Film in Memory

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As a cultural product that constructs our culture, movie is an important way of spreading ideas and social norms (Kubrak, 2020). The increment of the global film market and higher accessibility of films in the digital era guaranteed the film industry's future and influence (Hennig-Thurau et al., 2021). Therefore, having a theoretical toolkit that helps filmmakers generate attractive films can boost the efficiency of promoting behaviors and thoughts that benefit society. The behaviors and thoughts people learn from movies are stored in memory. Thus, it is vital first to understand how people storing, encoding, and retrieving film s in their memory to develop the toolkit.

Film is a type of narrative structure. Narratives are valuable because they can be remembered and influence individuals' future behaviors. Narratives reflect a sense of time, plot, characters, and other information (e.g., setting, emotion, culture). Researchers work to understand how memory of film is developed and what constitutes them by identifying factors that may influence film encoding, storage, and retrieval. These factors include the discrete structure of narrative memories and the temporal relation between events, emotion, and involuntary memory (Congleton et al., 2020; Cooper et al., 2021; Dev et al., 2022; Frisoni et al., 2021; Jeunehomme & D'Argembeau, 2022; Kurby & Zacks, 2021).

One area in which narrative memory has been investigated is in narrative text comprehension research. Several theories have been developed for how readers store the memory of narrative text. For example, the situation model is the mental representation theorized from text comprehension research. It demonstrates that people develop a non-verbal mental model to represent situations described in narratives (Glenberg et al., 1987). People construct mental representations which help them connect previous and current sentences through the

continuity of situational dimensions (e.g., time, space, and causation). More specifically, a temporal or causal continuity between incoming and previous sentences facilitates readers' process of the incoming sentence (i.e., discontinuity of temporal and causal dimensaion can slow down sentence processing). Early situation model studies mainly focused on single dimensions, but later research gradually integrated different dimensions and showed that readers monitor changes of multiple dimensions simultaneously (Zwaan, Magliano, et al., 1995).

Based on the idea of situational dimensions, the Event-Indexing Model emerged, and it expanded the amount of situation dimension to five (time, space, agent, causation, and intention). The model claims readers determine the connection and relatedness between events through the similarity of these situational indices (Zwaan, Langston, et al., 1995). Moreover, the Event-Indexing Model has been demonstrated in film watching experience and broken down into Event Segmentations as a finer process of understanding narrative comprehension (Zacks & Swallow, 2007). In this process, people detect the event boundaries while tracking the dimensions of the situation model.

To store films into narrative form, audiences must first go through the film encoding process, which largely overlaps with film watching experience. People always express emotion while watching films. It is a part of engagement with movies and a factor influencing film encoding. The definition of emotion is still under debate; however, based on the constructionist approach, it is a psychological construct through interactions between mental activities and physiological reactions (Lindquist & Barrett, 2012). In addition, for general purposes, emotion can be described via the level of arousal and valence. Audiences usually evaluate a film as impressive when they consider it is touching. This indicates a relationship between emotion and

attractivity of film. Therefore, understanding how emotion is involved in film watching is important for finding the key to constructing more attractive films.

Although film encoding and storing are essential, it is the retrieving process that determines a film's influence on individuals. The plots or content of films can sometimes be recalled unintentionally. Such a retrieving process without conscious control is called involuntary memory (Congleton et al., 2020). It may help audiences better understand films' content and therefore be influenced by the films more thoroughly. Different forms and sources of external input may have distinct influences on this unconscious retrieving process of films.

Thus, this paper aims to understand better the process of film encoding, film retrieving, and the static structure of remembered films. First, studies on the static structure of memory for narrative films will be reviewed. Secondly, this paper will review the impact of emotion on film encoding. Third, the nature of the involuntary retrieval of films will be reviewed. Finally, this paper will provide some general conclusions, including limitations of current studies and potential future directions.

Structure of Narrative in Memory

First, narrative films are stored in memory in a discrete form, specifically, a sequence of situation models. Studies of event segmentation support this. In previous studies, event segmentation was demonstrated using the event segmentation task, in which participants subjectively segment either fine or coarse events through self-report (Zacks & Swallow, 2007). In a recent study, Kurby and Zacks (2021) tested the event segmentation hypothesis with film through priming. They found a priming effect on target frames when it comes from the same event as cue frames compared to when they are from different event. This finding indicates people do detect event boundaries and segment narratives into multiple events. More than that,

one experiment of the study isolated the effects of event schema by replacing movie clips with a slideshow containing frames of events in random order. This reduced the chance of performing event segmentation with film-watching strategies. Although the priming effects became less significant in this experiment, the difference between the cross and the within-event group indicates event knowledge was applied during event segmentation.

Other than cognitive methods, there are studies using neurological methods to support the theory about the static structure of films in memory. A study conducted by Cooper and colleagues (2021) evaluated the role of the Posterior Medial Network (PMN) in the film-watching experience. In this study, two subsystems of PMN that react to film stimuli were identified via analyzing the fMRI images of participants recorded during film watching. They are the Ventral subsystem and the Dorsal subsystem. The Ventral subsystem is more activated during event transition, providing neurological evidence of event boundary detection.

