The Potential of 2D Animation as a Digitally Produced Art Form

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The computer graphics imagery revolution of the past decade has brought 3D animation to the forefront in Hollywood cinema, leading to the popular opinion that 2D animation is obsolete. However, digital animation techniques are giving rise to a new incarnation of 2D animation as a digital art form. The quality, accessibility, efficiency and vitality of digital production allows for new styles of 2D animation not possible before the advent of computer graphics. Computers allow for entirely new ways of producing, managing and enjoying animated films. Much of the public sees 3D animation as the product of this digital revolution, and anything else as obsolete. But 3D animation is only half of a larger digital revolution for all forms of animation. The success of 3D has led to a major oversight of the potential for 2D animation in a digital medium. This potential will begin to be realized in the coming years as digital 2D animation processes mature and rising artists push the boundaries of innovation that digital production systems allow.

Background

While many pioneers of animation were dabbling in film and drawings during the late 1800s, the first true example of American animation is by James Stuart Blackton, who was introduced to filmmaking by Thomas Edison. Blackton produced several pieces combining live action with some stop-motion animation, and eventually made *Humorous Phases of Funny Faces* (Fig. 1), featuring stop-motion shots of drawings on a blackboard. It is often considered the first true animated film. Animation techniques quickly developed thanks to contributions of additional pioneers like Émile Cohl, Winsor McCay and Walt Disney. Within 30 years, it had solidified as a specific art form.

Throughout the 20th century, Animation as an art form had split off into a wide range of styles and techniques. 2D animation was the flagship of the industry since its tighter control allowed for fluid movement and lively character performances. The development of “limited animation,” or animation that is styled not to follow a realistic approach, allowed 2D animation

to be produced at a practical speed and cost for mass distribution on television. Meanwhile, stop-motion animation languished as a distant second to 2D. Although it offered the advantage of not requiring continuous redrawing of characters, the technique produced stiff, chunky movement and required more capitol to build sets and characters.

During the 80s, computer graphics imagery began to emerge as a new tool for producing special effects in film and television. Industrial Light and Magic, the company founded by George Lucas for producing special effects in *Star Wars*, established a CGI department in 1979 for producing effects in his films. This computer graphics department was eventually sold to Steve Jobs in 1986. Dubbed Pixar, it set out as a computer hardware company selling CGI systems to government and medical organizations. Pixar began producing short CGI animations to demonstrate the uses of their hardware and submitted the shorts to SIGGRAPH, proving the practicality of CGI animation. In 1995, *Toy Story* was released, marking the first fully CGI feature film in the history of animation. The success of *Toy Story* and subsequent Pixar movies proved that 3D animation was a viable technique for the entertainment industry, and by the early 2000s, several other big studios adopted the technique with their own 3D animation departments. This shift in attention to 3D animated films caused a steep decline in 2D animation projects. As of today, Disney has not released a 2D animated film in theaters since 2004.

A Comparison of 2D and 3D

Currently, 3D animated feature films dominate the box office. A popular opinion exists that 2D animation in cinema is an obsolete technology, inferior to 3D animation. This had lead to a major oversight regarding the relationship between 2D and 3D animation styles and how they have transitioned into a digital world. It is true that digital 3D animation does have some advantages over traditional 2D animation, but to compare these two animation techniques directly is a bit short sighted.

What the majority of the public does not realize is that 3D animation is more appropriately compared to traditional stop-motion animation because it is, essentially, a digital recreation of a stop-motion production process. It is ironic that the most popular type of cinematic animation today is based on the techniques that languished in the background for most of the past century. In a 3D realm, characters are modeled and rigged very similarly to stop-motion figurines. Just as in stop-motion, the characters are placed in environments with cameras and lights, and the world is animated frame by frame to create the illusion of motion. The only major difference between stop-motion animation and 3D animation is that with 3D, the entire set exists digitally. The extreme control over this digital reality allows for movement and aesthetic qualities never before possible in stop-motion. CGI was such a huge step forward for stop-motion that it was hard to draw obvious connections, and gave 3D animation a more unique identity as an entirely new form of animation.

