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Visual storytelling through the void: a quantitative analysis of empty shot distribution across film genres

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Empty shots, serving as a distinctive cinematic technique, hold significant prominence within movie narratives, intricately shaping the visual interplay between shot duration and human presence. Despite studies demonstrating the application of empty shots in films, a dearth of quantitative analysis of empty shots across different genres exists, alongside a lack of accurate definitions and associated detection. This study introduces a novel approach that combines methods to define empty shots and assess their occurrence from 1905 to 2019 ($N = 2464$). The sample was selected based on the criterion of rating and popularity. Utilizing an advanced computer vision tool, empty shots were identified and examined for their distribution across film genres. Our findings reveal significant variations in empty shots among different movie genres. A three-tier classification system for genres was suggested, considering the proportions of empty shots and their roles in cinematic storytelling. By employing a viewer-centric framework and harnessing quantitative analysis, this study advances the definition of empty shots, and its empirical findings elucidate the diverse narrative functions of empty shots across various film genres, thereby enriching the scholarly discourse on the utilization of empty shots in the cinematic language.

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Introduction

In a pivotal scene towards the conclusion of *Shawshank Redemption*, two long-time companions reunite on the shores of Mexico. The vast expanse of the azure sky, glistening sea, and golden sandy beach dominate the visual composition, with the characters appearing as mere specks in the distance. This camera technique employed can be categorized as an "empty shot".

Empty shots are a common technique in filmmaking (Lapworth, 2016), but their definition and application remain contentious in academic research (Duan, 2021). The criteria for identifying empty shots have often been imprecisely defined, leading to disagreements among scholars. Some researchers, like Wang (2002), characterize empty shots as frames where human faces occupy only a small portion of the image. Others, such as Duan (2021), argue that empty shots must be entirely devoid of human presence. This lack of consensus complicates the study and analysis of this cinematic technique. Complicating matters further, film editing practices have evolved, with Nothelfer et al., 2009 noting a trend toward shorter mean shot lengths and more structured shot groupings. These variations make it increasingly difficult to establish a consistent statistical definition for empty shots. For instance, James Udden (2012) criticizes existing definitions as overly broad, arguing that they fail to capture the distinctive cinematic effects attributed to empty shots in previous studies. His critique underscores the need for a more precise and universally accepted definition of empty shots in film studies (Udden, 2002).

Despite the need for definition from the audience's perspective, the exploration and analysis of empty shots remain crucial, as they play a significant role in film analysis (Duan, 2021). The significance of empty shots within film analysis lies in their ability to visually depict the spatial relationships between key individuals and objects (Duan, 2021). Empty shots are set within a given scene, thereby acquainting viewers with the location and the inherent spatial dynamics (Brunsdon, 2007). Furthermore, empty shots serve not only to establish the temporal and spatial context within a scene but also to convey subtle emotions that may not be immediately apparent (Brunsdon, 2007). In this way, empty shots transcend the mere expression of time and space, operating on a deeper level to convey emotion and meaning.

Moreover, empty shots are closely tied to film genres and narratives, playing a crucial role in cinematic storytelling (Nothelfer et al., 2009; Cutting, 2016). While some studies have examined shot distribution within specific genres, such as art films (Benini et al., 2016) and horror films (Olliver, 2015), there is a lack of comparative analysis across genres. Understanding the distribution of empty shots across different genres is essential for a deeper comprehension of film narrative construction (Duan, 2021), highlighting the need for a quantitative analysis of their use in various genres.

While a few studies have attempted to quantify shots in films, they have generally focused on specific works by particular directors (Kovács, 2014; Svanera et al., 2019). Some researchers have used algorithms like SIM (Hanjalic et al., 1999), ToC (Rui et al., 1999), and SVM (Cao, 2007) to classify shot types, but these methods prioritize precision over specifically identifying empty shots. A more integrated approach is needed to bridge computer science and film studies (Pustu-Iren et al., 2020).

To address the research gap, this research conducted two studies: 1) an exploration of the operational definition of empty shots, focusing on sequences characterized by minimal or no human presence and extended duration (Duan, 2021; Brunsdon, 2007; Wang, 2002; Zhang, 2009); and 2) a large-scale content analysis examining the distribution of empty shots across popular films (Araujo, Lock, & van de Velde, 2020). By integrating machine learning techniques with related surveys, this study systematically investigates the definition and genre-specific distribution of empty shots.

This research makes several contributions. First, it advances a more precise definition of empty shots by employing quantitative statistical methods that integrate viewer-derived indicators. Second, it underscores the varying frequency and narrative functions of empty shots across film genres, suggesting that these shots provide new insights into symbolic representations of environmental impact. Lastly, while the theoretical integration of computational methods into film studies has been widely discussed, practical applications remain scarce (Chávez Heras, 2024). Our research addresses this gap by utilizing advanced image data mining on a comprehensive film corpus (Sun, 2022), demonstrating the effectiveness of algorithm-based models in film analysis.

