, living in one of the top DMAs¹ does. Roughly 49 percent of individuals who have seen a 3-D movie in the last year live in one of the top 20 DMAs. Moreover, roughly 22 percent of individuals living in one of these top markets have seen a 3-D movie, while only 15 percent of individuals living outside of these top markets report seeing a 3-D movie in the last year.

While the return of 3-D is just now picking up steam, consumers are taking note. Some 32 percent of US adults say they've heard, read,

¹ Designated Marketing Area (DMA) is a geographically defined media market

Nearly 26 percent of consumers say they would prefer to watch a movie at the movie theater in 3-D over watching the same movie at the movie theater in 2-D

or seen something about 3-D video content over the last 12 months. Perhaps unsurprisingly, individuals in major markets are more likely to have heard, read, or seen something about 3-D video, with 38% of individuals in the top 20 DMAs

reporting they've been exposed to information about 3-D content, while only 28 percent of those outside these markets report the same. Nearly a third of the people who have heard, read, or seen something

	% of Total Population	Among percentage of population who have heard, read, or seen something about 3-D content in the last 12 months	Among percentage of population who have heard, read, or seen something about 3-D content in the last 12 months
Interested in learning more about 3-D video content	18%	32%*	28%*
Interested in watching 3-D movies or television shows in your home	16%	20%	19%*
Interested in playing 3-D video games in the home	14%	26%*	19%**
Believe 3-D makes for a better movie experience	19%	30%*	23%*
Would prefer to watch movies in 3-D instead of 2-D	15%	23%*	17%*
Would prefer to buy a 3-D movie over the same movie in 2-D	12%	16%**	12%*
Would prefer to watch a 3-D movie in a movie theater instead of watching the same movie in the theater in 2-D	26%	38%*	36%*

Table II

*statistically significant at the 1% level

** statistically significant at the 5% level

52 percent of consumers who have actually seen a 3-D movie in the theater in the last year say they'll watch another one over the next 24 months.

about 3-D video in the last year say they've also seen a 3-D movie in the theater. Clearly, as consumers are becoming increasingly aware of 3-D video they are becoming more engaged in the media and are in turn going to see 3-D movies in the theater. Even when adjusting for other variables like age, income, and education – individuals who have heard, read, or seen something about 3-D video in the last year are roughly 74 percent more likely to report that they also saw a 3-D movie in the theater in the last year.

Still, there is significant progress to be made – especially when it comes to 3-D in the home. Only seven percent of US consumers say they've seen a 3-D movie demonstration on a 3-D television set, and only three percent say they've actually purchased a television capable of displaying 3-D content.

Understanding the Opportunity and Challenges for Manufacturers of 3-D Capable Hardware and the Producers of 3-D Content

While the 3-D experience within the home remains nascent, it holds

great promise for device manufacturers, content creators, and content distribution channels. Among consumers, there is clear interest and enthusiasm for the 3-D experience. Nearly 26 percent of consumers say they would prefer to watch a movie at the movie theater in 3-D over watching the same movie at the movie theater in 2-D, with 19 percent of consumers believing 3-D makes for a better movie experience.

Interest in certain 3-D related activities also suggests 3-D content could thrive within the home. For example, 16 percent of consumers are interested in watching 3-D movies or television shows in their home, 14 percent of consumers are interested in playing 3-D video games in their home, and 12 percent of consumers are interested in buying a movie in 3-D over buying the same movie in 2-D. It is important to remember that 3-D is still a very new technology and consumers are just becoming familiar with what a true 3-D experience entails. As Table II on the previous page highlights, as consumers personally experience 3-D or as they hear and read more about it, they become increasingly interested in experiencing 3-D across a range of platforms and media types.

