

## Research Article

# Research on the Application of 3D Animation Special Effects in Animated Films: Taking the Film Avatar as an Example

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Nowadays, 3D animation special effects are used more and more frequently in film and television works. The integration of its animation special effects enhances the visual impact of the film and makes it easier to resonate with the audience. Movies that use three-dimensional animation special effects have a more prominent performance in both visual effects and artistic expression. Taking the film Avatar as an example, this study is committed to providing a reference for the research of three-dimensional animation effects in Chinese film and television works through the analysis of the practical application effects of three-dimensional animation effects. Three dimensional technology provides technical support for film and television special effects, which has achieved unprecedented development. It combines reality with virtualization, brings virtualization to the screen, and then presents it to the audience, contributing to the progress of Chinese film and television art.

## 1. Introduction

With the development of computer software and hardware, 3D animation technology came into being, which has brought great changes to the art of film and television. Xu (2019) believes that 3D animation special effects production is a new multimedia technology derived from computer technology [1]. 3D animation special effects technology can ignore the limitations of time, space, place, characters, and conditions and can display complex, abstract, and attractive visual effects or special effects through computer operation, so as to enrich the image of characters or things in the film. In 1977, the dazzling effects and strange space display in Star Wars made people understand the three-dimensional animation special effects technology for the first time. In 2009, “Avatar”, which was popular all over the world and achieved a remarkable box office miracle, directly announced the coming of the era of 3D special effects.

Today, 3D animation special effects technology has been quite mature and has been widely used in film and television production, such as animated films, film and television special effects, and stunt lenses. The three-dimensional animation special effect technology can simulate the effect of

real objects in the computer virtual environment, reproduce the three-dimensional scene in real life, and improve the beauty of the scene special effect of film and television works. Through the use of three-dimensional animation effects, the level and efficiency of film and television production have been greatly improved. At the same time, the application of this technology promotes the picture effect to achieve a qualitative leap, fully meets the audience’s rising visual requirements, makes the audience feel immersive, and thus increases the audience’s resonance. Zheng said that using 3D animation special effects technology in film and television postproduction can effectively achieve the expected special effects of film and television works [2]. The three-dimensional animation has rich and diverse expression methods, which enhances the artistic expression and appeal of the works, and breaks through the development of general animation art. Su said that with the support of high-tech technologies such as 3D animation special effects, the lifelike “virtual reality” of film and television works can bring immersive aesthetic experience to the audience [3]. Liu said that 3D animation technology can save film production costs, protect the safety of actors, and produce a stronger visual impact effect [4]. Three-dimensional animation

technology plays a beautifying effect and three-dimensional animation technology can be changed at any time to show the three-dimensional sense of these things. Zhu et al. believe that compared with real shooting or other forms of expression, 3D animation technology can express more abundant pictures and display them more freely [5]. 3D animation technology shows complexity, scientific principles, and abstract concepts in simplified and vivid forms. Du et al. believe that 3D animation special effects technology has brought more forms of expression to film and television work. The use of 3D animation and special effects technology can complete the lens with a high difficulty coefficient in film and television works and the lens that cannot achieve the shooting effect, and improve the viewing experience of the audience on the basis of saving time and cost [6]. Hu (2020) directly said that 3D animation special effects technology provides a shortcut for the improvement of film art [7].

Kong believes that, in a sense, the visual effect of using special effect art in film and television production has surpassed the film itself. It shows that 3D animation special effects for film and television are important for films [8]. Of course, no matter how useful 3D animation special effects technology is, the most important thing for film and television works is strategy and creativity. Wang et al. said that in film and television works, 3D animation special effects technology is only an auxiliary technology and its value is to better express creativity. If it is separated from the strategy and creativity of film and television advertising, 3D animation special effects technology will be nothing new [9].

The focus of this study is to analyze the application of 3D animation special effects in animated films, taking the film Avatar as an example. It is committed to providing a reference for the research of 3D animation special effects in Chinese film and television works through the analysis of the practical application effect of 3D animation special effects, and contributing to the progress of Chinese film and television art.

## 2. Development and Characteristics of 3D Animation Special Effects Technology

To make 3D animation special effects, we need to establish a virtual space, use a virtual camera to record the motion change trajectory of the whole animation, then render it, and finally complete the complete video screen through special effects and editing. Three dimensional animation has appeared since the 1970s. Its function is to record the movements of dancers. Later, with the development of computer technology, 3D animation special effects technology has developed well. Nowadays, 3D animation special effects have been widely used in film and television works.