Related works

The unknown space and invisible semiotics: empty shots. The empty shot is a widely employed cinematic technique (Lapworth, 2016). Although previous research has predominantly examined its use by Asian directors such as Hou Hsiao-Hsien and Ozu Yasujiro, this technique is prevalent across a broad spectrum of films, suggesting that empty shots are not confined to particular regions or filmmakers but are a versatile tool utilized by directors from various backgrounds and cinematic traditions (Duan, 2021). However, the concept of "empty shots" remains ambiguous due to the absence of a precise definition. This ambiguity prompts several questions: Can empty shots encompass characters? Are purely scenic shots or those with minimal character presence classified as empty shots? This uncertainty often results in researchers focusing on related concepts, such as long shots, insert shots, and establishing shots, rather than directly addressing the notion of empty shots (Brunsdon, 2007). The overlap between these shot types further complicates the issue. For instance, insert shots, which interrupt the action to highlight details, often lack human presence – a characteristic shared with empty shots (Duan, 2021). Similarly, empty shots can function as long shots to showcase scenery or as insert shots capturing objects (Duan, 2021). For example, Deleuze (1986) observed that empty shots or landscapes share many similarities with still-life compositions. Despite this definitional ambiguity, empty shots are integral to film narrative and emotional expression, functioning comparably to other types of shots. The significance of empty shots in cinematic storytelling, as emphasized by Cutting (2016) and Bálint, Rooney (2018), underscores the necessity of a more precise definition.

Given the complexity of the concept of the empty shot, film semiotics offers a valuable approach to its interpretation. From a semiotic perspective, empty shots can be understood as analogous to empty symbols (Li, 2018), which lack a specific referent but possess well-defined boundaries in their sign representation (Duan, 2021). In this framework, the signifier of an empty shot—such as a landscape or object—is its visual content, while the signified represents the deeper meaning associated with the shot (Fan et al., 2019). This notion is similar to the use of white space in Chinese landscape painting, which invites interpretive engagement (Fan et al., 2019). Renowned directors often employ this technique to evoke a serene, unemotional oriental esthetic, reminiscent of the melancholic beauty found in Song and Yuan literati paintings and aligned with classical Chinese philosophical concepts (Guo, 2022). For example, in Hou Hsiao-Hsien's *Dust in the Wind*, a poignant forest scene communicates profound emotions of love and sadness through its silent atmosphere,

compensating for the absence of characters with rich symbolism and emotional depth.

Additionally, scholars have integrated semiotics with film studies to create a universal model for film analysis. Metz (1991) introduced the concept of film language as a specific subsystem applicable to individual films while striving to establish an underlying system for all films. Further, Umberto Eco (1979) proposed that individual frames in films can be viewed as segmented images with three distinct levels: symbols akin to rhetorical devices, signs, and meanings: this segmentation technique allows films to create an artistic language that transcends reality. These theoretical endeavors suggest the existence of a universal model with profound implications behind all movies (Liu, 2009).

Empty shots and film genre. Empty shots, film narrative, and genre form a tightly interconnected trio in cinema, collectively shaping meaning and producing specific narrative effects (Cutting, 2016; Duan, 2021). Different film genres exhibit distinct narrative styles, with shots serving as central elements in story-telling (Cutting, 2016). As a unique type of shot, the distribution of empty shots varies across genres (Kovács, 2014), and exploring this distribution enhances our understanding of film narrative construction (Duan, 2021). For example, Brunsdon (2007) con-ceptualizes empty shots as "empty spaces" in cinema—such as bombsites and derelict areas—that introduces a "hesitation" in the cinematic image. These spaces offer multiple interpretations both within and beyond the film's narrative, serving as sites of significant narrative and analytical inquiry.

Empty shots play a crucial narrative role by establishing atmosphere, transitioning between scenes, offering visual com-mentary, and creating anticipation (Duan, 2021). The use of empty shots is influenced by a film's genre and narrative structure, affecting the pacing and rhythm of the story (Qin, 2021). The frequency and duration of these shots vary according to genre-specific conventions: horror films employ them to build suspense, art house films for contemplation, and action movies to establish locations or provide brief moments of calm before intense sequences (Duan, 2021). For instance, Nothelfer et al., 2009 explores the relationship between shots and film genres, demonstrating how shot selection significantly influences a film's narrative and genre categorization. Action films often use rapid shots to mirror swift movements in fight scenes, while dramas favor longer shots to accommodate extended dialogs. Although Nothelfer's study is limited in scope, it has sparked further exploration into the relationship between shot composition, narrative construction, and genre classification, laying the groundwork for the present study's examination of empty shots from genre and narrative perspectives.

