A study of spatial guidance in narrative VR animation under cognitive psychology

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Abstract. With the continuous evolution of virtual reality technology, new forms of media art have emerged. As one of the artistic expressions under this medium, VR animation exhibits characteristics that are distinctly different from those of traditional film media. While embracing the new medium's features, narrative VR animation needs to pay more attention to the delivery of story content. This requires directors to construct a rich and rational guidance system within the virtual space to ensure that audiences can smoothly experience the entire plot without feeling overwhelmed or bored. Therefore, this article shifts the research perspective and explores how narrative VR animation can effectively build a spatial guidance system from the viewpoint of cognitive psychology. It begins by outlining the spatial characteristics of narrative VR animation and then uses cognitive psychology to explain the allocation mechanism of attention resources, analyzing the key spatial factors that attract audiences of narrative VR animation. Finally, taking the VR animation "Gloomy Eyes" as an example, this paper provides a detailed analysis of how it guides the audience through visual, auditory, and motion elements in the virtual space and enhances the viewing experience. The analysis indicates that by integrating the selectivity, sustainability, and transferability of attention, as well as the limitations of cognitive resources, effective guidance designs can be implemented for narrative VR animation in terms of visual, auditory, and motion aspects.

Keywords: Cognitive psychology, VR animation, narrative, spatial guidance

1 Introduction

As Virtual Reality (VR) technology evolves, its devices have been extensively introduced to the market. Production companies continuously attract artists to develop new artistic forms related to this medium, effectively increasing VR's prevalence in society. However, as industry investment and market competition intensify, audience expectations and participation demands for this novel form of entertainment are also rising. Consequently, VR content is increasingly discussed due to its unique media characteristics. [1] Among these, VR animation represents one of the products born from this

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new medium. Therefore, how to utilize the unique features of the VR medium to attract audiences and tell compelling stories has become a focal point for VR animation content creators and interactive video producers. Nevertheless, a significant portion of current VR animation research focuses on interactivity and immersion, which evidently limits narrative-driven VR animations. These narrative VR animations lack extensive physical interaction; however, participating viewers can freely choose their viewing direction without explicit constraints but cannot alter the story framework or details, constituting a superficial level of interactivity. For such VR animations, the challenge for creators lies in narrating a complete story within a virtual space while evoking strong perceptual effects among participants—a goal they continually strive to achieve.

Bordwell elevates the active role of audiences in storytelling to a prominent position in film narrative, treating narrative as a process rather than a statement. He argues that traditional narrative theories prompt audiences to think about films in more complex ways and thus shifts towards developing narrative theories from the activities of the audience. He believes that audiences construct stories within the film according to rules of understanding.[2] The role of the film is to cue and provoke the audience through different modes, with the audience being active during the viewing process. Therefore, there are two core components in his film narrative system: one is the construction of the story by the audience's cognition, and the other is the cues and guidance provided by the text's patterns to the audience's cognition. Regarding the perception and cognition of the audience, Bordwell first finds support from exploring the theory of cognitive activity. In this theory, perception and cognition are closely related. Perception becomes an active process of hypothesis and experimentation. During this process, images lead the subject to make assumptions and inferences, playing a significant role in understanding the story. Additionally, the theory considers the activity of watching films as a dynamic psychological process that controls perceptual abilities, prior knowledge and experience, as well as the content and structure of the film itself. From the perspective of perceptual ability, the characteristics of the human visual system determine the illusionary media features of films. The bottom-up and top-down processes of the visual system during film viewing affect the audience's perception. Secondly, the content and structure of the film itself encourage the audience to construct stories and complete the narrative process. Therefore, interpreting new media art brought about by virtual reality technology from the perspective of audience cognition has research feasibility.

VR animation differs from traditional film media in that it has no boundaries within the frame. The 360-degree panoramic image space not only breaks the conventional film framework but also introduces new challenges: how to effectively guide and maintain audience attention within the space, thereby enhancing the VR experience. Since the narrative perspective in VR animation is no longer constrained, this creates uncertainty between the scenes predetermined by the director and those chosen by the viewer. In response, Ruth Aylett suggests that producers of virtual reality content can attempt to use cues that interest viewers to establish an attention-guiding model, focusing the audience’s attention on crucial plot elements.[3] Some researchers have begun to explore the relationship between virtual reality imagery and methods of guidance, which broadly falls into two categories: one classifies these images accord-