3D animation special effects technology is very convenient and fast. The producer only needs to design the object image, adjust the relevant actions, and set the rendering parameters, and the computer will generate a series of continuous graphic documents according to the relevant programs. 3D animation special effects are not affected by the real place, people, and climate and can

complete the scenes that are dangerous or impossible to shoot in reality. At the same time, whether it is a scene existing in real life or a fantasy scene, 3D animation special effects technology can present it perfectly; the picture it represents will be very real, so that the audience will not feel contradictory or false. In the movie Avatar, the mysterious and beautiful Pandora planet is made by three-dimensional software, in which the Neville and various monsters are all made by computer virtuality.

3D animation special effects technology is efficient and convenient, but it also has some certainty. As a computer technology, 3D animation special effects technology requires a high level of professional technology for the producers of film and television works. In the production process, with the improvement of the complexity of the production process and the required authenticity, the cost of 3D animation special effects technology will also show an exponential growth trend. Avatar has a total investment of 310 million US dollars, more than half of which is spent on 3D digital technology.

*2.1. 3D Animation Special Effects Save Human and Material Resources for Film Creation.* When shooting special effect shots of film and television works, producers need to spend a lot of human, material, and financial resources to make scenes, arrange personnel, and shoot pictures. Some special effects shots are dangerous, and after you spend your energy shooting, the picture may not be able to achieve the desired effect. The three-dimensional animation special effects solve this problem well. By using three-dimensional animation effects, producers can produce realistic scenes, characters, or action pictures.

*2.2. 3D Animation Special Effects Provide a Variety of Forms of Expression.* In the past, in order to create some scenes in film and television works, producers needed to use complex ways to express them, but the final effect of such scenes may not be ideal. Now, because of the three-dimensional animation special effects, producers can use this technology to make realistic scenes and integrate people and real scenes into them, so as to finally produce realistic pictures without conflict, thus improving the artistic value of film and television works.

*2.3. 3D Animation Special Effects Can Bring a Real Visual Experience to the Audience.* In the past, due to the limitations of film technology, the content of film and television works was difficult to display perfectly, so the audience could not fully understand the aesthetics contained in film and television works. Today, 3D animation special effects technology has broken the restrictions of technology on the development of film and television works. Producers can perfectly restore the pictures they want to describe through three-dimensional animation special effects technology, which will increase the beauty and interest of film and television works and thus enhance the audience's sense of film viewing experience.

### 3. Artistic Expression of 3D Animation Special Effects

The great changes brought about by 3D animation have made a great breakthrough in lens expressiveness. In the virtual three-dimensional space, the characters, together with various auxiliary devices, present vivid dynamic pictures for the audience. In the film *Avatar*, adjusting the virtual light can realize the visual feast of light and shadow transformation. Light also plays a vital role in the production of content. As an element of visual art, light and shadow can strengthen the sense of space in the animation scene, promote the three-dimensional scene to be more three-dimensional, and make the picture feel more in depth. A strong sense of context cannot be reflected by ordinary animation or special effects. Both in terms of vision and appeal, it provides a certain reference value for the future development of the animation film industry.

The effective control of light and shadow can better express the inner emotions of animated characters. 3D animation can realize the integration of scenes and characters' inner emotions, adjust colors, and make reasonable changes in light and shadow, so as to enhance the artistic vitality of animated scenes. Therefore, the role of light and shadow in three-dimensional space, model material, and picture effects is irreplaceable. It gives the animation film the soul and makes the animation more vivid and vivid. In the process of character action changes, it also needs to be connected with relevant characters to carry out special effects animation on the whole, presenting a kind of aesthetic feeling on the whole, and dealing with details more carefully to improve the overall quality of the animation film. The audience experiences the processes of immersion, disengagement, and immersive viewing, which can promote the sustainable development of film and enhance the influence of art.

The quality of an animated film depends on the composition of the overall picture. Perception, cognition, and emotion are integrated into the three-dimensional space. The flexibility and diversity of composition give the picture a strong appeal. It not only gives the audience a distinct and impressive visual impression but also plays an important role in promoting the overall aesthetic performance of the film. Three-dimensional animation special effects greatly broaden the expressive vision of animation.