Cinemetrics: digital humanities and film studies. In the digital humanities era, interdisciplinary dialogs have gained prominence in film studies, opening new avenues for exploration (Pustu-Iren et al., 2020). Quantitative film analysis dates back to 1912, with Stockton's study of shot lengths in 25 films (Tsivian et al., (2016)). Salt's work in the 1970s and 1980s highlighted the potential of statistical methods in analyzing film style (Salt, 1974, 2009). Despite these advancements, the field has historically been limited by resistance within the humanities (Walkowski, 2020). The rise of digital technologies has revitalized interest in quantitative approaches, supported by tools like programming languages, algorithms, and big data analysis (Pustu-Iren et al., 2020).

Computer-aided analysis of moving images has become increasingly important within this interdisciplinary framework, which spans computer science, media informatics, film studies,

and archival research (Bateman et al., 2016; Walkowski, 2020). The *Cinemetrics* platform (Gunars & Yuri, 2016), for instance, enables intuitive film data documentation and visual analysis, encompassing humanities computing, computer science, "Multi-media Information Retrieval" (MMIR), and film history (Mike, et al., 2016; Dang, 2020; Pustu-Iren et al., 2020). *Cinemetrics* is the expression of a newly open space of interactions between digital technologies and film study approaches which include statistics and stylometry, multimodal narrative skill, artistic research, and so on (Walkowski, 2020).

Recent studies have employed quantitative methods in film analysis, focusing on concepts like authorial fingerprints and cognitive patterns across different directors (Kovács, 2014; Svanera et al., 2019), film color (McGowan & Gaset, 2023), as well as style and narrative (Choudhary et al., 2019). However, these studies often involve limited sample sizes with rather simplified definitions of these concepts (Walkowski, 2020). Also, research on "empty shots" has mainly been qualitative, lacking systematic quantitative analysis with big data which aligns more effectively with the evolving status of research objects in a dynamic and digital environment (Walkowski, 2020). Some studies examine empty shots in terms of their relationship to environment, space, and narrative (Zhang, 2009), while others explore their use by directors like Hou Hsiao-Hsien (Geng, 2021) and Yasujiro Ozu (Lapworth, 2016). While these studies under-score the significance of empty shots, they have not thoroughly examined extensive samples across various film genres. This limitation suggests that the findings may not apply to contemporary films or their narrative functions across film genres. Therefore, this study seeks to blend quantitative and qualitative approaches to explore empty shots across genres, leveraging statistical techniques to identify recurring empty shots that transcend individual directors, providing insights not easily discernible through casual observation (Bateman, 2014)

Drawing from the discussion above, two research questions have been formulated from distinct perspectives. These questions will be expounded upon in the subsequent section.

RQ1: *What are the operational parameters for the definition of empty shots from audiences' perspectives?*

RQ2: *How is the prevalence of empty shots related to the genre of the film?*

Research methods

To address the research gap, we employed a mixed-method approach, combining surveys with deep learning to define and analyze empty shots concerning film narratives. Emerging tech-nologies, such as the Yolo framework, enable objective analysis of shot length (Vacchetti et al., 2020) and facial recognition (Jin et al., 2017) in films. By identifying the exact duration of empty shots and the ratio of faces within a scene, we can accurately locate empty shots across the frames of a film (Redmon et al., 2016). Our research is divided into two main studies: (1) Using surveys, we assessed viewer perceptions of the duration of machine-recognized empty shots and the face-to-empty-shot ratio; and (2) we applied Yolov5 to identify empty shots across a range of films based on these parameters. This study was approved by the institutional review board (IRB) of College of Literature and Journalism of Sichuan University, following the Declaration of Helsinki while informed consent was obtained from all participants for participation in the study.

Study 1: definition exploration and survey design. Time dura-tion and the absence of humans are key elements that distinguish empty shots from other shots (Duan, 2021). Empty shots use specific images to convey the time and space of the story,
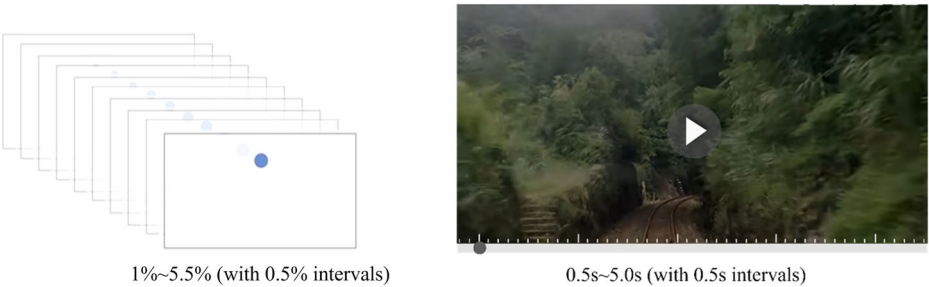
1%~5.5% (with 0.5% intervals)   0.5s~5.0s (with 0.5s intervals)

Fig. 1 Illustration of stimuli of Facial proportion (Left) and time duration (Right).