This elusive connection can be demonstrated by analyzing the 2006 animated film *Flushed Away* (Fig. 2), a collaboration between Aardman Animations and Dreamworks Animation. Aardman, of Wallace and Gromit fame, has a long reputation as a modern, successful stop-motion animation studio. During the production of the feature film *Flushed Away*, the significant role of water in the story presented a problem for the stop-motion techniques normally used. Water is particularly difficult to film in stop-motion and can easily damage the plasticine character models. In order to avoid major production problems, Aardman decided to create the entire film using modern CGI animation. Artists created the digital character models directly from the plasticine models, and in order to more fully emulate a stop-motion feel, animators did not add motion blur to the mouths of the speaking characters. What resulted was a movie that looks and feels a great deal like Aardman's previous stop-motion work, but is completely digitally created. When compared to Aardman's most recent stop-motion feature, *Wallace & Gromit in The Curse of the Were-Rabbit* (Fig. 3), the similarities are numerous. The 3D

space is clearly defined with photographic depth of field and volumetric shading on figures. Both films also feature similar usage of bright colors and three-point lighting systems. When comparing still frames, *Flushed Away* has a slightly smoother, softer look, while *Wallace & Gromit in The Curse of the Were-Rabbit* has a grittier appearance; the real-world set has a more complex interplay of shadow and ambient light, and the models feature more erratic textures with a greater degree of real-world imperfections not duplicated in the CGI film. Overall, though, they are very much alike.

Still, *Flushed Away* is about as close as 3D animation comes to stop-motion. The technology has begun to diversify since its creation as artists explore the range of styles possible in the medium. Compare the Aardman aesthetic of *Flushed Away* to the photorealistic style of *Final Fantasy: The Spirits Within* (Fig. 4), the wooden marionette style of *Star Wars: The Clone Wars* (Fig. 5) or the cel-shaded comic style of *Waltz with Bashir* (Fig. 6). Each style attempts to emulate a particular kind of aesthetic found in other genres of art. As research expands, new kinds of 3D rendering algorithms allow for these new artisitc styles. As with traditional forms of animation, artists will instigate research and development as they search for new ways to realize their creative visions.

While this multitude of aesthetic styles seems quite diverse, it is the motion of the characters that connects them all as digital 3D entities. Returning to the comparison of *Flushed Away* and *Wallace & Gromit in The Curse of the Were-Rabbit,* 3D animation takes a huge step away from its stop-motion counterpart once the characters move. Compared to stop-motion, the control and precision of digital 3D animation with this technique, when done well, allows it to produce much more convincing motion and immersive worlds for an audience. This was the appeal that caused traditional 2D animation to outshine stop-motion, since its 2D plane allowed artists to create smoother, more appealing motion without worrying about a third dimension. If digital animation is not done well, however, it will show in the characters' unnatural movements

caused by the linear tweening of the computer. This same problem exists in digital 2D animation, when automated tweening is applied to 2D transitions.

Just as stop-motion animation has found new life in a digital medium, traditional 2D animation has a digital equivalent. The real issue is that the disparity between the appearances of traditional and digital is much less, although this could change in time. With 2D animation, a set is not built nor is a character rigged (in most cases). Instead, everything is directly created in the realm of the visual plane. The transformation of stop-motion into a digital realm of 3D animation can be just as significant for 2D animation, but it has yet to be completely realized.

Quality

During the past two decades, digital techniques have slowly been changing the way that traditional 2D animation is produced. In the late 80s, Disney and Pixar had developed the Computer Animation Production System, a large collection of hardware and software designed to computerize the post-production process of cel animation, making all inking, painting and sequencing of frames digitized. Artist still created all the frames and backgrounds by hand, on paper, but CAPS provided a more efficient way of painting and compiling these drawings after they were done. It is important to point out that the concept of complete digital 2D animation would use a computer digital from start to finish. The process would be essentially "paperless." Instead of drawing frames on paper, the artists would be creating all drawings in a digital environment either using drawing tablets or alternative digital illustration techniques. CAPS, therefore, has been a kind of intermediary step from a traditional world to the digital age.

