

Physics in Masaaki Yuasa's Films: Space-Time Light and Shadow

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ABSTRACT

Film provides a concrete form for time's existence. It freezes the linear time of human perception, and quantifies it through editing and cutting, making it closer to the essence of time to a certain extent. Without the bondage of reality, animation can freely design scenes, and compositions, to present the infinite possibility of time and space. This paper analyzes Masaaki Yuasa's first film, "Mind Game" and deconstructs its unique light and shadow expression and space-time concept. By comparing the high similarity between the space-time construction in the mind game and Einstein's theory of relativity, this paper combines art and physics to analyze the formation of Masaaki Yuasa's stream of consciousness technique. In Masaaki Yuasa's film Mind Game, he created a high-speed world, well constructed space-time and demonstrated Einstein's theory of relativity. The Mind Game differs from a three-dimensional point of view and a naturalistic expression. The image of character and space in the Mind Game directed by Masaaki Yuasa highly coincides with the space-time described in Einstein's theory of relativity. Masaaki Yuasa's film shows more possibilities for animated films to explore it.

Keywords: Masaaki Yuasa, Einstein, theory of relativity, animation, Four-dimensional space.

1. INTRODUCTION

In 2004, Masaaki Yuasa brought the space-time advantage of animation to the extreme with his first film Mind Game. His style is unique, his works have strong personal color, and his visual expression is extremely Fauvism, with bright colors and changeable collocations that go beyond the limit of imagination. His unique style has a lot of repercussions. The exaggerated characters and randomly distorted time and space make the audience seem to travel around in a dream. Masaaki Yuasa made excellent use of the special expressiveness of animation to show the high-dimensional that we can't perceive. Time and space cannot be seen in the three-dimensional world. They seem to not exist.

The research on Masaaki Yuasa's films is mostly about its unique character design and painting style. There are also many discussions about perspective and distorted lens of his films. This paper tries to explore the essence of time and space in Masaaki Yuasa's mind game from his unique painting techniques and the concept of high-dimensional space and time embodied in his films.

Special relativity [1] is a theory published by Einstein in 1905. It creates a new view of space-time and describes

the concepts related to time expansion, length contraction, and the Doppler effect.

At present, there is no relevant research in the academic circles. Although there are a lot of analysis on film space-time, there are few literature combined with relativity. Therefore, this paper aims to explore the infinite possibility of space-time expansion of animation space endowed by nature in combination with the theory of relativity and the use of multi dimensions in animation. The research on the space-time presentation techniques in Masaaki Yuasa films will be helpful to animators who want to expand the space-time expression forms of animated films in the future.

2. EINSTEIN'S THEORY OF RELATIVITY

According to Einstein's theory of relativity, three-dimensional space (real world) adds to one-dimensional time and becomes four-dimensional space-time. The world described by Masaaki Yuasa in the mind game is just like what the objects look like in the four-dimensional space-time of the high-speed world described in the theory of relativity.

3. SPACE-TIME CONCEPT IN MIND GAME

3.1. Animation concept

Masaaki Yuasa has been committed to changing the spatial form of animation. He doesn't want to draw animation realistically. He said in an interview that he wants to make an animation that looks like an animation (different from the real world). "In 3D animation, the shapes don't change when it moves. I think in 2D animation, we should show what the author wants to express by layout design, deforming shapes of objects or characters and changing how we draw background, etc." [2] The painting method is not limited to realism which makes it easier for Masaaki Yuasa to approach the space-time form different from the space on Earth. The technique of deforming shapes of objects or characters is used in the *Mind Game* to explore the story of time reversal. This visual effect combined with the plot coincides with the space-time presented in Einstein's theory of relativity.