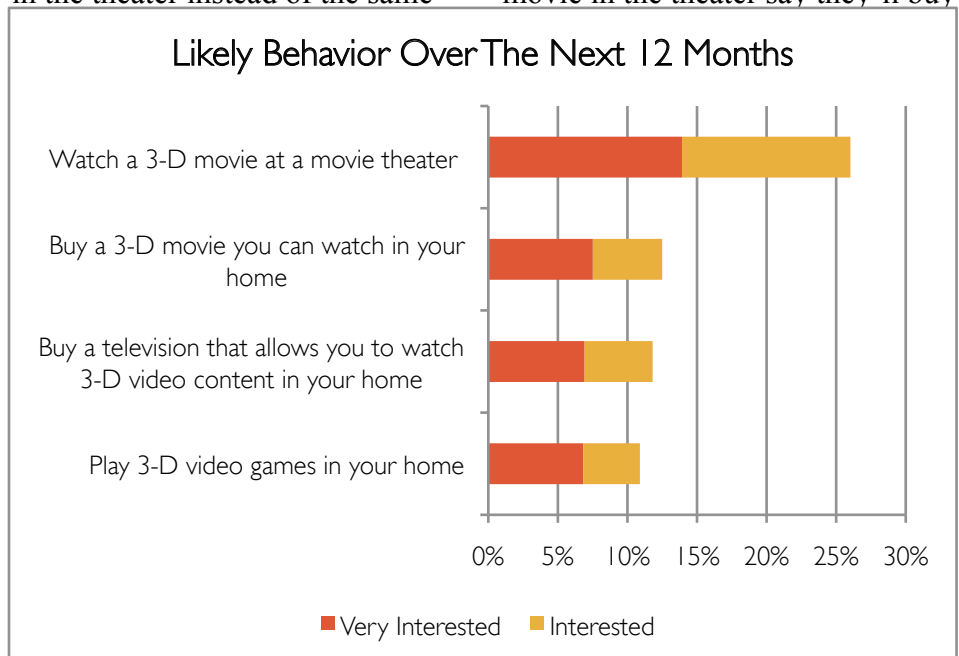
Over half of US adults said having to wear special glasses or holding their heads relatively still while viewing 3-D content would have no impact on the likelihood of them purchasing a 3-D television for their home.

As was the case with technologies like High Definition television, interest in 3-D video content increases as consumers experience it first-hand. For example, while 19 percent of all US adults say 3-D makes for a better movie experience, 30 percent of US adults who have actually seen a 3-D movie in the theater in the last 12 months say that 3-D makes for better movies. Thirty-two percent of consumers who have seen a 3-D movie in the theater in the last 12 months want to learn more about the technology compared to 18 percent overall and just 15 percent of consumers who have not seen a 3-D movie in the last 12 months.

For those who saw a 3-D movie in the last year, 38 percent say they would prefer to watch a 3-D movie in the theater instead of the same

movie in 2-D – compared to just 23 percent for US adults who have not seen a 3-D movie in the last twelve months. Lastly, while 26 percent of US adults say they’ll watch a 3-D movie in the theater in the next two years, 52 percent of consumers who have actually seen a 3-D movie in the theater in the last year say they’ll watch another one over the next 24 months. These results are significant even when controlling for other consumer characteristics like age, income, and education and make clear that experiencing 3-D first-hand is influencing how consumers perceive the 3-D media.

Experiencing 3-D first hand in the theater looks like it will also influence the adoption of 3-D technologies in the home. Eighteen percent of consumers who have seen a 3-D movie in the theater say they’ll buy



Nearly half of consumers indicated they would spend more to have a television set capable of displaying 3-D content

a 3-D movie for home use compared to just 11 percent for those who have not seen a 3-D movie in the theater in the last 12 months.

With 3-D still in its infancy, the numbers of households interested in 3-D will continue to grow in the years to come. Nearly 16 percent of US adults are interested in watching 3-D movies or television content in their home and 14 percent are interested in playing 3-D video games in their home. All told, more than 26 million households are interested in a 3-D content experience in their home.

The growing interest in 3-D content is also evident in the activities consumers plan to engage in over the next two years. For example, over a quarter of US adults plan to watch a 3-D movie at a movie theater in the next 24 months, compared with just 17 percent of US adults who say they've watched a 3-D movie at the theater in the last year. Nearly 12 percent of US adults plan to buy a television capable of displaying 3-D content in the next two years and roughly 12 percent of US adults also plan to buy 3-D movies for home viewing in the next 24 months.

Once again, seeing is believing. While 26 percent of adults plan to watch a 3-D movie in the theater in the next two years, over half of those who saw a 3-D movie in the theater in the last twelve months plan to do so again within the next two years. The same group of consumers who have seen a 3-D movie in the theater in the last 12 months are also more likely to buy a 3-D ready television as well as 3-D movies they can watch in their home. Similar results are also true for those who have heard, read, or seen something about 3-D in the last year.