To highlight the differences between traditional 2D animation and digital 2D animation, one should consider the evolution of *The Simpsons* cartoon franchise. When *The Simpsons* started out in 1989, the cartoon was produced via completely traditional means (Fig. 7). Drawings were inked on celluloid and painted, and the painted cels were then stacked, photographed and edited. The signatures of this traditional process include the cel flares around characters against

backgrounds, light falloff and color distortion across the visual plane, as well as color inconsistencies across character cels. The creators of *The Simpsons* were some of the longest holdouts in an industry quickly converting to CAPS-like systems. By the end of the 90s, the producers were forced to switch to digital painting because all traditional cel painting companies had gone out of business. In 2006, while producing *The Simpsons Movie* (Fig. 8), producers adopted an entirely paperless process. Animators illustrated characters with tablet drawing screens, then inked and painted the art digitally as well. This entirely digital process resulted in a visually refined style, and offered several unique advantages. In *The Simpsons Movie*, cel flares are avoided, line quality and weight is continually consistent, and color is uniform spatially and temporally. The characters and objects all feature regular use of shadows to add depth, and the movie was produced with a larger color palette than ever used on the television show (Brooks, 2007).

Quality benefits from digital production because on the computer, mistakes can always be corrected. All the same features that stand out in *The Simpsons Movie* can be carefully controlled in a digital form. Clearly, digital production offers several advantages that are immediately visible when viewing the final product of a piece. But there are far more significant advantages in the backend of the animation process that bare mentioning.

Accessibility

The second major advantage of digital 2D animation to be widely recognized is its ability to cater to a wide range of production teams, all the way down to a single person. One of the caveats of traditional 2D animation is the huge demands of resources and manpower to accomplish anything worthwhile. The process required, from start to finish, a large coalition of artists, materials and equipment. As Simon Downs of Loughborough University states, “The problem of animation has always been one of scale. The magnitude of the leap from student animator to broadcast professional was large and frequently overwhelming.” (Wells, 2006). The

huge demands meant that any kind of traditional animation was a large and team-driven endeavor, and not a solitary activity. But digital 2D animation brought with it the tools that changed the scope of how 2D animation could be produced, edited and distributed. Programs such as Flash and Toon Boom offer frame-by-frame illustration on a digital stage, where characters, backgrounds and props can be created and combined digitally without the need of expensive celluloid, paints, lighting and film equipment. Digital 2D animation has the unique ability to scale in its scope, from a huge Hollywood feature film to the simplest short, allowing for a single person to produce their own film from start to finish.

This is by no means an exaggeration, as can be seen in the film *Romeo & Juliet: Sealed with a Kiss* (Fig. 9). Former Disney animator Phil Nibbelink wrote, directed and animated the entire film by himself over the course of 4½ years. Nikkelink used an entirely digital production pipeline, doing all the illustration and painting with a drawing tablet in Flash 4. He was able to get a limited theatrical release of his film and gained a small following as a pioneer of the most extreme type of independent filmmaking (Cold Hard Flash, 2006). Nikkelink's effort demonstrates an entirely new avenue now available to storytellers, where entirely digital production systems can eliminate the need for a large studio infrastructure.

This range of accessibility helps put the basic tools of animation in the hands of a much wider audience. However, quality of craftsmanship becomes a concern: "The low cost of Flash, however, turned everyone into a Flash animator in much the same way that everyone you met was a DJ, or everyone was 'working on a script' – there wasn't always a guarantee of quality." (Wells, 2006). Nikkelink had the advantage of being a professional trained and practiced Disney animator, and was well versed in the feature production process. Accessibility does present a double-edged sword when it allows unqualified artists to produce sub-par animation and infiltrate media sources with lower quality work. This can attach a negative association to digitally produced work.