Table 1 Descriptive analysis of the perception of empty shots for face proportion and time duration.						
	Perception of Empty Shot (Mean and Standard Deviation)				**F (9, 290)**	**p-value**
Face Proportion	1.0%	1.5%	2.0%	2.5%	3.0%	9.36	p < 0.01
	6.97 ± 1.50	6.80 ± 1.52	6.17 ± 1.66	6.03 ± 1.83	6.37 ± 1.19		
	3.5%	4.0%	4.5%	5.0%	5.5%		
	5.97 ± 1.92	5.83 ± 1.26	5.63 ± 1.56	4.3 ± 1.60	4.47 ± 1.53		
Time Duration	0.5 s	1.0 s	1.5 s	2.0 s	2.5 s	17.43	p < 0.01
	3.43 ± 1.28	3.57 ± 1.72	3.97 ± 1.81	3.73 ± 1.29	3.97 ± 1.33		
	3.0 s	3.5 s	4.0 s	4.5 s	5.0 s		
	5.30 ± 1.84	5.47 ± 1.87	5.87 ± 1.68	6.5 ± 1.20	6.27 ± 1.44		

suggesting the passage of time through changes in non-human scenery (Qin, 2021) and pausing the film's diegetic flow (Duan, 2021). Following this perspective, we explore and define empty shots from the perspectives of time duration and human absence. Study 1 investigates the definition of empty shots, using two sets of stimuli that vary in face occupation (1–5.5%) and shot duration (0.5s–5s). Figure 1 presents the materials used in the questionnaire. Face proportions in the experimental materials were based on existing literature to ensure that face size and shot duration align with typical empty shots (Cherif et al., 2007; Kovács et al., 2019).

To be more specific, the stimuli were carefully designed to examine time and face proportion. For face proportion, close-ups were used to effectively capture facial expressions and intricate details, with the constraint that the height of the face should not exceed 5% of the video frame's height (Kovács et al., 2019; Cherif et al., 2007). Regarding the duration of empty shots, Cutting et al., (2012) reported a peak-to-trough magnitude of approximately 1.1 seconds for the films they studied, which had an average shot length of about 5 seconds. A similar observation on average shot duration from 1960 to 1985 was also confirmed (Svanera et al., 2019). Thus, 5.5% of faces with 0.5% intermediates and 5-second frames with 0.5-second intermediates were prepared for the experiment.

A total of 300 participants with varying levels of familiarity with films were recruited through Amazon Mechanical Turk (AMT) for this study (mean age = 36.41 years, SD = 10.89; 167 men, 133 women). AMT was chosen for its diverse pool of registered workers, making it suitable for cross-cultural research and providing a broader perspective on worker perceptions (Aguinis et al. (2021)). Among the participants, 28 indicated their educational attainment as high school graduates or below, 85 reported having completed some college, while 187 stated they were college graduates or possessed higher qualifications. The sample was drawn from both film enthusiasts and general viewers, ensuring a comprehensive perspective. Concerning the experimental procedure, participants were initially explained the general objective of this study and informed they could quit the task if they felt uncomfortable while still being paid for their time.

Following their consent to participate, 300 respondents were allocated at random to one of ten facial scenarios (each comprising 30 participants) and one of ten time-duration scenarios; both sets of scenarios were randomized. We began by briefing participants on their task of identifying empty shots in film sequences, providing them with our research-specific definition to ensure a shared understanding. Subsequently, they were exposed to the stimuli and were asked to rate based on their perception of the extent to which the content aligned with the concept of empty shots. Each material corresponds to one question: To what extent does it belong to an empty shot? (1 = strongly disagree; 9 = strongly agree). The 9-point Likert scale was used because identifying an "empty shot" in cinema is subjective and nuanced, varying based on personal experiences (Duan, 2021). This scale allows participants to express the degree to which they perceive a shot as empty, capturing a range of opinions beyond a simple binary choice (Bargagliotti & Li, 2013). Participants were compensated by 0.5 US dollars (United States government, 2022) and the average completion duration was around 1–2 minutes.