See the appendix for a description of 3-D TV technologies which were on display at CES in 2009.

3-D TV Purchasing Decisions

From a methodological standpoint, it can be difficult to ascertain consumers' true beliefs regarding new technologies that many have yet to personally experience. Still, when it comes to 3-D technology, we find a surprising number of consumers apparently unaffected by some of the unique aspects that accompany viewing 3-D content as we know it today. For example, we found that over half of US adults said having to wear special glasses or holding

16% of people age 18-29, regardless of their familiarity with 3-D showed an interest in buying a 3-D TV

their heads relatively still while viewing 3-D content would have no impact on the likelihood of them purchasing a 3-D television for their home. Moreover, these results did not change among the group of the population that has seen a 3-D movie in the theater in the last year.

Access to 3-D content is a logical and natural driver for 3-D capable television sets. Roughly 25 percent of US adults said being able to rent 3-D content would positively influence their decision to buy a 3-D-ready television set. Having access to 3-D content through cable, satellite, fiber-optics, or over-the-air broadcasting increased this number to 28 percent.

As you would expect, the price of 3-D content also influences consumers' willingness to buy television sets capable of viewing 3-D content. Twenty-eight percent of US adults said they would be more likely to purchase a 3-D capable television set if 3-D movies cost the same as 2-D movies. Still, 30 percent of US adults said it would have no impact on their decision to purchase a television set capable of viewing 3-D content if available 3-D movies cost up to \$10 more than standard 2-D movies. Our study revealed a similar find-

ing when looking at the cost of the actual television set. Nearly half of consumers indicated they would spend more to have a television set capable of displaying 3-D content – with 15 percent indicating they would spend an estimated 25 percent or more on a television set capable of viewing 3-D content. Here again, as consumers experience 3-D, they find themselves more interested in the technology and in this instance more willing to spend for the technology. For those who have seen a 3-D movie in the last year, 60 percent are willing to spend more on a 3-D television for their home and 19 percent are willing to spend up to 25 percent more.

The table on the following page highlights the demographic characteristics of those most interested in learning more about 3-D, as well as those interesting in purchasing a 3-D television in the next 24 months. As manufacturers, content producers, and distribution channels look for the greatest market opportunity, these demographic traits will likely show the most promise.

	% of Total Population	Percentage interested in learning more about 3D	Percentage interested in Buying a 3D TV
Age			
18-29	20%	31%	16%
30-49	38%	19%	11%
50-64	24%	13%	10%
65+	16%	9%	11%
Race			
White (non Hispanic)	68%	13%	8%
Black	12%	37%	25%
Hispanic	13%	29%	17%
Other	8%	18%	13%
Education			
Less than High School	6.50%	25%	17%
High School	25.80%	22%	14%
Some College	27.00%	19%	15%
College +	40.70%	15%	8%
Household Income			
Less than \$30K	21%	24%	23%
\$30K-\$50K	23%	21%	17%
\$50K-\$75K	23%	16%	6%
Greater than \$75K	33%	17%	7%
Children	50%	22%	12%
Region			
Urban	52%	20%	14%
Suburban	26%	18%	8%
Rural	22%	12%	12%
Top 10 DMA	27%	25%	12%
Top 20 DMA	39%	22%	12%

Table III: Demographics of Interested Consumers

Q: Assuming you had the capability to view 3-D video content on a television at home, what types of video content would you LIKELY view in 3-D?