ing to the forms of presentation in virtual reality technology for individual analysis. For instance, Zhang Fan, in "Composition and Visual Guidance in Virtual Reality Films," categorizes VR films into three types: immersive VR films, interactive VR films, and game-like VR films.[4] The other approach classifies visual guidance methods under film narratology, considering coercive guidance as the most direct and effective visual guidance method in VR films. In addition, Dai Yuhong and others have established a guiding system composed of visual, auditory, and interactive elements by analyzing the narrative language features of VR cinematography. Du Xin analyzes the spatial narrative configuration of VR from the perspective of embodied media characteristics, exploring how to deepen the audience's understanding of the narrative. Jia Yunpeng believes that more attention should be paid to the blank spaces in visual design, related targets, and the depth relationships between scene elements during the guidance process.[5] Meanwhile, Brown and others have demonstrated through specific experiments on attention guidance that sound is the most effective method for prompting, and combining character actions with sound effects can better generate interactive behavior. In summary, scholars primarily discuss the audience guidance system in VR imagery based on film narratology, with VR animation, as a subset of VR imagery, seldom analyzed separately regarding its guiding function. This article shifts the research perspective, analyzing the perceptual information and allocation of attention resources of the audience from a cognitive psychology standpoint, thereby exploring how to effectively guide the audience in narrative VR animations within a spatial context.

"Gloomy Eyes," a collaborative VR animation by Jorge Tereso and Fernando Maldonado, poignantly explores the love story between a human girl and a zombie boy who together reignite the sun. This short film received critical acclaim, earning a nomination for Best VR Animation at the 47th Annie Awards and securing the VR Crystal Award at the 29th Annecy International Animation Film Festival's VR section. Given its richer narrative compared to typical VR animations, "Gloomy Eyes" is thoughtfully divided into three interconnected segments, granting viewers the freedom to embark on their chosen chapter. While the film's interaction is confined to visual exploration without altering plot progression or outcomes, meticulous design ensures an immersive experience through a comprehensive guidance system within the panoramic space. This article leverages attention resource allocation in cognitive psychology to analyze the biased tendencies of audiences during film viewing through the basic characteristics of selective, sustained, and transferred attention. Combined with the spatial features of VR animation, a narrative guidance core comprising visual, auditory, and motion aspects is formed. Through specific discussions of guidance cases in these three aspects, it demonstrates that visual, auditory, and motion elements are crucial factors in capturing audience attention in narrative VR animations. Finally, using this tri-core guidance system as an analytical foundation, the spatial guidance configuration in "Gloomy Eyes" is discussed. The film utilizes stereoscopic models and stage effects to establish the story's spatial background, with scenes blending through rotation and deformation. The use of floating islands and theatrical lighting emphasizes scene distribution, focuses audience attention, and guides narrative development. This control over stage angles and adjustable sense of distance enhances the audience's

desire to explore the story background, compensating for the lack of extensive interactivity. Particularly at the beginning of the film, which is a critical scene to attract the audience's initial interest, determining whether they will continue watching. Therefore, this paper uses "Gloomy Eyes" as a case study to delve into the construction of effective navigational frameworks in virtual environments, enhancing storytelling engagement without overwhelming complexity.

To summarize, the research in this paper focuses on how narrative VR animation scientifically constructs a spatial guidance mechanism under the perspective of cognitive psychology. Firstly, the spatial characteristics of narrative VR animation are systematically sorted out, revealing the media innovation qualities spawned by the fusion of virtual reality technology and animation art. Subsequently, with the help of cognitive psychology theory, the distribution mechanism of human attention resources is analyzed in depth, which provides a theoretical basis for understanding the spatial navigation system of VR animation viewers. Finally, this theoretical framework is applied to the detailed analysis of the short film “Gloomy Eyes”, which verifies and demonstrates the practical value of effective spatial navigation strategies.