Some forms of animation do not even require the artist to be trained as an animator. In machinima, video is captured in real time from virtual simulations. Artists control characters within a scene and "act" out the desired motion, instead of creating animation frame by frame. This process evolved from the interactivity in video games, when players found that they could use the real time rendering within a game's world as a storytelling device. Several popular machinima series have emerged on the Internet, such as *Red vs Blue: The Blood Gulch Chronicles* (Fig. 10). Using the video game *Halo*, player characters are manipulated, their motion is dubbed with dialogue and the footage is edited to create an animated film. This process is essentially a real-time 3D animation tool. The ramifications of this technique are interesting. If 3D animation is analogous to stop-motion, that would make machinima analogous to digital puppetry. Could real-time animation also be a practical approach for 2D animation? Considering there is no true 2D equivalent to puppetry, a live-action 2D animation technique would require an entirely original process design. In the author's opinion, it merits experimentation.

Efficiency

Traditional production of 2D animation creates huge burdens on a studio that are lessened under a digital production system. In traditional 2D animation, a slow moving character requires a new drawing for every other frame of the film. If the character is moving quickly, a new drawing must be created for every single frame. Digital animation, both 2D and 3D alike, introduces the option of automated in-betweening, or "tweening." This technology is a digital analogy to tweening process that has been part of the animation process since its inception. A lead animator's most important role is to illustrate the most important poses for a character in motion. But rather than drawing every single variation of those positions themselves, the animator passes these "key" positions to a tweening artist, who then draws the in-between frames based on the lead animator's drawings. The computer takes this process one step further, by eliminating the human and making it all digital. When tweening digitally,

animation software uses algorithms to draw each frame in between a pair of extreme positions created by the digital artist.

Another major hurdle for traditional methods lies in the relative cost of producing animation in the real world. Both processes will require expensive equipment to produce quality work, but traditional animation requires additional overhead in order to produce final animated video: film, paper, drawing supplies, ink, paint and celluloid. These materials are all unneeded in a digital production pipeline.

Digital production techniques not only save money, they also save time. When drawing traditional frame-by-frame animation, an artist would need to run demo sessions to record and test the quality of a character movement or run cycle. This would take at least 24 hours for the animation to be shipped to the photographer, recorded onto film and the film sent back to the animator for review. But in a digital world, that motion can be created and played back instantly, allowing the artist to immediately identify and correct mistakes. Inking and painting has a large degree of unknowns in a traditional sense as well. When producing *The Simpsons*, the producers would ship key drawings and time sheets to the tweening and painting studio on Korea, and two or three months later the animation would come back in fully inked, painted form. But no process is perfect, and several retakes were requested for every episode. These retakes are both time-consuming and expensive, and require additional time as the producers wait for the retakes to be completed, inserted, and reviewed. Digital production allows artists to avoid all of these burdens; rendering a scene on a computer takes minutes to do a task that used to take months.

Working in a digital realm offers the ability to correct mistakes, working towards a pre-established vision, but the flexibility of the medium also allow for high levels of experimentation never before possible. Swappable assets and characters allow for endless possibilities, and the relative ease of swapping these assets makes experimentation a worthwhile investment when

developing a project. Artists can instantly create multiple renders of different backgrounds, props or characters. They can modify speed, duration, position and scale to any degree and almost instantly compare results. This quick and inexpensive experimentation is crucial to developing the potential of digital animation as a device for new kinds of storytelling.

Another large advantage of digital 2D production is the ability to reuse material indefinitely throughout a single episode or across an entire series of shows. Digital assets in production pipelines never lose quality and require zero additional time or money to implement into new footage. These assets can also be duplicated. So if the script calls for a forest or snow storm, artists need not create hundreds of trees or thousands of snowflakes, they only need to create one. From there the asset can be cloned and instanced across the scene, saving amplitudes of time and energy. Digital animation also has the clear advantage of being infinitely sharable and distributable. If more than one studio is working on the same project, and assets need to be shared between collaborators, digital assets can be shared instantly and for an infinitesimally small amount.