### 4. Simulation Verification

*4.1. Expression Form Analysis of Animation Special Effects.* 3D animation technology can perfectly and accurately present scenes that cannot be shown in reality through computer three-dimensional animation special effects. No matter how complex ideas and diverse the ideas are, modeling, special effects, and background texture can be achieved through three-dimensional animation. With the advantages of animation technology, a three-dimensional simulation model can be established to show the three-dimensional effect of virtual objects through the model, creating a beautifying effect, fully displaying the sense of three-

dimensional design. Visually, it can also be more intuitive and cool, giving consideration to the scene and details. Visual shock requires the layout of all elements in the interaction between the lens and the scene. Now, we analyze the expression forms of 3D animation special effects and ordinary animation special effects, make charts according to the statistical information, and obtain the following Table 1:

Table 1 shows the statistical results of the two groups of animation special effects in the form of expression. The data results of three-dimensional animation special effects in the sense of form design, the consideration of scene and detail, and the layout of all elements have reached more than 92%. From the comparison of the results, it can be indirectly concluded that the image expression processed by three-dimensional animation technology has more rendering power and observability.

According to the data information in Table 1, Figure 1 is obtained:

As shown in Figure 1, the visualization effect of the two groups of data in the form of an expression is shown. Compared with the data, there is a statistical significance of  $t < 10.000$ ,  $p < 0.05$ . It is obvious that there is a great difference between the two groups of data and the display of 3D animation special effects is more tense. Therefore, the development and wide application of 3D animation technology can better adapt to the animation film market.

*4.2. A Comprehensive Analysis of Two Groups of Animation Effects.* 3D technology has given a lot of technical support in animated films, which can preview the design results in advance, see the future display effect, and play a role in boosting the subsequent development of animated films, making the picture more realistic, with more visual impact, complete immersion, and enjoy the beauty of the picture. The addition of three-dimensional animation art has created a new situation for animated films. After the release of the film *Avatar*, it has caused great repercussions in the society and achieved the best market effect. Revolutionary progress has been made in special effects production, and animated films are an important platform to show advanced production technology. Now, we compare the preview results, visual and auditory effects, and audience satisfaction of the two groups of animation special effects. According to the data comparison results, we make a chart and obtain Table 2:

Table 2 shows the analysis results of two groups of animation special effects in the preview results of special effects production, visual and auditory effects, and audience satisfaction. In the visual and auditory effects, the atmosphere can be rendered through three-dimensional animation special effects, making the story more vivid and three-dimensional. The data comparison is as high as 97%, which improves the visual impact. The content of special effects production is also displayed with high-quality effects.

According to the statistical results in Table 2, Figure 2 is obtained:

As shown in Figure 2, the comprehensive comparison visualization effect of the two groups of animation effects is shown. The general animation effects are lower than the

TABLE 1: Expression form analysis of two groups of animation effects (%).

Group	Sense of form design	Give consideration to scenes and details	The layout of all elements
Ordinary animation special effects	73.45	70.38	70.19
3D animation effects	92.34	93.78	93.27