2 Spatial Characteristics of Narrative VR Animation

Marie-Laure Ryan will present digital narrative through the relationship between virtual reality technology and narrative, and examine narrative modes through the lens of interaction, categorizing it into four: (1)Telling mode: telling someone the story of what happened, as in novels and oral stories. (2) Mimicry mode: acting out a story in the moment, playing the role of a character. (3) Participation mode: creating stories in real time through role-playing and behavioral choices. (4) Simulation mode: implementing the creation of stories by using an engine to realize an arrangement of events according to rules and inputs.[6] According to the four narrative modes distinguished by Ryan, narrative VR animation belongs to the first mode of telling, where the audience participates in the narrative to a lesser extent and is only framed by the interactive interface, and the audience itself does not influence the story itself or change the order in which it is told. It serves to make the story text readable and is only concerned with the physical presentation of the story. Therefore, the audience's interaction with the image is limited to being able to independently choose the angle and content of the image viewing, focusing on playing the anthropomorphic advantage of virtual reality technology to provide the audience with a maximum spatial immersion experience. As a result, the spatial characteristics of narrative VR animation are organized as follows:

Freedom of spatial perspective: Virtual reality technology eliminates the sense of screen boundaries, allowing viewers to escape the frame constraints typical of traditional cinema. Unlike conventional films, where the director's creative intentions dictate viewing content, VR grants audiences autonomy over their visual experience. Consequently, the director's once concentrated power over imagery is progressively diluted. This shift enables uninterrupted storytelling through viewer-controlled perspectives, fostering a personalized engagement with the narrative. However, it also

introduces challenges, as the absence of directed attention may hinder audiences from capturing pivotal story elements necessary for a cohesive understanding of the plot.

Authenticity of the spatial scene: Virtual reality technology crafts an enclosed virtual realm for audiences, liberating them from the confines of two-dimensional spaces to immerse them in a 360-degree panoramic, three-dimensional visual landscape. This omnidirectional perspective fosters a profound sense of spatial envelopment, enabling intimate exchanges and close observation of story characters, thereby intensifying empathy and identification. Concurrently, the integration of spatial surround sound technology wraps the virtual world tightly around the viewer's consciousness, creating an illusion of genuine presence that sparks deep emotional resonance with the narrative, culminating in an authentic and emotionally resonant experience.

The mobility of spatial consciousness: In the pursuit of immersion, VR animations often envelop viewers in a dreamlike visual realm. The boundless nature of this space can lead to disorientation, causing audiences to passively absorb every element without purposeful engagement, which dilutes the narrative's memorable anchors. Typically, an individual's stream of consciousness necessitates a focal point within the environment; it serves as both a mnemonic trigger for recalling past experiences and a thread weaving through the entire storyline. Consequently, distinctive spatial objects become vital for anchoring the viewer's awareness in an otherwise boundaryless expanse, enhancing their connection to the fantastical world presented.

3 Audience's Cognitive Guidance Structure

3.1 Information Processing of Perception

Perception is the brain's comprehensive reflection of the various attributes, components, and their interrelationships of objective entities. It transforms diverse information (such as light, sound, taste, etc.) obtained from the environment through sensory organs into experiences of objects and events.[7] Currently, cognitive psychology regards perception as the brain's organization and interpretation of sensory information, which is the process of acquiring and elucidating the meaning of sensory input. This process involves information processing that relies on an individual's existing knowledge and experience, as well as an active and selective cognitive construction process by the individual. Therefore, contemporary cognitive psychology mainly divides the information processing of perception into two types: bottom-up processing and top-down processing. Bottom-up processing refers to the process starting from external stimulus information, emphasizing the role of retained information in sensory organs in perception. For example, when recognizing English words, one would first identify various features of letters (such as straight lines, slanted lines, etc.), and then combine these features to form words (Figure 1). In contrast, top-down processing refers to the process whereby individuals use their existing knowledge, experience, and concepts to process current stimulus information. For instance, filling in missing words in a sentence based on context.

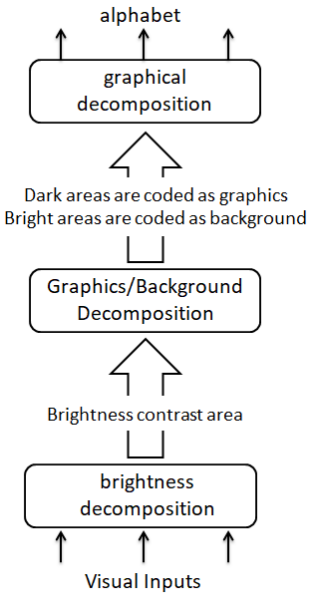

Fig. 1. Bottom-up information processing process.