Vitality

Digital 2D animation found its first practical applications as an ideal distribution mechanism during the relatively early days of the Internet. When dial-up access was prevalent, connections and codecs alike were not powerful enough to provide streaming video as we know it today. Instead, 2D vector animation was the ideal way of delivering streamlined animation during the end if the 90s. This was the original driving force of the development digital 2D animation.

Since Flash began as a necessity for delivering animation over low bandwidth connections, content created in Flash is often assumed as overly simplistic. This is apparent in the earliest episodes of the web cartoon series *Homestar Runner* (Fig. 11). Launched in 2000, *Homestar Runner* started out in an extremely crude form to keep file sizes low and reach a wider

audience. While the look is greatly refined today, *Homestar Runner* still is distributed in its native Flash format. In order to keep file sizes small, this "classic" Flash style requires the use of primitive shapes, solid colors, limited shading and no textures. It has come to be the style most often associated with Flash animation.

Today, the widespread availably of broadband Internet connections and maturity of streaming video proliferation has changed the way web content is viewed. Instead of delivering animation in a Flash format, it has become more acceptable to convert Flash animation into video for sites like YouTube and Metacafe. This means that the style of Flash animation is no longer dictated by bandwidth constraints, but is free to adapt any look or feel imaginable. Nickelodeon's first all-digital cartoon series, *El Tigre: The Adventures of Manny Rivera* (Fig. 12), demonstrates the influence of this style on popular culture and modern professional productions. *El Tigre* is animated in Flash, but offers a rich variation on the earlier Flash cartoons of the Internet. Because it is being produced for television and video distribution, simplicity of the figures is irrelevant. Higher levels of detail will no longer adversely affect video file size. Therefore artists are free to illustrate the characters in any way they choose. Characters in *El Tigre* are rich in detail, color gradients, surface textures, and lighting effects. Environments feature various surface textures and details. While the overall style borrows the unrealistic hard edges, smooth curves and sharp corners of "classic" Flash art, the additional detail allows the style to define a unique feel for the cartoon, free from the "classic" Flash archetype. The role as a space-saver put a lot of restrictions on what could be done with 2D animation and kept the digital world locked in a fairly rudimentary style for several years. But this kind of modern thinking has allowed 2D digital animation to not be stereotyped as a tool for bandwidth shaving, but an entirety new medium for storytelling.

One could argue that there is a large amount of unexplored value in the abstraction of traditional animation ideas within a digital realm. When photography gained prominence as the

new way to capture and represent reality, painting was freed from the burden and began to evolve in new ways that led to contemporary art abstraction. If 3D animation begins to take on the role of the ideal representation of an objective reality, then perhaps 2D animation will branch out into more abstract forms of expression in much the same way. Digital production also would help facilitate this, because the art is no longer confined to pen and ink materials. Colors, lines and shapes can be created digitally in an infinite variety of styles.

There also is a great deal of unexplored territory in hybrid style animation: the combination of core 2D assets and 3D rendered elements. This is actually where 3D animation first entered the mainstream media, as it was first implemented into complex environments in large Disney movies such as *Beauty and the Beast* (Fig. 13). In the ballroom sequence of *Beauty and the Beast*, the ballroom itself was a 3D rendered environment. This early use of 3D is apparent, with its extensive use of lighting gradients and material textures. The motion of the room stands out as well, since traditional backgrounds hardly ever changed shape and perspective in congruence with foreground characters. 3D animation found other methods of fitting into 2D animated genres. In the Cartoon Network miniseries *Star Wars: Clone Wars* (Fig. 14), 3D objects like buildings and ships were rendered to cohere with the flat, cartoon style developed for the show. By using a shading algorithm to replicate the look of painted 2D cartoons, inorganic objects could be quickly and consistently rendered in 3D, a task that would have been very laborious if done by hand. In the figure shown, the clone soldiers are normal 2D illustrations, but the ship behind them is a 3D model that has been rendered to match the characters' style. Alternatively, 3D modeling can be composed of any number of 2D and 3D elements. The ratio of these elements can have a large impact of the style of the scene, and is an area of great potential for future experimentation.