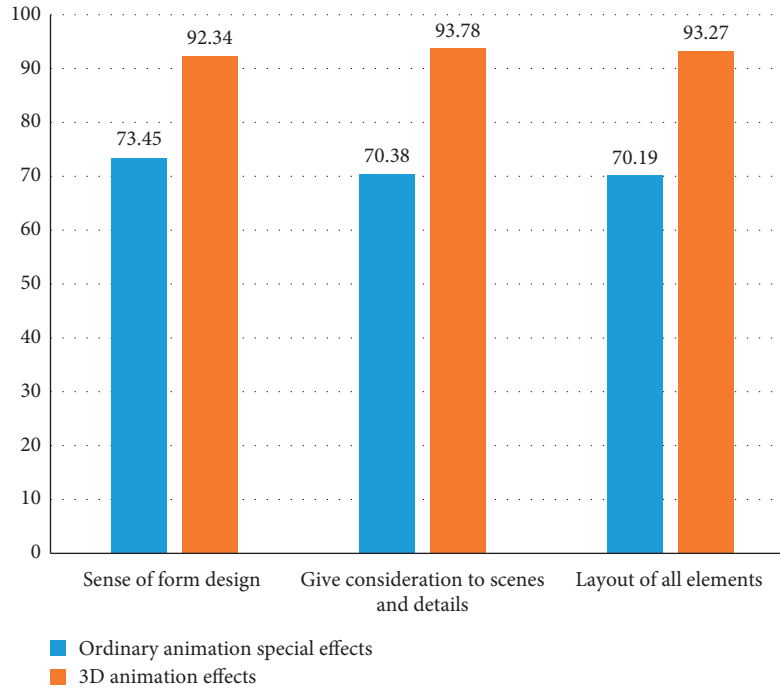


FIGURE 1: Visualization of the expression form of two groups of animation effects (%).

TABLE 2: Comprehensive analysis of two groups of animation effects (%).

Group	Preview results of special effects production	Visual and auditory effects	Audience satisfaction
Ordinary animation special effects	69.34	74.39	73.67
3D animation effects	93.45	97.23	95.54

three-dimensional animation effects in terms of public satisfaction, which indirectly shows that the three-dimensional animation effects can better adapt to the broad audience, and the satisfaction of the audience can directly reflect the impact on the willingness to watch the film.

**4.3. Effectiveness Verification of Two Groups of Animation Effects.** With the rapid development of computer technology, the production of three-dimensional animation special effects has become the main direction of design. Compared with ordinary animation special effects, three-dimensional animation special effects have super-intensity model-building ability, and can visualize the best effects of performance. Under the high-efficiency production content, in the auxiliary elements of the film, the analysis is carried out for the transformation of roles, backgrounds, and lights. Three-dimensional animation has a broader development and application space. The effective collocation of scenes and characters can make the animation more hierarchical as a whole. After the production of 3D animation, it has high

flexibility and diversity. Now, the effectiveness analysis of 3D animation special effects and ordinary animation special effects is verified. According to the data results, charts are made and Table 3 is obtained:

Table 3 shows the efficiency analysis results of two groups of animation special effects. The efficiency, pioneering, and diversity of three-dimensional animation special effects in animation films and television are significantly better than ordinary animation special effects. Under the effect of efficiency, it can improve the work efficiency of production and design, and under the effect of pioneering and diversity, it can improve the quality of animation film and television.

According to the comparison data in Table 3, Figure 3 is obtained:

As shown in Figure 3, it shows the effectiveness of verification and analysis visualization effect of two groups of animation special effects. Compared with ordinary animation special effects, three-dimensional animation special effects can be made into an overall moulding result through design ideas and design drawings, which can show the

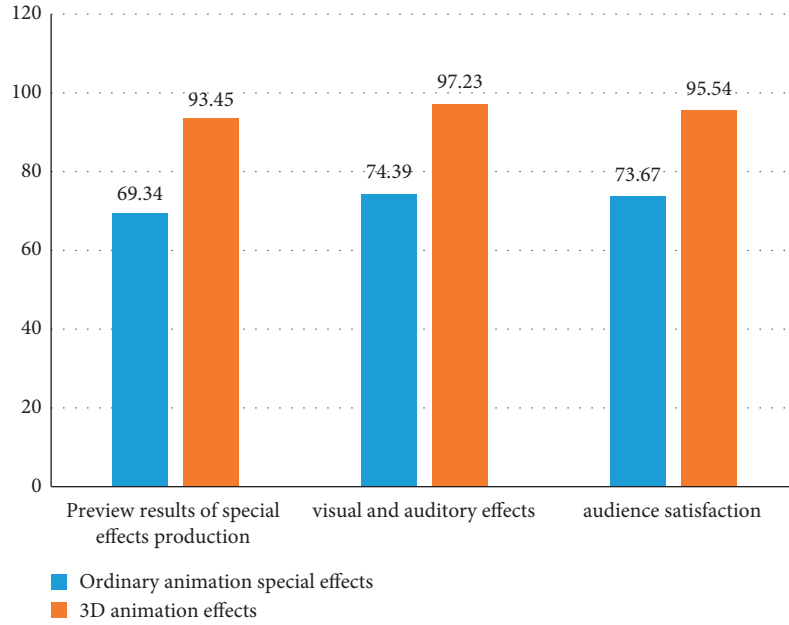


FIGURE 2: Comprehensive comparison and visualization of two groups of animation effects (%).