The process of perceptual information processing reveals that perception is the organization of sensory input into meaningful entities, necessitating an interaction between current stimuli and stored knowledge and experiences to yield outcomes. Consequently, VR animation creators should be cautious when selecting themes and guiding materials, avoiding subjects with low popularity or niche cultural references. This is because audiences, upon entering an unfamiliar virtual space, instinctively seek out and prioritize content and objects that pique their interest and are within their understanding. Conversely, the presence of multiple unfamiliar items in a novel environment not only escalates the initial knowledge investment for creators but also significantly diminishes the audience's sense of immersion and exploratory curiosity.

3.2 Cognitive Resource Allocation for Attention

Attention is closely related to consciousness, yet the two are not entirely equivalent. Attention refers to the direction and concentration of one's mental activities towards certain stimuli. Its core lies in the selective processing and analysis of incoming information while ignoring other stimuli. Attention possesses three fundamental characteristics:

First, selectivity, which means that individuals focus on and select only a portion of the myriad stimuli for processing.

Second, sustainability, implying that based on an individual's goals and intentions, attention remains constant on a particular stimulus over an extended period without being distracted by other stimuli.

Third, transferability, which denotes the ability to shift attention from one stimulus to another according to one's needs, objectives, and intentions.

The three characteristics of attention reveal that it is a crucial psychological activity within the individual. Through attention, individuals select, control, and regulate external stimuli to process and handle the most critical information effectively. From this perspective, discussing the cognitive resource limitations of attention based on the internal psychological mechanisms of viewer attention is essential for addressing issues VR animation producers should avoid when constructing guidance systems. Don Norman has categorized human cognitive activities based on the allocation of cognitive resources into two types: resource-limited and data-limited. Resource-limited refers to situations where sufficient cognitive resources allow smooth cognitive processing. Data-limited, on the other hand, occurs when attention is hindered by low-quality or unprocessable stimuli. In such cases, even an abundance of cognitive resources cannot ensure successful cognitive tasks. These theories on the cognitive resource constraints of attention serve as a vital reminder to VR animation creators to avoid these pitfalls in designing spatial guidance systems. For instance, in a crowded and noisy scene, listening clearly to a character's dialogue can be challenging for viewers, even with heightened attention and substantial cognitive resources dedicated to the task. However, by leveraging the three fundamental features of attention, a smooth viewer guidance process can be achieved. At this point, creators can redirect the viewer's attention by having another character involved in the dialogue break away from the crowd, shifting the viewer's gaze and allowing them to indirectly gather information from the actions of the other character. This process of attention diversion is precisely the spatial guidance mechanism employed in VR animations.

3.3 Spatial Guidance System for the Audience

In traditional movies, in order to attract the audience's attention and stimulate their emotional experience, camera movement, scene scheduling and screen composition are usually used, and the audience's visual focus is controlled through the clever use of picture frames. However, narrative VR animation breaks the boundaries and narrative mode of traditional images, transforming the viewer who was originally outside the frame into a participant in the space, with a significant change in both role and position. However, from a cognitive perspective, the human perceptual system and attention allocation mechanism have not changed. Therefore, based on the previously discussed attentional characteristics and their cognitive resource limitations, combined with the spatial characteristics of VR animation, we can categorize the spatial guidance system into three kinds of guidance modes centered on vision, sound and motion.

Visual-centered guidance

In the perceptual process of human interaction with objects, vision plays a pivotal role as the primary receiver of stimulus information within enclosed virtual spaces, dominating the acquisition of cognitive resources. This sensory modality enables viewers to discern crucial stimuli amidst complex environments. Fundamental visual elements such as light and shadow, as well as color variations, inherently guide viewer attention. The contrast between light and dark areas and strategic color combinations

can accentuate focal points in the visual field, thereby capturing and concentrating the viewer's attention, making them the initial focus of interest. In the animation "Buggy Night," the imagery initially captivates the audience through a stark black background paired with a pair of bright white eyes, facilitating easy comprehension of the visual narrative. Subsequently, a spotlight is employed to direct the viewer's gaze, creating a striking interplay between the illuminated area and its surrounding darkness. The audience's line of sight naturally follows the path of the spotlight, maintaining engagement. This directional guidance not only imparts a sense of orientation but also prompts exploration of the storyline.