The extreme rush to 3D features has already created a desire to return to the nostalgic appeals of 2D animation. With the upcoming 3D animated Disney film *Rapunzel* (Fig. 15),

director Glen Keane has expressed his intent to push the capabilities toward a more traditional look: “After two years of finding that there is something special about hand-drawn pushing CG in a direction that can happen, I realized that this is a necessary drive. I want to make the computer bend its knee, to execute what an artist envisions, to make it respond like a pencil.” (Animation World Magazine, 2006) As the figure shows, the conceptual style of *Rapunzel* is being pushed to resemble an oil painting. Keane mentions that he does not want complex features like photorealistic hair; instead he wants to instill a warm kind of sincerity in the style of the film, a kind of “more dimensional animation.”

The Future of Animation

In 2004, the Disney Feature Animation department decided that audiences only wanted to see 3D animated films and consequently shut down their traditional 2D animation studio. The Computer Animation Production System that had changed the way animated feature films were produced only 15 years earlier was completed dismantled and scrapped. Only one CAPS machine was left installed for reading old movies made in this format. The best-known name in animated feature films of the last century had given up on 2D.

CAPS was last used during production of the animated short, *The Little Match Girl* (Fig. 16). The film was created using the same 2D process as all Disney features over the past decade, but became a channel for the growing desire among directors to try new styles in animation. Director Roger Allers wanted *The Little Match Girl* to have a watercolor look to match the painted backgrounds. The film’s artistic coordinator, Dave Bossert, described the colorization process: “We were able to do [the painting] in our CAPS system by processing the line drawings to give it the appearance that pigment pooled towards the edges of the paint shapes as it does in real watercolor paintings. We were also able to create a mottled grain within the painted character.” (Barbagallo, 2006). This experimentation in the late life of traditional 2D animation would be a spark that led to new stylization efforts.

When Robert Iger became the new CEO of Disney in 2005, he pulled the company in a direction back toward its more imaginative, creative ideals and tried to shed accumulated layers of bureaucracy. The Disney acquisition of Pixar in 2006 caused a large influx of some of the world's most talented animators, and appointed John Lasseter as chief creative officer of the Disney/Pixar animation studios and principal creative advisor for Walt Disney Imagineering. Lasseter and his colleagues at Pixar helped to reinvigorate an interest in the roots of animation and the potential for creating new 2D animated feature films. By now, though, restoring the CAPS system would be difficult and expensive, and even then the hardware would be extremely obsolete based on today's standards.

Instead, Disney has begun experimenting with what it calls a "paperless" production pipeline, that is, digital 2D animation. The first experimental form of this to be seen in theaters was the 2007 short *How to Hook Up Your Home Theater* (Fig. 17). The film was a modern take on the classic Disney shorts of the 40s and 50s, starring Goofy as an unlucky everyman attempting to mumble through the difficult task of setting up a modern HDTV entertainment center. The film was done 50% with traditional hand-drawn paper illustrations and 50% digitally, so both could be compared side by side. "The whole idea of going primarily paperless with the Harmony/Cintiq package was not only to make the short efficiently, but also to set the table for the 2D features coming down the road," explains Kevin Deters, co-director of the film. "What they wanted to do from a leadership standpoint is examine how we did things in the past and figure out what we could do better," (Desowitz, 2007). Comparing *How to Hook Up Your Home Theater* to a classic Goofy short, such as *How to Fish* (Fig. 18), illustrates the sophistication possible in a digital system. *How to Hook Up Your Home Theater* is remarkably true to the original. Background softness, line tone, shadow and shading all correlate well, making *How to Hook Up Your Home Theater* seem like it came out right alongside the others. The noticeable differences in the modern short would probably be the wider color range (notably the bright

orange of Goofy's shirt) and quality of image. Not surprisingly, these are the same qualities that stood out in the animation of *The Simpsons Movie*. These early examples point to a strengthening reputation that digital 2D will develop as more work becomes purely digital. The believability of this "neo-classic" Goofy short also is testament to the limitless range of styles that can be achieved in digital 2D animation. Undoubtedly, the range between *Homestar Runner* and *How to Hook Up Your Home Theater* demonstrates the wide visual capabilities of the medium.