TABLE 3: Effectiveness analysis of two groups of animation effects (%).

Group	Efficiency	Pioneering	Diversity
Ordinary animation special effects	68.73	68.25	67.58
3D animation effects	95.45	94.37	96.31
$t$	7.564	6.876	7.425
$p$	0.038	0.042	0.039

specific details of animation production. Modeling and simulation technology can better improve the production efficiency and bring the public novel and vivid feelings from the perspective of multiple performances.

*4.4. A Comparison of the Artistic Expressiveness of Two Groups of Animation Special Effects.* 3D animation can not only enrich the visual effects of animated films but also have more artistic expressiveness. 3D animation has become the main trend in the future development of the animation industry. Once a little careless, it will directly affect the effects of animated films. 3D technology makes the animation scene effectively combined with the technology in the production process. The light and shadow of animation are constantly changing, as is the integration of characters and places in the background. Under the three-dimensional animation technology, the virtual environment constructed by the model will simulate the light and shadow, background, and characters in a three-dimensional manner, so as to achieve a very intuitive and three-dimensional picture effect. Now, we analyze the artistic expressiveness of the two groups of animation special effects and make charts according to the statistical data information. Table 4 is obtained:

Table 4 shows the comparison results of the two groups of animation effects in light and shadow expressiveness,

dynamic and spatial expressiveness, and texture and detail expressiveness. From the statistical results, it can be indirectly shown that the animation artistic expressiveness of three-dimensional technology can be better presented, which plays a good role in enhancing the expressiveness of animation art.

According to the expressiveness in Table 4, Figure 4 is obtained:

As shown in Figure 4, it shows the visual effects of artistic expressiveness analysis of two groups of animation special effects. Compared with different special effects, three-dimensional animation special effects can better promote the development of animation films, better adapt to the development trend of the times, and enhance the influence of this effect in the production process.

## 5. Discussion

The development speed and level of the animation film industry are constantly improving. The current development of the application of three-dimensional animation special effects has made the film industry have better progress and development. Both the film screen and the production technology have been greatly improved, which has promoted the better expansion of the performance space of the animation film and improved the production effect and level of the overall film. Cai constructed a film special effect animation in a new aesthetic space by taking the theoretical concept of immersion threshold and aesthetic space as the starting point. Combined with the cooperation of visual and auditory, editing, and cooperation, it will show the immersion of film special effect animation in aesthetic space [10]. Huang can improve the clarity of the video picture presented in the computer digital art design of the film by establishing a digital art model, drawing 3D animation

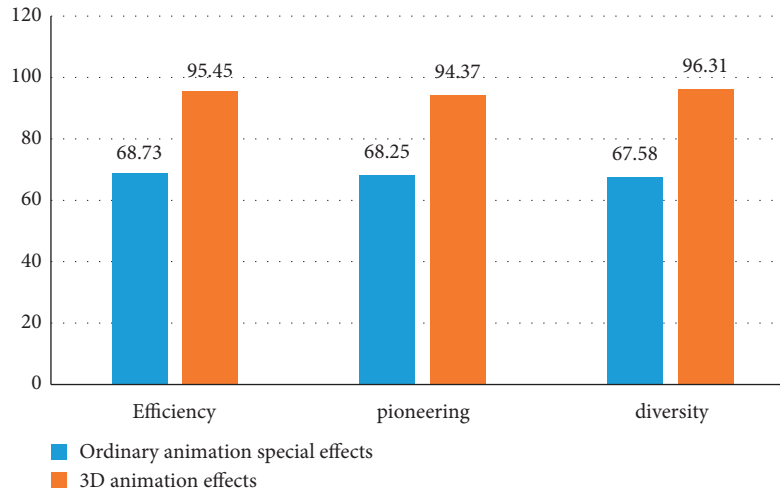


FIGURE 3: Effectiveness analysis and visualization of two groups of animation effects (%).

TABLE 4: Comparison of the artistic expressiveness of two groups of animation special effects (%).