Voice-centered guidance

In addition to the visual senses, hearing is the second largest sense among the five senses to receive external information. Unlike the visual information acquisition with the limitation of the human eye's perspective range, the auditory acquisition is omni-directional, which can provide the audience with a wider range of stimulation information and enhance the authenticity of the audience's perception of the virtual world. In the virtual space, the size, orientation and rhythm of the sound are all factors that attract the attention of the audience. Compared with traditional theater venues, space surround sound technology can play a greater effect in the VR space, the close sense of enclosure and and intimate distance so that the sound is transformed into a kind of private stimulation information. At this time, the sound guidance undoubtedly focuses the audience's mental attention, so that the first time to find the location of the sound source and the content of the sound. When visual attention is interfered with, auditory is often a powerful means to divert the audience's attention, avoiding a purposeless shift in the audience's consciousness. For example, in the animation “Pearl”, it tells the process of a father and daughter chasing their music dreams. The whole short film puts the audience's perspective on the passenger seat in the car, and the line of sight is to some extent blocked by the car frame, so the guidance of the sound at this time is particularly smooth. When the childhood girl opens the car window in her father's backseat, the fast and slightly louder sound of the wind instantly draws the viewer's attention to the girl's movements with the bottle in her hand in the dimly lit space. By the time the girl crosses over to the top window of the car and the bottle in her hand creates a regular vibrating sound with the wind, it becomes gradually apparent that she is catching fireflies. The vehicles traveling outside the car, however, are shown by the sound of their horns from near to far and from loud to small, prompting the viewer to change the setting of the story. These sound changes can orderly guide the audience to observe the events happening inside the car as well as the changes of the characters' emotions under the situation of obstructed vision.

Movement-centered guidance

Motion is a significant phenomenon that triggers visual and auditory perception. People's gaze tends to follow moving objects, while hearing can capture motion information faster than sight, endowing moving entities with attributes and a sense of distance. Consequently, motion leverages the combined effect of vision and hearing to attract viewer attention, thereby guiding the narrative progression of a film. In the animated short "duet," the growth stories of a boy and a girl are depicted separately. Despite the lack of vibrant colors and clear audio transitions, the vivid character

movements skillfully converge the viewer's gaze and auditory focus onto individual growth journeys, enabling the complete presentation of two parallel storylines before the audience. Within the film, after the protagonists' first encounter and separation during infancy, a puppy's run towards the left side of the space directs the audience to follow the boy's path. Later, upon their second meeting and parting, the girl's dancing and running motions captivate viewers, prompting them to adjust their perspective. After several similar cross-motion cues, the audience gains a clear understanding of both characters' developmental experiences.

4 Spatial Guidance Analysis of VR Animation “Gloomy Eyes”

This film's narrative span exceeds that of typical VR animations, leading the director to segment the story into three parts. The first part introduces the backdrop of the tale, where the sun hides in response to human hypocrisy, plunging the world into darkness and allowing zombies to emerge from underground. The rulers of humanity command their subordinates to capture these zombies. The protagonist, Nena, a young human girl, encounters Gloomy, a zombie, by chance. The second part recounts the love story between the male and female leads, with the sun no longer feeling alone due to their love. The third part depicts the protagonists overcoming prejudices and hardships together. Ultimately, the sun briefly reappears to take Nena and Gloomy away, leaving the world in darkness once more.

4.1 Visual-centered Guidance

The theme of the story revolves around love and light, with the overall visual guide system characterized by contrasts between warm and cool tones, complemented by the interplay of lighting against a backdrop of darkness. These two sets of visual contrast effects are extensively employed throughout the narrative progression of the story. At the beginning of the film, the audience finds themselves enveloped in darkness, only for their attention to be suddenly drawn to a glowing firefly. The audience's gaze follows the movement of this light source as it circles around before settling on Nena. Nena captures the firefly and places it inside a lantern, creating a makeshift guide light. Subsequently, this focused beam of light follows Nena as scenes transition. The stark visual contrast created by the light source against the pitch-black background compels the audience to focus solely on the single bright image presented in the space, a technique that effectively captures viewer attention through the interplay of light and shadow (Figure 2).Moreover, the film utilizes contrasts between warm and cool color tones to concentrate viewers' attention. As Gloomy and Nena flee from the room, the antagonist opens the door, letting in a beam of red light. Concurrently, the right side of the frame is illuminated by blue light, showcasing the route taken by the protagonists in their escape. This juxtaposition of contrasting colors highlights the difference in areas lit, subtly hinting at the characters' personalities and the unfolding storyline. Furthermore, given that the spatial backdrop is entirely shrouded in darkness, the diversity of colors becomes another means to engage the audience. During Gloomy and Nena's

date, the space is filled with a colorful carnival scene, which stands in stark contrast to the faint and monochromatic light sources seen in earlier segments. Overall, these elements – variations in perceived light intensity, color shades, and hues – serve as crucial mechanisms for guiding the audience's experience throughout the film.