The data were analyzed using one-way ANOVA in SPSS24. The results (Table 1; Fig. 2, left; detailed post-hoc comparisons in Appendix 1) show significant variations in perceived emptiness across different face proportions (F(9, 290) = 9.36, p < 0.01) and shot durations (F(9, 290) = 17.43, p < 0.01) (Fig. 2, right). Notably, perceived emptiness varied significantly with face proportions between 4.5% and 5% (p < 0.05) and shot durations between 2.5 and 3.0 seconds (p < 0.05), suggesting that shots with face proportions of 5% or less can be categorized as empty, and shots over 3 seconds with objects in the frame are also frequently perceived as empty.

Study 2-1: movie selection. A total of 2,464 acclaimed films from 1905 to 2019 were selected based on their ratings and popularity. Each film required a minimum rating of 8.0 and at least 2,000 reviews on both Douban and IMDb, ensuring their mainstream status and broad cultural and linguistic relevance (Ericson, Goodman (2013); Alex, 2017; Juan (2020)). Specifically, Douban
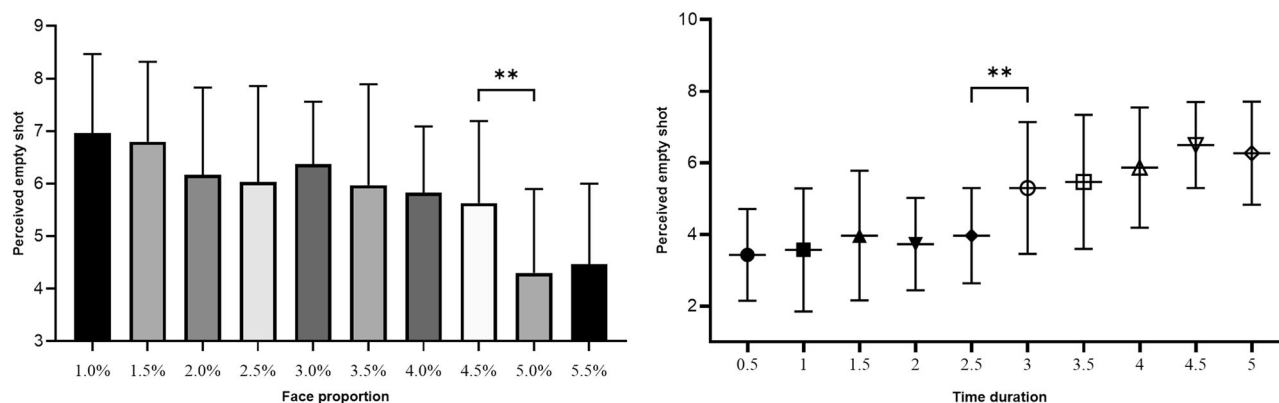
Note: ** denotes a significant difference

Fig. 2 The participants' assessment of the degree of empty shots for images with varying proportions of faces (Left); The participants' assessment of the degree of empty shots for videos with varying durations of landscapes (Right).
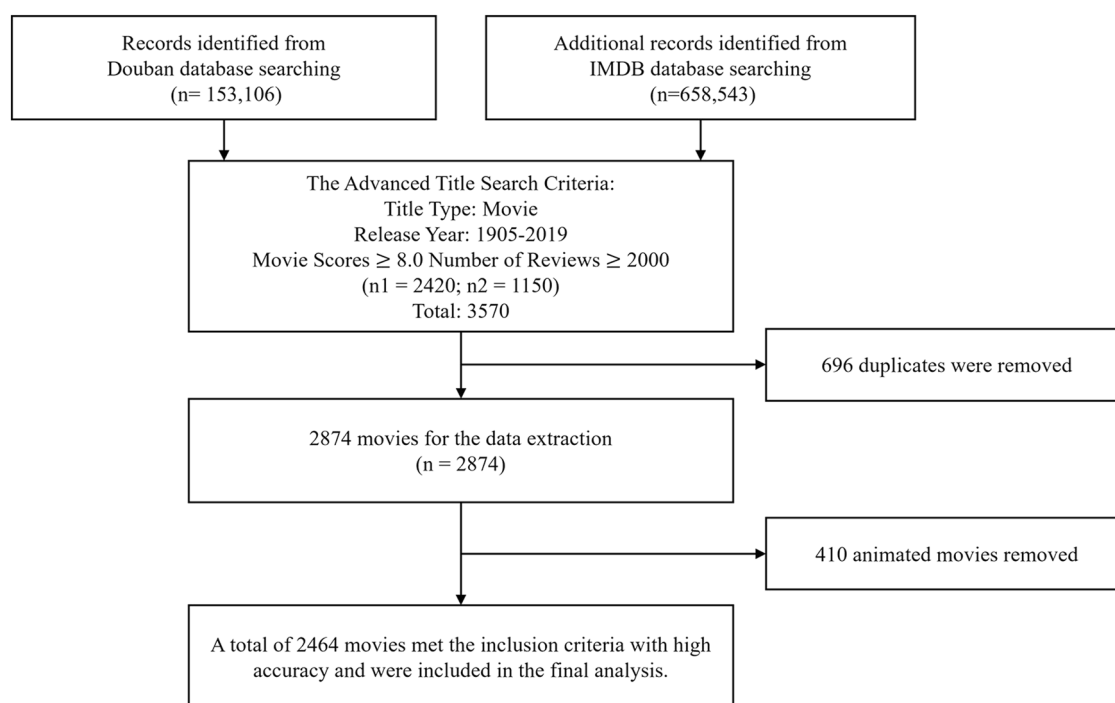