However, knowing people segment films into events does not explain why mentally replaying a movie involves less time than watching it. Two hypotheses were stated in a study conducted by Jeunehomme and D'Argembeau (2022): the discontinuity hypothesis and the acceleration hypothesis. The discontinuity hypothesis suggests people only recall fragments of film during mental replay, whereas the acceleration hypothesis claims people recall the whole film with an accelerated rate during mental replay. In the study, the discontinuity hypothesis was supported by the duration of reexperience and content reports of video clips. This study suggested a possibility of how people compress films in memory by extracting fragments of events. The discontinuity of compressed experience also confirmed the existence of event segmentation. While the narratives are stored as a sequence of discrete events represented by event fragments, people also store a continuous sense of events in memory, which is the

temporal relationship between events. In Frisoni and colleagues' (2021) study, audiences' temporal memory was investigated, and a serial position effect appeared when the film is fully encoded. People estimate the time stamp of a frame more accurately if it is closer to the beginning or the end of the movie or the event boundaries. Moreover, when part of the film is missing, audiences would have more space for the missing part on their mental timeline of the film.

Emotion's Impact on Film Encoding

For a film to be stored in a specific narrative structure, a process of encoding must happen first. Many extraneous factors can influence the encoding process, and emotion is one of them. The films that provide stronger emotional reactions are described as more impressive than others by their audiences. However, it is less clear how are such impressive experiences generated through the encoding process. In Dev and colleagues' work (2022), 373 undergraduate students were randomly assigned to watch either a high-emotional arousal or low-emotional arousal clip of a Hindi drama encoded by experimenters. The subjects were then required to recall as many details as possible. In the end, they were given a set of frames from the clips and asked to rearrange them in the order in which they recalled the clips. In the result, the information recalled by the high arousal group shows a higher richness, more details, and higher accuracy on the temporal order of frames. This supported the gust feeling of emotion influences how people view a film's impressiveness as it helps audiences encode films with higher accuracy. However, the study simply operationalized emotion perceived by encoding emotion demonstrated in clips, which is questionable. Also, this study mainly focused on negative emotions. Future studies should be applied to positive emotion and evaluate valence's impact.

Involuntary Retrieval of Film

The stored film and the film-watching experience will be meaningless without the retrieval process since it is vital for generating behavioral and psychological outcomes. The retrieval process can be either intentional or unintentional, involuntary memory falls into the latter category, and it is a common phenomenon in daily life. Sometimes a film scene would replay in people's minds without any signal. A bridge between reality and film can be generated through such experience. Therefore, it is crucial to understand how the involuntary memory of films is triggered to develop techniques of filmmaking that help influence audiences' thoughts. Congleton and colleagues (2020) recruited 520 participants to watch a Point of View (POV) video clip and assess their memory retrieved through Likert-type scales after a cue phase, in which subjects were randomly assigned into the visual cue only, auditory cue only group, and combinatory cue group. After analyzing the relationship between retrieval cues and retrieved information, the researchers found a sensory-modality-specific effect. Visuospatial cues led to more involuntary retrieval than auditory cues, and the involuntary memories triggered by visuospatial cues were more likely to be dominated by visual content. Through investigating the involuntary retrieving process, this study provides insight into the environmental impact of post-watching experiences of films. However, the study used films with only POV shots, while general films are constructed with different shot types. Thus, more studies should be conducted on non-POV films.

Conclusions

Based on the literature presented above, some general conclusions can be made regarding how a film is stored in memory for audiences and how it is encoded and retrieved. First, the static structure of narrative films in memory are sequences of situation models that are

compressed as fragments of events align with a sense of the temporal relationship between them (Kurby & Zacks, 2021; Cooper et al., 2021; Jeunehomme & D'Argembeau, 2022; Frisoni et al., 2021). Second, a higher level of arousal of emotions perceived from films can lead to more encoded details (Dev et al., 2021). Third, the involuntary retrieval of films is more sensitive to visual cues, leading to more retrieval of visual content (Congleton et al., 2020). However, there are several limitations that should be noticed. First, only the arousal level of negative emotion was investigated, and the impact of valence and positive emotion should also be studied. Second, the reliability of the self-report methodology applied in the involuntary memory study should be evaluated. Finally, other than POV shots, more general shot types should be used for studying involuntary memory. While the theoretical framework of how film narratives are structured and stored in memory is mature, the scarcity of studies on film encoding and retrieving should be noticed. In the future, researchers should consider more factors that can potentially impact the encoding process, such as the order of emotions expressed in the films, the physiological condition of audiences during film watching, and the lightening and auditory condition of the film-watching location. Moreover, how films' plots interact with the involuntary retrieval process is worth investigating. Researchers can also focus on how voluntary and involuntary retrieval of film plots helps audiences solve real-life problems. More integrated theoretical frameworks should be targeted. There is currently Scene Perception and Event Comprehension Theory (SPECT) integrating receiving stimuli and comprehension processes (Loschky et al., 2019). However, researchers could expand their scope to post comprehension process and focus more on the cognitive, developmental, and behavioral outcomes of film watching. This will require researchers to develop finer elements that are involved in the interaction between emotion, memory, and other mental events during or after film watching experience. With such finer

elements, an integrated model of film watching experience can be theorized. More specifically, a computational approach should be considered to predict the film-watching experience and outcome more precisely. For instance, a directed graph can simulate discrete narrative structure by using sets of information as the finest elements of recognized event fragments and order relationships between sets as perceived temporal relationships. Such a structure will generate a state machine-like network with high flexibility and abstractness. By studying the manipulation of directed networks of events, it is possible to simulate executive functions' impact during film watching experience.

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