Content

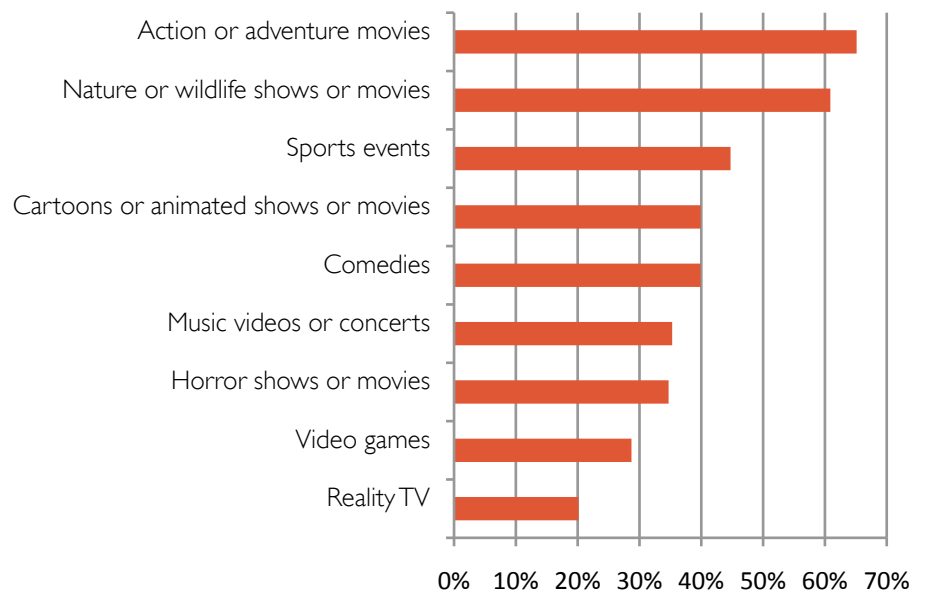
As the figure on the next page highlights, consumers are interested in diverse 3-D content if they have the ability to watch it on a home television set. Over 60 percent of US adults say they will likely watch action and adventure movies and nature or wildlife shows and movies. When forced to select the single most influential content genre influencing the purchasing decision, 22 percent of consumers indicated action and adventure movies. Second on the list was sports programming with 17 percent of US adults indicating sports programming would be the most influential content genre on their purchasing decision, followed by nature or wildlife shows, which were selected by 14 percent of consumers.

Individuals who have seen a 3-D movie in the last year do show more interest in four specific 3-D content genres

than those who have not seen a 3-D movie in the last year. These include 3-D cartoons or animated shows and movies, action or adventure movies, music videos, and videogames. These results might be interpreted in two ways. First, because these four genres are the genres most seen in 3-D, individuals who especially like these four genres may simply be drawn to 3-D because of their personal taste in content. Alternatively, individuals who have seen a 3-D movie in the last year might well have seen one of these genres and left so impressed with their 3-D experience that they are now interested in watching more of the same genre in 3-D. Certainly, when HD was a nascent technology and a wide selection of content was scarce, consumers were impressed with the HD experience regardless of the content actually watched.

As of the writing of this report, most of the major relevant standards bodies have either exploratory committees or full-fledged efforts surrounding 3-D underway.

Broad Interest Across Possible 3D Genres



3-D Standards

For 3-D to become widely available in homes, the major players in the ecosystem (content providers, service operators, distributors, consumer electronics manufacturers, etc.) will need to agree on certain standards to ensure that 3-D material can be created and displayed reliably.

As of the writing of this report, most of the major relevant standards bodies have either exploratory committees or full-fledged efforts surrounding 3-D underway. For example:

- *The Society of Television and Motion Picture Engineers (SMPTE) kicked off its 3-D Task Force in August, 2008, with the goal of creating a mastering format for 3-D material.*
- *The Consumer Electronics Association held the first meeting of its 3-D Discovery Group in October, 2008*
- *The 3D@Home Consortium was officially announced in April, 2008*
- *Other technology bodies relevant to broadcast (ATSC, MPEG, etc.) and discs (Blu-ray Disc Association, DEG, the DVD Forum, etc.) are reportedly looking at 3-D topics as well.*

Concluding Thoughts

3-D content in the home remains in its infancy, but the results of this study

suggest there is great promise. There is early consumer interest, even though information and demonstrations are not widespread. Personal experience with 3-D is clearly key. Throughout this study, we found consumers were more interested in 3-D once they had experienced it firsthand. Therefore, very much like in the early days of HDTV, the ability for consumers to see 3-D on home TV sets will be critical to capitalizing on latent demand. Furthermore, as more movies are released in 3-D in the theaters, more consumers will become aware of the experience, and will likely be more disposed to consume different forms of 3-D content beyond movies, into games, sports, broadcast TV, and the like.