There was a possibility that Disney would expand this paperless technique for production of its upcoming 2D animated feature film, *The Princess and the Frog*, which represents Disney's first attempt at a 2D feature since 2004. But recently the studio has announced that all animation will still be conducted via traditional methods using paper. A new pipeline for digital post-production has been developed to replace the CAPS system. Still, the proof that entirely digital 2D animation can succeed lies in the thousands of popular Internet cartoons and new digitally-produced shows on television. These upstart concepts are freer to experiment and invent future methods, while Disney is choosing to be safe and stick with methods in use for nearly a century. It was the Disney company that was the first to prove a feature-length animation was possible, but this author expects that it will take the work of new artists and technicians to prove the potential of fully-digital 2D features.

Conclusion

Several insights can be deduced from the information collected in this essay. The underlying structure of thought supporting these ideas is that 2D animation and 3D animation both have traditional and digital forms, and the evolution into this digital manifestation has been different for both types of animation. While digital technology has revolutionized the 3D animation process, 2D animators are still reluctant to accept new digital techniques. A major oversight exists whereupon these animators do not realize the huge potential that 2D animation has as a digitally produced art form.

Certainly the information regarding future animation projects seems to point toward a growing trend of 2D animations that want to be more like 3D, and 3D animations that want to be more like 2D. This leads the author to wonder if the digital revolution will bring about a slow merging of the style types until the line between 2D and 3D animation can no longer be clearly defined. This is good news to the world of animation because a desegregated animation landscape would lead to a greater emphasis on individualistic animation styles, regardless of dimensional origins.

The digital animation revolution is just now entering its third decade of development. There remains much to be discovered when it comes to the new possibilities with digital production. While 3D animation is still maturing, 2D animation has barely begun its own process of experimental development. This potential will begin to be realized in the coming years as digital 2D animation processes mature and rising artists push the boundaries of the directions of growth that digital production systems allow, giving the public new ways to experience old and new stories alike. The vigor and determination of young artists today will continue to drive the digital revolution of tomorrow. Someday, their efforts may well find a harmony between 2D and 3D animation and establish an overarching brotherhood in the animation realm. They will nurture a new art form that allows a full range of style to mature and develop into a long future of conceptual and meaningful storytelling.

Figure 1.
Vitagraph Company of America. *Humorous Phases of Funny Faces*. 1906. 3 min.
http://www.imdb.com/title/tt0000554/.

Figure 2.
Dreamworks Animation. *Flushed Away*. 2006. 85 min.
http://www.imdb.com/title/tt0424095/.

Figure 3.
Aardman Animations. *Wallace & Gromit in The Curse of the Were-Rabbit*. 2005. 85 min.
http://www.imdb.com/title/tt0312004/.

Figure 4.
Square Company. *Final Fantasy: The Spirits Within*. 2001. 106 min. http://www.imdb.com/title/tt0173840/.

Figure 5.
Lucasfilm Animation. *Star Wars: The Clone Wars*. 2008. 98 min. http://www.imdb.com/title/tt1185834/.

Figure 6.
Bridgit Folman Film Gang. *Waltz with Bashir*. 2008. 90 min.
http://www.imdb.com/title/tt1185616/.

Figure 7.
20th Century Fox Television. *The Simpsons*. Season 1. 1989. http://www.imdb.com/title/tt0096697/.

Figure 8.
Twentieth Century-Fox Film Corporation. *The Simpsons Movie*. 2007. 87 min. http://www.imdb.com/title/tt0462538/.

Figure 9.
Phil Nibbelink Productions. *Romeo & Juliet: Sealed with a Kiss*. 2006. 76 min. http://www.imdb.com/title/tt0830199/

Figure 10.
Rooster Teeth Productions. *Red vs. Blue: The Blood Gulch Chronicles*. 2003. http://www.imdb.com/title/tt0401747/

Figure 11.
Harmless Junk. *Homestar Runner*. 2000. http://www.imdb.com/title/tt0847172/

Figure 12.
Nickelodeon Animation Studios. *El Tigre: The Adventures of Manny Rivera.* 2007. http://www.imdb.com/title/tt0805837/.