Fig. 3 Workflow of the movie screening process.

and IMDb, globally recognized platforms, provide extensive information on films, TV shows, and industry professionals, making them invaluable resources for informed viewing choices (Sun, 2023; Ramos et al., 2015; Vaz et al., 2022). While mainstream films are enduring, ratings for newly released films often fluctuate before stabilizing over time (Cizmeci & Öğüdücü, 2018). To ensure stable and representative ratings, we chose films produced between 1905—when platforms began recording ratings—and 2019, by which time ratings had generally stabilized (Canini, Benini, & Leonardi, 2013; Tsao, 2014). The film selection process is illustrated in Fig. 3.

Study 2-2: empty shots identification. The empty shots identification involved three key steps: (1) data preprocessing: images were resized and normalized to prepare them for the neural network; (2) feature extraction: convolutional and pooling layers reduced resolution while extracting high-level semantic features;

(3) post-processing: low-confidence predictions were filtered out, retaining only detections meeting the threshold criteria.

Given that the shortest movie shot typically exceeds 0.5 seconds (Chen, 2020) and that a standard film has 24 frames per second, images were extracted every 12 frames (i.e., every 0.5 seconds). Human body identification and positioning were then performed, balancing accuracy and speed. Figure 4 provides an example of extracted images from the film *Intouchables*. This method demonstrated strong performance in detecting and identifying human faces within movie frames, particularly using the Coco dataset, a well-known benchmark for object detection and segmentation (Lin et al., 2014; Appendix 2).

Throughout these processes, the Yolov5 approach (Redmon et al., 2016), focused on visual concept detection, was employed. Yolov5, a deep-learning framework, is recognized for its fast and accurate real-time object detection (Bochkovskiy et al., 2020). It features a lightweight architecture that enhances detection performance (Jocher et al., 2021), employs a single-stage
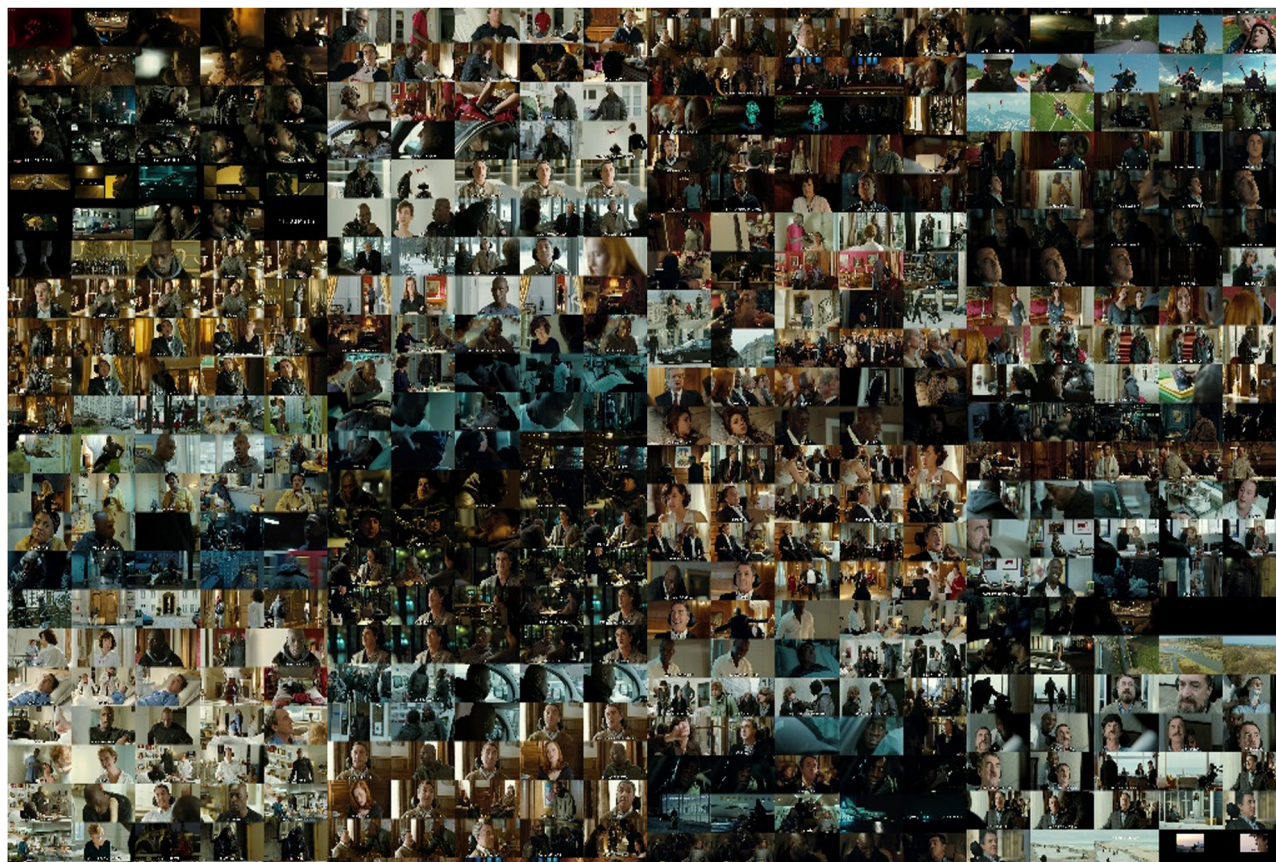
Fig. 4 Mosaic of all frames extracted from Intouchables.