To begin to further understand the technologies, trends, and consumer feedback on 3-D in the home, ETC recently established the “Consumer 3D Experience Lab” -- a successor to its Digital Cinema Lab and the Anytime/Anywhere Content Lab.

One interesting note in closing -- in this study, consumers indicated that 3-D may make them more likely to watch TV in a group than currently watch television and movies together in their home. So, perhaps 3-D can continue and even grow the age-old ability of the television to bond individuals together!

Appendix: 3-D TV Technology @ CES 2009

From ETC's Consumer Entertainment Technology Report -- 1/2009¹

"3D is not a gimmick... 3D is ready for prime time."

- James Cameron
Director

Introduction

Further indicating the excitement about 3D in the home, 3D was everywhere at the 2009 International Consumer Electronics Show (CES). The CE industry is steering 3D toward the home – and it's racing ahead at full throttle.

In addition, Hollywood's 3D push was palpable at CES, evidenced by the top tier, yet-to-be-released content featured in the bigger booths (Cloudy with a Chance of Meatballs, Monsters vs. Aliens, Ice Age 3) and the high profile guests that appeared during keynote addresses.

Sir Howard Stringer from Sony brought out Jeffrey Katzenberg and John Lasseter to preview upcoming 3D projects (Tom Hanks also took the stage) – while Panasonic

announced a new initiative to cooperatively develop a 3D standard to allow full 1080p 3D content on consumer devices.

And 3D proponent James Cameron appeared via video and expressed his enthusiasm regarding the potential of an exciting new home delivery system.

Current Climate

CE manufacturers are actively seeking ways to take 3D technology from the theater into the living room while hoping to bolster consumer interest.

There are approximately two million 3D-ready TV sets in homes today, but there is limited "true 3D" content and broadcasts ready

¹The CE Tech Team:

David Wertheimer, ETC
KC Blake, ETC
George Gerba, Disney
Carolyn Giardina, Journalist
Bryan Gonzalez, ETC
Dennis Kuba, Disney
Phil Lelyveld, Advisor to ETC
Rob Scott, Media Consultant



Tom Hanks shows Sir Howard Stringer how to use Sony's 3D specs.

“Unlike earlier attempts, it’s not just a gimmick to try to sell a bad horror movie. It’s a whole different picture now.”

- **Doug Darrow**
Texas
Instruments

to roll. Chris Chinnock of 3D@Home Consortium and Insight Media predicts there will be 3.5 million 3D-ready TVs in homes by year’s end; Michael Lewis of Real D puts the number at 10 million within five years.

Are Consumers Ready?

One way to drive adoption is to broaden the variety and quality of



available content. At CES, Sony and 3ality Digital presented a 3D version of the FedEx BCS Championship game shot using 3ality’s image-capture technology and transmitted live in 3D to 80 theaters around the country via Cin-edigm’s CineLive satellite network.

The take-away for many was that this was another good test and positive next step; however, there is more experimentation and learning to be done. The critical point is that creative and technical forces will need to continue to work together in order to foster 3D’s

development and to train the 3D filmmakers and artists of the future.

Products & Solutions

While consumer adoption of 3D digital cinema is impacted by a limited number of screens, a lack of content and compatible devices has so far stalled 3D TV. Do consumers still see 3D as a gimmick? Will they go to the trouble of wearing 3D glasses at home? These questions and others were addressed in Las Vegas through a broad range of technology presentations and new products.

Companies including Sony, LG, Panasonic, Philips, Samsung, Mitsubishi and Texas Instruments touted TV technologies capable of displaying 3D. And others such as Real D and Dolby have developed technology that provides the correct visual information to the left and right eye using polarizing lenses that filter two versions of video footage.

Sony, for example, was quiet regarding specifications but made a major push during Stringer’s keynote and various prototypes displayed in its booth. Of particular interest to many attendees were the Real D PlayStation 3 demos that featured a number of videogames

"In the history of film, I believe there have been two revolutionary events: the transition from silent movies to synchronized sound in the 1920s, and then the arrival of color in the 1930s. And now here we are 70 years later, and the movie industry is entering the third period of great revolutionary change with the arrival of 3D."

- Jeffrey Katzenberg
DreamWorks
Animation

in full stereoscopic effect.