3.2. Plot

This film is divided into three time-space effects: the main story line and two memories of the sub-storyline. In the first part, Nishi was shot by Atsu, the gangster who was chasing the father of Nishi's childhood crush Myon. After Nishi died, he went to heaven and saw God. Because he was unwilling to die, he ran desperately to the blue gate leading to the return, then he was reborn. In the second part, after rebirth, Nishi killed Atsu and ran away with Myon and Myon's sister Yan. Finally, the car fell off the bridge and everyone fell into the belly of the whale. Nishi, Myon, and Yan met an old man who had lived here for 30 years. They began struggling to escape in the belly of a whale, and eventually they got out and flew into the air. Then there is the montage of the protagonist's life experiences. The part about the future fragment is like them in a parallel universe, and the story has changed. The third part is that the film goes back to the beginning of the film when Aniki (Senior Yakuza member) is ready to hunt them down, but at this time, Aniki seems to have experienced a reversal of time, so he made a different choice. Thus, Atsu doesn't have enough time to follow Myon to the subway, and everyone's lives change. The sub story line tells the story of the time period between the old man in the belly of the whale and Myon's father. The two memories are at the beginning and end respectively, and the content also changes.

4. MASAAKI YUASA'S SPACE-TIME NARRATION AND CREATIVE TECHNIQUES

4.1. Doppler effect of light

Masaaki Yuasa used a lot of wide-angle perspectives to show the scene. The distortion brought by this perspective is a major feature of him. The strange feeling of the combination of wide-angle perspective and space and character deformation makes the *Mind Game* seem to show a time and space reaching the speed of light.

In fact, the plot itself is just like a story about a person surpassing the speed of light and going through time travel. After Nishi was shot by Atsu, Aniki said: "it would be good if I had a time belt." Thus, after Nishi entered heaven, Nishi made the first time travel. There are two blue and red gates on the left and right sides of the God. The God let he enter the red gate and wait for his fate which is to disappear. But Nishi didn't want to die like this, so he entered the blue door and began to run desperately. Because the images of the characters are very flat, and the space in the blue door is very three-dimensional, its perspective effect becomes very strange, like a two-dimensional creature walking through the light. The red and blue gates here correspond to the Doppler effect of light. [3]

The Doppler effect shows that when a car approaches us, the wavelength becomes shorter and the frequency becomes higher, which will produce blue movement, and the sound we hear will be sharper, while when it is far away from us, it will have the opposite effect, and the sound we hear will become lower. When combined with Einstein's theory of relativity, this theory means that when an object rushes towards the observer at a speed close to the speed of light, its light color should be blue when it rushes towards them and red when it goes away. Red represents expansion and distance, while blue represents contraction and approach. In the story, God let Nishi go to the red space, which means that he would be far away from the present world and die. When Nishi returns to the present world, he has to try his best to get into the blue gate. Finally, God was moved by him and let him surpass the speed of light and go back in time. Thus, he returned to the tavern where Atsu killed him.

4.2. Scene analysis when approaching the speed of light

The most amazing twist of time and space is the escape scene after Nishi returns to life and kills Atsu. He drives his car and is chased by the gang boss. In this part of the play, Masaaki Yuasa uses the ultra wide-angle lens to the extreme. Through the distorted perspective, the twisted and inclined streets give people a feeling that the space is squeezed. Dynamic lines give people a strong visual impact. The space is integrated into a specific whole, and the characters and environment are constantly changing shape. Nothing is limited by appearance or physics. This is similar to the image of the shape of people and things when they move close to the speed of light. This chase

play well visualizes the scene seen by the characters when they approach the speed of light, and time and space become a part of the plot. When approaching the speed of light, the flattening of space makes the object look squashed, the shortening of length leads to an increase in height, and this is the two-dimensional figure that Masaaki Yuasa has been showing. Space is not nothingness, but one of the substances that make up the world. Einstein likened space to an entity that can bend, deform and fluctuate. "Human beings are not in an invisible square box, but more like trapped in a huge and easily deformable mollusk." [4] The space in the mind game is constantly changing. When the audiences look aside from Nishi's car, the objects passing through the window are the same as those described in Einstein's theory of relativity when approaching the speed of light. The width shrinks, the height becomes longer, and distant objects begin to move closer, which shortens the medium range. This creates the feeling of flattening the landscape. When the train reaches half the speed of light, the object on the outside of the train will lengthen vertically. [5]