Fig. 2. Path diagram of the firefly.

4.2 Voice-centered Guidance

The audio in the animation "Gloomy Eyes" encompasses music, sound effects, and dialogue. The dialogue is primarily conveyed through a third-person narrator, adopting the perspective of a zombie hunter to narrate the story's progression, assisting the audience in comprehending the plot. Additionally, the spatial orientation of sound effects enhances the appeal of conflict scenes within the narrative. For instance, when Nena leads Gloomy in search of a witch to restore his magic, the transition between scenes is skillfully managed by the changing volume of their approaching footsteps. At this juncture, the harmony between the sound level and the footsteps is maintained. However, the sudden introduction of a distant yet gradually intensifying car engine noise instinctively draws the audience to seek its source, only to reveal it as the antagonist's vehicle. This juxtaposition of two distinct sound elements—the former's crisp and clean footsteps against the latter's loud and chaotic engine roar—creates a stark emotional contrast, facilitating the establishment of a tense and contradictory spatial atmosphere.

Beyond sound effects and dialogue, music plays a pivotal role in guiding and capturing the audience's attention throughout the short film. The setting of the entire piece employs floating islands to evoke a sense reminiscent of stage drama performances, with music serving as an exquisite tool for expressing the narrative rhythm and character personalities. The first appearance of the villain is accompanied by violin melodies and piercing vocals, which gradually transition to a dull and feeble tone as the antagonist descends from above. This sonic shift not only vividly portrays the charac-

ter's role within the film but also lays the groundwork for their personality traits and behavioral motivations.

4.3 Movement-centered Guidance

In this film, character movements are typically intertwined with spotlights and sound effects, serving as connectors for scene transitions. When depicting the living spaces of Nena and the antagonist, the narrative cleverly employs a spotlight to trace Nena's walking path, linking together the entire room. Starting with Nena's slow descent down the stairs into the antagonist's bathroom area, followed by her opening the door and descending further into her own quarters, this fluid sequence of actions is consistently illuminated by the spotlight, effectively capturing the audience's gaze. As the light source fades, the volume of Nena's footsteps on the floor increases, culminating in the sound of a door opening that introduces Nena's room into the frame. This series of movements forms the foundation for scene presentation, where, compared to static backgrounds, the moving characters evidently exert a stronger pull on viewer engagement (Figure 3).

Fig. 3. Trajectory of Nena's movement.

5 Conclusion

Through the aforementioned analysis and discussion, narrative VR animations have transcended the limitations of fixed perspectives and identities inherent in traditional cinema. However, due to the paucity of interactive behaviors, directors are compelled to fully engage the audience's attention and cognition, prompting a conscious selection of crucial stimuli within the virtual space, thereby facilitating the successful completion of narrative activities. From a cognitive psychology standpoint, the spatial guidance system in VR animations leverages the constant characteristics of perception systems

and attention allocation to address the novel features of this medium. By understanding the selectivity, sustainability, and shift of attention, as well as the constraints on attentional cognitive resources, creators can effectively guide their work in visual, auditory, and motion aspects. Consequently, while narrative VR animations continue to prioritize the visual text, the methods employed for guidance within the virtual environment serve as vital means to amplify artistic impact and visual intensity.

References

1. Du Xin. "Attention Guidance-Based Research on VR Narratives." Doctoral Dissertation, Graduate School of Technology & Design, Kookmin University, Seoul, 2020.
2. Bordwell D. Narration in the fiction film[M]. Routledge, 2013.
3. Aylett R, Louchart S. Towards a narrative theory of virtual reality[J]. Virtual Reality, 2003, 7: 2-9.
4. Zhang Fan. Composition and Visual Guidance in Virtual Reality Films [J]. Film and television production, 2017, 23(08):78-82.
5. Liu Congna. Research and Application of Light and Shadow Guidance in Narrative Virtual Reality Imaging [D]. Beijing University of Posts and Telecommunications, 2021
6. Marie-Laure Ryan, " Narrative and the Split Condition of Digital Textuality " dichtung-digital 34.1 (2005), <http://www. dichtung- digital. com/ '2005/1/Ryan> .
7. Liang Ningjian. Contemporary Cognitive Psychology [M]. Shanghai: Shanghai Education Publishing House, 2003.1.