Displays

Mitsubishi and Samsung have developed TV sets designed for glasses that use shutters synchronized with the timing of video frames and an infrared cue from the display source. Samsung reported plans to launch its newest stereoscopic 3D product – a 22-inch 3D monitor compatible with NVIDIA's new GeForce 3D Vision graphics card. The system uses active shutter glasses and a 120Hz LCD monitor.

Samsung also showed two prototype 3D displays. The first was a 240hz, LED backlit LCD with full



Mitsubishi LaserVue running 3D.

1080p 3D. This model uses active shutter glasses, but these new glasses are smaller and lighter than the previous design – getting much closer weight-wise to the polarized version. The picture was bright and very compelling. No firm plans announced, but they would probably release it in 2010, and could

see potentially selling 8 million in their mid-range sets. Samsung also had a 240hz micropolarized display running at 720p. Next to the backlit LCD, the polarized display was dim and softer, and the interlacing was quite apparent.

LG showcased 3D TVs with built-in conversion engines that will handle different left-eye, right-eye multiplexing formats including top-bottom, side-by-side, and checkerboard. They also showed a 55-inch LCD XPol, passive-glasses panel, 1920x1080, that accepts top/bottom, side-by-side, and frame-by-frame. It looked great and at 450 nits, actually seemed brighter than other currently available displays.

Texas Instruments demonstrated the new Mitsubishi LaserVue running Dolby 3D and Real D 3D. TI claims the laser technology provides similar brightness to other displays but a much better color purity. The results were impressive.

Panasonic announced the debut of "the world's first 3D Full HD Plasma Home Theater System" (3D FHD) at CES. Panasonic's new system claims to enable the viewing of "true-to-life" 3D FHD images by using a Panasonic 103-inch

plasma HDTV and a Panasonic Blu-ray player, capable of distributing full HD (1920x1080 pixels) images to the left eye and right eye through active shutter glasses.

Compression & Conversion

Companies including Sensio and TDVision are working on compression formats designed to handle the higher amount of information required of 3D footage. Most are trying to remain compatible with existing televisions and convert 2D-to-3D for broadcast.

Sensio previewed its S3 3D decoder that the company says can be embedded into third-party players or can be downloaded to a PC by

consumers (ArcSoft plans to embed S3 into its player technology). TD-Vision Systems demonstrated its encode-once, deploy-anywhere solution to 3D content encoding. The TDVCodec encoding and decoding system for HD 3D supports Blu-ray and broadcast at up to 1920x1080p resolution.

Intel showed the *Monsters vs. Aliens* trailer on a 3D TV that reportedly had been rendered in real-time using Intel's Intru 3D software (the booth also featured demonstrations of 35 games on micro-polarized displays from iZ3D powered by Intel's Core i7 processor). Soyo showcased its 2D-to-3D dimensionalization processing chip – for live signals as well as

“Panasonic doesn't think 3D HD for the home is far away at all. We want to see a Full 3D HD standard created in 2009, so we can start a 3D product business in 2010. But for it to be successful, we know there needs to be adequate 3D HD content.”

- Yoshi Yamada
Panasonic



TDVision Systems offers an “encode-once, deploy-anywhere” solution to 3D content encoding – including 1080p per eye display encoding.

About 3D:

"It's like dreaming with your eyes open."

- **Jon Landau**
Producer

prerecorded media – that they claim eliminates the need for a PC/processor between the STB and the display. Soyo takes a Hyundai LCD display and builds in a 2D-to-3D dimensionalization processing chip. The dimensionalization, which works for live signals as well as prerecorded media, adds a 4-second delay to displaying the image. They say that they synch and similarly delay the audio, but it wasn't clear how that would work for home theater systems. They are showing a 46-inch 3D HDTV display for Blu-ray and live broadcast signals, and 22- and 24-inch monitors for gaming.

Samsung, in addition to its prototype 3D LCDs, demonstrated real-time 2D-to-3D conversion that was also very compelling.

Dolby demonstrated its invention aimed at delivering 3D to the home. The setup: A Mitsubishi 3D-ready TV with active glasses, a Panasonic Blu-ray player and an HDMI cable connection. It played 3D with the setup via a Blu-ray Disc that was created by using a Dolby development for pre-filtering and preparing the content for encoding (H. 264). It next played the 3D content on a Hyundai 3D-ready LCD TV with passive glasses. The

goal was to show that one could get 3D in the home via standard players and available display systems, as well as mimic current professional and consumer paths. Dolby added that the technology could also lend itself to broadcast apps.