When the speed increases again, the right angle disappears and is replaced by an arc. The disorder of time and space is manifested as a stream of consciousness. After their car fell off the bridge, he returned to become the little blue man of his first death. He ran forward desperately and shouted "I didn't want to die," but his body disappeared in the process of his running. The God's voice sounded in the background and said, "Why are you back so soon?". At this time, it can be understood that Nishi is already dead. The time pause here can be understood in three ways. Firstly, a stop in which time does not pass due to his death. Secondly, if the chase scene shows the image of a person approaching the speed of light, the expression after the car crash is the time stop because he's reaching the speed of light. When the speed is close to the speed of light, the current state will expand and devour the future and the past, and the interval between the past and the future will be smaller and smaller. When the speed of light is realized, the three states of time will be integrated into one, so it will become the eternal present that will not change. Third, his life with Myon in the belly of the whale can be understood as a pause in time. Nishi, Myon, Yan, and the old man in the whale have been isolated from the world outside the whale. For people outside the whale belly, since the infinite expansion of time is no longer felt, the images and clocks of Nishi, Myon, Yan, and the old man are frozen forever. The time dimension they feel is different. The isolation in the whale's belly gives them a sense of time pause.

When the last four people try to escape from the whale's belly, the chaotic scene is also like trying to escape from a black hole. Yan's body is infinitely elongated into a silk like spaghetti, which coincides with the visual effect of people outside the black hole looking at people in it "As you get closer, gravity will gradually

tear apart the atoms of your body until the nuclei of your atoms are pulled into spaghetti too." [6] When they finally escape from the whale's belly and the montage ends, the scene of the old man's time belt rotating counterclockwise indicates that time is going back. Then the film goes back to the scene of Aniki sitting in the car monitoring Myon at the beginning. He turned to confirm where he was and looked like he was in a magical trance. It was obvious that he had experienced time travel. Unlike the two-dimensional drawing at the beginning of the film, he became a three-dimensional shape in the rearview mirror. He no longer chooses to chase Myon as at the beginning of the film, but runs to the station to find his old lover. Therefore, Atsu has no time to run into the subway to catch up with Myon, and their lives have changed. Finally, after the change, everyone has changed from two-dimensional person to a real person, and the world has changed from gray to color, indicating that everyone has come back from their own mind game. He seems to flatten the three-dimensional space on the two-dimensional paper, and the characters are the two-dimensional projections of these three-dimensional real people.

4.3. Parallel universe in "The Tatami Galaxy"

Masaaki Yuasa discussed the theme of time reversal in his first film, *Mind Game*, and then further extended it in *The Tatami Galaxy* to perfectly show the different possibilities of a person in many parallel universes. Different from the time reversal of the *Mind Game*, *The Tatami Galaxy* is a story about a parallel universe. In the last episode, the protagonist can cross different parallel worlds through his bedroom. In other words, his room is a universe, a Misner space. [7] His bedroom is like a wormhole. The left wall and the right wall are similar to the two mouths of the wormhole, and he can go to another world by crossing the bedroom wall. Masaaki Yuasa constructed a wonderful story through the time and space of complex narrative magic reality. He expressed the idea that life is the result of your choice, which is the core idea contained in *Mind Game*. It shows the world of Feynman's historical summation, [8] and quantum has all possible history. The uncertainty of quantum mechanics means that the universe has more than one history. Trace the universe back in the opposite direction of the big bang to the Planck scale. The historical summation of particles is the historical summation of the universe. Different paths will lead to different universes.