detection method for increased speed (Milan, Haizhou (2016)), and supports multi-scale inference, enabling robust detection of objects across various sizes (Jocher et al., 2021). Identifying key elements like persons, locations, and times is essential for detecting empty shots, which were further analyzed concerning different film genres (Pustu-Iren et al., 2020).

Results and discussions
To explore the relationship between empty shots and film genres, we first examined traditional genre classifications from IMDb and Douban, which combine initial assessments by critics with viewer feedback (Boor, 1990). While these categorizations provide a foundation, they do not fully align with the concept of empty shots. Tarancon (2010) highlights that movie genres are fluid and resist oversimplification, with both audience-driven and academic classifications recognizing the importance of repetition and variation in storytelling. Considering the unique role of empty shots, we organized the data into three distinct groups: (1) Adventure/ Sci-Fi films (Group A), with an empty shot ratio over 25%, often use these shots to establish vast, futuristic settings; (2) Horror, Mystery, Thriller, Fantasy, and Disaster genres (Group B), with ratios over 20%, utilize empty shots to build tension and highlight key locations; and (3) Comedy, Romance, and Family films (Group C), with around 15% empty shots, use them to subtly comment on everyday life, as seen in the works of directors like Yasujirō Ozu. Specifically, the first cluster predominantly emphasizes macro and grandiose scenes, while the latter two clusters focus more on micro scenes. Films with narratives closely intertwined with characters' daily lives tend to exhibit a lower ratio of empty shots, whereas those with a weaker connection to everyday life tend to feature a higher proportion. Thus, the presence of empty shots in films may prompt a reconsideration of

the genre system as a flexible and evolving framework, challenging its conventional boundaries.

While empty shots are found across various genres, they are particularly prevalent in certain groups of movies that utilize them to enhance mood, build suspense, and emphasize thematic elements, contributing to the overall narrative and esthetic appeal. The prevalence of empty shots can be attributed to three key factors: 1) their narrative ambition and role in scene composition for effective storytelling (Lipovetsky, 2019); 2) technical and visual considerations, as film technology influences cultural discourses like narratives, art, and games (Rettberg et al., 2022); and 3) their emotional influence and connection to everyday life, as scholars have extensively studied the impact of shot types on emotions (Bálint, Rooney (2018); Cutting, 2016). By investigating these perspectives - narrative analysis (Cutting, 2016), emotional proximity (Soleymani et al., 2009; Bálint, Rooney (2018); Brighter & Rader, 2019), and the application of special effects (Meng, He (2021)) - this study provides an understanding of the relationship between film genres and empty shots.

Scene composition and narrative ambition. Exploring the complex relationship between narrative and nature has long been a focus in the study of science fiction and adventure films. This exploration has led to Group A films exhibiting a higher proportion of empty shots. Historical perspectives have often depicted nature as powerful, unpredictable, and dangerous, mirroring societal attitudes and themes prevalent in films. Christopher's analysis of environmental discourse since the 1950s illustrates how these films have influenced our understanding of the natural world, emphasizing civilization, science, and technology over nature, and asserting human dominance in uncharted territories (Christopher, 2002). This focus on human progress

over the natural environment highlights the importance of considering the cultural dimensions of our relationship with nature.