Group	Light and shadow expressiveness	Dynamic and spatial expressiveness	Texture and detail expressiveness
Ordinary animation special effects	70.83	78.62	76.34
3D animation effects	92.67	96.51	96.78

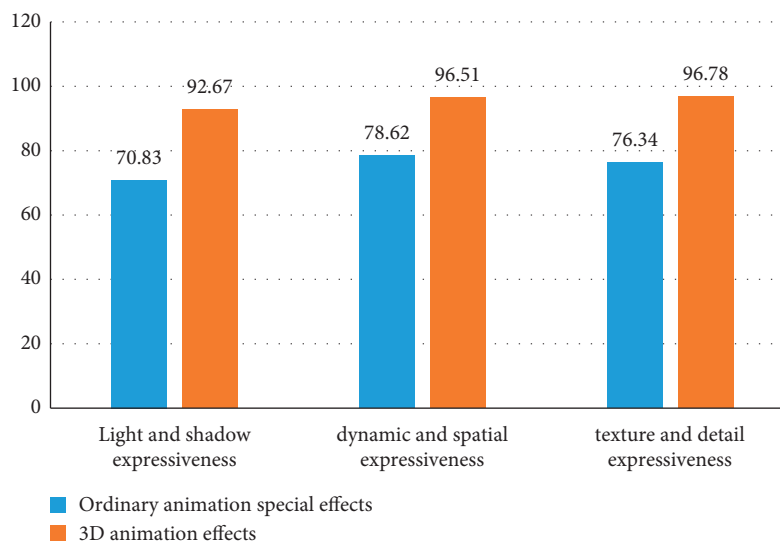


FIGURE 4: Visualization of artistic expressiveness of two groups of animation effects (%).

special effects, and outputting 3D special effects digital art. Compared with the traditional design method, the texture of the picture has been significantly improved, which verifies the computer digital art design of 3D animation special effects production [11]. Wei discussed the interactive animation special effects production of visual communication design. Many advanced technologies will be used for design and creation, making its animation films more appreciative, better realizing the effect of conveying information, promoting the diversification of film forms, and ensuring the effective implementation of three-dimensional animation

special effects technology in the film [12]. Wang pointed out that the application of three-dimensional special effects has become an important manifestation of the extension and integration of animation film art. The unique aesthetics of computer animation and the sensory impact on a broad audience have also promoted the aesthetic picture of virtual reality [13].

Yang et al. showed that the controller has excellent performance in anti-interference and reasonably optimized the parameters of the ADRC [14] The controller is a key part of the whole user experience, especially for the animation

special effects application. Yang et al. can process the image quality through several image processing effect parameters for the adaptive fractional integral mask noise reduction algorithm, which can effectively improve the image enhancement ability of the fractional differential mask [15]. In three-dimensional animation, we make the image more vivid and make the image colour more realistic.

In this study, based on an in-depth study of the impact of three-dimensional animation effects in animated films, this technology has been widely used in the entertainment field: its main applications include film and television special effects and character animation; three-dimensional technology improves the audience's sense of experience when watching animated films. The results show that three-dimensional animation effects not only greatly promote the development of film and television works but also create a new situation for the development of film and television works, bring new vitality to the development of film and television works, and let the broad audience enjoy a beautiful visual feast.

## 6. Summary

This study takes the film Avatar as an example to explore the application of 3D animation special effects in animated films. The integration of 3D animation special effects into animated films can better shoot animated films, so that they have a realistic sense of 3D visual and auditory effects. 3D animation special effects can not only produce animated films but also complete film and television shots that cannot be solved by real shooting. It will not be affected by weather, seasons, and other factors, and has strong modifiability, and the quality requirements are easier to control. It can play an unprecedented audio-visual impact on the stories and products. Three dimensional animation special effects are integrated into animated films, in order to better capture the realism with three-dimensional visual and auditory effects. Audiences get emotional resonance through the on-screen experience. This empathy ability comes from the impact of sensory and unconscious inner perception activities. The experience process from vision to the heart is the expansion of film creation. By analyzing the forms of expression, artistic expressiveness, and visual and auditory effects of three-dimensional animation special effects and ordinary animation special effects, this study can maximize the advantages of three-dimensional animation special effects technology, make a great breakthrough in the expressiveness of film lens, and promote the sustainable development of the animation film industry [16, 17].

## Data Availability

The data underlying the results presented in the study are available within the manuscript.

## Conflicts of Interest

There are no potential conflicts of interest in our paper.

## Authors' Contributions

All authors have seen the manuscript and approved it for submission to your journal.

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