5. PAINTING SKILLS AND STYLE

5.1. Dimension game

Masaaki Yuasa used a lot of watercolor, real people, collage, and other techniques in the mind games. Two dimensional plane figures and watercolors are incompatible with the perspective background. Such an inconsistent painting style makes the characters seem to

be collaged on the picture. Even the occasional real people do not appear in the form of a three-dimensional object, but rather like printed photos superimposed on children's graffiti. Masaaki Yuasa said in the interview: "It's like getting into the picture. If it's cardboard, it will be a sign that I entered in two dimensions, but when the watercolor background actually comes out and I think It's a picture, suddenly there is a perspective and it is three-dimensional. It would be interesting to move to. It is good that there is a space properly in the rough-cut image that a proper background is moving in 3D rather than a proper background is moving properly in 3D I thought it was." [9] Such collages are like the spatial relationships covered by origami art. In the *Mind Game*, when Nishi tells Myon the story, Masaaki Yuasa draws the characters in the story told by two-dimensional characters into three-dimensional. The inversion of three and two dimensions here is really interesting. It seems to symbolize that two-dimensional is higher than three-dimensional, as the people in Einstein's four-dimensional world look like two-dimensional.

5.2. Masaaki Yuasa's painting style

In general animation, space is a normal whole. Characters exist in the animation space, which has no relationship to internal objects. But in Masaaki Yuasa's space, he attached the characters to the space and turned them into something of quality. At the same time, his use of color is very exaggerated, and he has participated in many Fauvist techniques. The lines and composition of objects can be changed at will, and the sky can be any color. Therefore, many colorful images are piled together in Masaaki Yuasa's films to express emotion and imagination. He used color to reflect depth and depth, thus replacing shadow and perspective.

5.3. Two-dimensional character

Another strange feature of Masaaki Yuasa's works comes from the lack of Euclidean spatial depth dimension caused by the elimination of character shadows. His characters and objects lack a dark, three-dimensional sense and shadow. The characters often have no shadow, and even a thin sheet from the side. He completely flattens the polyhedron in four-dimensional space into a plane. Masaaki Yuasa once mentioned in the interview that he wants the painting of *The Tatami Galaxy* looks like the style of printmaking. [10] Actually he uses this style in many of his films. Traditional Japanese prints do not show shadows. As an optical phenomenon, shadow is at the core of the basic concepts of space, time, and light in the West. In low-speed life, the side behind the light source is the shadow. However, at a high speed close to the speed of light, we can see both sides of the object at the same time, and in this way, the light and dark boundaries will be confused, and the shadow will become more and more blurred. When the speed is close to 186,000 miles per

second, the shadow disappears. Without shadows, the viewer cannot determine the time reflected in the painting or where the light comes from. Japanese painters regard shadows as dispensable, which shows that Masaaki Yuasa and Japanese culture have their own way of expressing the relationship between space, time, and light, which was later expressed by Einstein through a formula.

The shadow in Masaaki Yuasa's film is more psychological, not realistic, but the feelings expressed by the characters. He will visualize the emotions and psychological activities of the characters. For example, in the *mind game*, Nishi accepted the encouragement of the old whale in the whale's belly and no longer felt sad. When he danced with Myon and Yan, the space was distorted extremely, and the characters became seven different colors and changed colors constantly. This is the juxtaposition of space to replace the linearity of time. It explains the story and the characters' psychological activities through spatialized scenes. When Nishi first died and came to heaven to see God, the appearance of God was also changing. The God said that what he saw here was just the emotional projection in Nishi's brain. The observation of characters was subjective, corresponding to the viewpoint of observers in relativity, which was the concept of relativity. The psychological activities of the characters in the whole work are enlarged by Masaaki Yuasa. In Masaaki Yuasa's high-speed world, everything can be changed. Whether the events are at the same time or successively, and what color and shape the objects have, are not things independent of human activities.

6. CONCLUSION

To sum up, Masaaki Yuasa creates a high latitude animation world through his unique style. What we create in three dimensions is very difficult, but it can be easily drawn in two dimensions. Animation shows its infinite possibilities. He can turn strong, abstract emotions into powerful scenes. It is also interesting to integrate physics into art. The collision between the two can develop multiple possibilities of the world. There are countless forms of space-time expression of animation, and only a very narrow side is discussed in the paper. Now animation has moved from 2D to 3D, and its expression methods should be richer. However, most of the current animation is not as advanced and stream of consciousness as the animation space expression in 2D era, but more limited to the space-time view of live action film. It is hoped that more artists like Masaaki Yuasa will explore more forms of space-time artistic expression in the future.

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