3D Without Glasses

Several companies including LG, NEC and Philips showed 3D TVs that do not require glasses, but viewers typically seemed frustrated – or at least disappointed – with the experience when they weren't perfectly positioned for the full effect. LG showed an autostereoscopic 42-inch (VGA resolution) aimed at digital signage. As one viewer re-



A new generation of 3D glasses.

marked, "It's not bad when you're in the sweet spot."

Philips offers a display that bypasses the glasses altogether by playing specially created videos that contain two frames for each scene, one with color information, and the other with grayscale depth

“3D is not something you watch... It's a place you're taken to.”

- **Yoshi Yamada**
Panasonic

information.

Alioscopy has developed 3DHD autostereoscopic 3D LCD displays with an open architecture that allows standard video to be shown and 3D content to be rendered with off-the-shelf 3D software applications. The demonstration was interesting, but again, one needed to be positioned just right for the experience to be worthwhile.

And More...

CES attendees also saw other 3D-related items including NVIDIA's GeForce designed to make any game or movie 3D (a consumer

alternative to Real D), Miracube 2D/3D switchable LCD monitors, new 3D glasses from Vuzix with a built-in camera for “augmented reality visualization,” the 3D Minoru webcam from Novo, and impressive 3D gaming monitors from iZ3D.

A start-up called PrimeSense is making possible a 3D (webcam-size) camera that captures 2D+ depth data in realtime. Using the depth map, they can create real-time keys and mats that allow for the removal of the background. PrimeSense has made a smart business model decision to be a fab-less



Vuzix showed an early prototype of 3D video glasses with a built in camera linked to software for an augmented reality experience. Unlike purely video viewing glasses, the new Vuzix model is constructed with see-through displays – along the lines of heads-up displays in aircrafts and cars – so you can see the world through the video.

semiconductor company and to work with major OEMs to create and market the hardware, while working with creative and software companies to build applications and games on top of their software.

Forecast

Adoption of 3D TV will be contingent upon standards for recording, transmitting, receiving and interpreting 3D signals – and compatible discs, players and TVs that uniformly display 3D content. And despite 3D's prevalence at the show, manufacturers are still waiting on content. Samsung reps, for example, explained they are thinking about how to potentially bring the active shutter glasses LCD model to the market, and what various bundles (glasses, movies, etc.) might be, but they want to know that there will be content to drive adoption.

Jeroen Brouwer of Philips 3D Solutions contends the industry is in need of a 3D standard to effectively move forward. (Additionally, he believes the mass market will not accept 3D in the home until there are glasses-free TVs.) On the technology, he observed progress at CES and believes there are displays that are ready for market, “but without an established for-

mat, we only have one-half of the puzzle.” With this in mind, Philips is committed to participation in the SMPTE 3D Task Force, CEA, EBU and other standards-setting initiatives (this commitment was mirrored by other vendors).

Additionally, the ETC and USC will be working to raise the bar in terms of training young professionals. According to Perry Hoberman of USC: “There is an ever-growing need for professional filmmakers with experience and training in stereoscopic 3D, and no one is better poised than the USC School of Cinematic Arts to take a leadership role in the development of this new medium, which is exactly why we are currently establishing a new Center for Stereoscopic Imaging.”

We've reached a point where the market for 3D in the home has legitimate potential (and a growing number of proponents, as emphasized at CES). For 3D TV to become a reality, commercial adoption will be reliant upon the industry identifying and leveraging new strategies, new forms of compelling storytelling, and the tools and standards to effectively bring it to fruition.

There's much work to be done, but

the vendors at this year's CES want us to believe that we are closer than ever before.

“The studios are putting a lot of money into producing 3D movies for digital cinema, and there’s an incredible slate of 3D movies coming,” in 2009, said Brad Hunt, former chief technology officer of the MPAA and now president of consulting firm Digital Media Directions. “They’re now very interested in creating a thriving 3D home video market to generate payback for their investments in making these movies.”