Figure 13.
Walt Disney Feature Animation. *Beauty and the Beast*. 1991. 84 min. http://www.imdb.com/title/tt0101414/.

Figure 14.
Cartoon Network. *Star Wars: Clone Wars*. 2003. http://www.imdb.com/title/tt0361243/.

Figure 15.
Walt Disney Animation Studios. *Rapunzel* . 2010. http://www.imdb.com/title/tt0398286/.

Figure 16.
Walt Disney Feature Animation. *The Little Matchgirl*. 2006. 7 min. http://www.imdb.com/title/tt0816562/.

Figure 17.
Walt Disney Animation Studios. *How to Hook Up Your Home Theater*. 2007. 6 min. http://www.imdb.com/title/tt1114718/.

Figure 18.
Walt Disney Productions. *How to Fish*. 1942. 7 min. http://www.imdb.com/title/tt0034873/.

Sources

Barbagallo, Ron. “Shedding Light on the Little Matchgirl.” Animation Art Conservation. 2006. Retrieved 27 Oct. 2008. < http://www.animationartconservation.com/little_matchgirl.html>.

Beck, Jerry. Animation Art: From Pencil to Pixel, the World of Cartoon, Anime, and CGI. New York: Collins Design, 2004.

Brooks, James L.; Groening, Matt; Jean, Al; Scully, Mike; Silverman, David; Castellaneta, Dan; Smith, Yeardley. *The Simpsons Movie*. Audio commentary [DVD]. 20th Century Fox, 2007.

"CAPS (Computer Animation Production System)." Nation Master. Retrieved 25 Oct. 2008. <http://www.nationmaster.com/encyclopedia/CAPS-(Computer-Animation-Production-System)>.

Cholodenko, Alan. The Illusion of Life. Sydney: Power Publications, 1991.

Cholodenko, Alan. The Illusion of Life 2. Sydney: Power Publications, 2007.

Corsaro, Sandro, and Clifford Parrott. Hollywood 2D Digital Animation: The New Flash Production Revolution. Boston: Course Technology PTR, 2004.

Crafton, Donald. Before Mickey. Chicago: The University of Chicago Press, 1982.

Desowitz, Bill. "How to Hook Up Your Animated Short at Disney." Animation World Magazine. 16 Nov. 2007

Gilland, Joseph. “The Animated Scene: ‘Paperless Animation Production’ — Myth or Reality?.” Animation World Magazine 16 May. 2006

"Little Mermaid Team Discusses Disney Past and Present." Animation World Magazine. 8 Sept. 2006. <http://news.awn.com/index.php?ltype=cat&category1=Events&newsitem_no=17907>

McClean, Shilo T. Digital Storytelling: The Narrative Power of Visual Effects in Film. Cambridge: The MIT Press, 2007.

“One Man, One Movie, 112,000 Drawings.” Cold Hard Flash. 17 Oct. 2006. Retrieved 26 Oct. 2008. <http://coldhardflash.com/2006/10/one-man-one-movie-112000-drawings.html>

"Pixar Animation Studios." Ohio State University. 20 Oct. 2008. <http://design.osu.edu/carlson/history/tree/pixar.html>.

Simon, Mark. Producing Independent 2D Character Animation: Making & Selling A Short Film. Oxford: Focal Press, 2003.

Subotnick, Steven. Animation in the Home Digital Studio: Creation to Distribution. Oxford: Focal Press, 2003.

Walters, Faber and Helen. Animation Unlimited: Innovative Short Films Since 1940. HarperCollins Publishers, 2004.

Wells, Paul. The Fundamentals of Animation. Lausanne, Switzerland: AVA Publishing SA, 2006.

Williams, Richard. The Animator's Survival Kit. London: Faber and Faber, 2001.