The use of empty shots in science fiction and adventure films challenges traditional viewpoints by offering a non-anthropocentric perspective and fostering a more harmonious relationship between humans and the natural world (Duan, 2021). These shots function as a bridge between the natural environment and humanity, which is particularly evident in these genres known for their grand narratives, intricate world-building, and stunning landscapes (Christopher, 2002). Artistically composed empty shots often highlight expansive landscapes, capturing the vastness and natural beauty of the environment (Meng, He (2021)). For example, in the film *Brokeback Mountain*, empty shots highlight foreground characters or animals while magnifying the natural environment (Chen, 2020). Similarly, *Seinfeld* (1989–1998) strategically uses empty shots to enhance cinematic language, transcending plot, or character development to engage with thematic and esthetic elements of the genre (Frezza, 2014). Many of these shots function as long shots, underscoring the environment's resilience and enriching the films' narratives (Surace, 2020). Consequently, a higher proportion of empty shots is observed in these genres.

From a cinematic narrative standpoint, empty shots are intricately woven into the plot to advance the story and provide essential exposition (Duan, 2021). This storytelling technique aligns with the ambitious scope of these films, which explore humanity's destiny and intertwine scientific progress with profound reflections on the human condition and the world's fate (Meng, He (2021)). Much like ancient heroic epics, classical literary forms engage with sublime themes that transcend individual experiences (Rawls et al., 2019). These narratives often feature heroes undertaking grand journeys across vast temporal and spatial landscapes (Meng, He (2021)). Space movies, as a quintessential subgenre of science fiction, inherit these epic qualities, embracing expansive settings, heroic characters, and grand narratives (Meng, He (2021)).

In contrast to the expansive narratives and scene compositions of science fiction and adventure films, genres such as horror, suspense, family, and comedy often feature less grandiose narratives, resulting in fewer expansive shots and a lower proportion of empty shots. Horror and thriller films aim to generate fear and suspense through jump scares, atmospheric tension, and psychological manipulation (Olliver, 2015). Their narratives typically focus on core conflicts or threats, placing characters in precarious situations (Cutting, 2016). In these genres, empty shots often function as transitional elements that emphasize sudden spatial or temporal shifts, thereby intensifying the sense of unease (Duan, 2021).

Conversely, family films center on themes of love, friendship, and personal growth (Lapworth, 2016). Romantic comedies, following conventions such as the master plot, character archetypes, setting, and audience response, often explore cultural conflicts (Tan, 1996). These films usually feature relatable protagonists or family units navigating challenges or embarking on shared adventures (Tan, 1996). They emphasize heartwarming moments, comedic elements, and moral lessons, blending the beauty and romance of everyday life to offer comfort to audiences (Guo & Zhang, 2019). The focus on personal experiences and interpersonal relationships in these genres naturally results in a lower prevalence of empty shots, in contrast to the epic, landscape-driven visuals of science fiction and adventure films (Rawls et al., 2019).

Technical and visual demands. Science fiction and adventure genres frequently necessitate sophisticated visual effects (VFX), expansive computer-generated imagery, and elaborate set designs to render imaginative worlds convincingly lifelike (El Fahli, 2022).

Such technical requirements may mandate prolonged shots exhibiting visual splendor, thereby heightening the proportion of empty shots (Corbett (1998)).

The technical framework of space films, a subgenre of science fiction, is closely intertwined with their reliance on advanced cinematic technology, including the use of empty shots to convey grand and ambitious narratives (Meng, He (2021)). For example, the short Swedish science fiction film *Wanderers* illustrates this relationship through its integration of actual space imagery and Computer-Generated Imagery (CGI). By combining real space visuals with CGI, the film creates impressive depictions of the cosmos, highlighting the technological essence central to space films (El Fahli, 2022).

In contrast, the genres of family, comedy, and romance typically depend less on ostentatious visual effects and prioritize character interactions and dialog (Guo & Zhang, 2019). This reduced emphasis results in a lower occurrence and distribution of empty shots in these genres. Genres such as family, comedy, and romance prioritize human-centered realism over extravagant visual effects and empty shots, focusing instead on character interactions and dialog. Conversely, science fiction and adventure films often emphasize visual splendor through elaborate VFX and set designs, leading to increased use of empty shots to heighten the grand narratives. By examining specific examples and data, we can further illustrate how these contrasting priorities shape the prevalence and function of empty shots in different film genres, offering insights into the dynamic interplay between visual spectacle and narrative depth (Fig. 5).

Emotional proximity and connection to daily life. Based on the distribution of empty shots, it is worth noting that horror films also exhibit a relatively high proportion of empty shots compared with other genres. Two explanations might be possible for this phenomenon: an esthetic perspective that values liminal spaces and the emotional impact derived from such spaces. These aspects frequently intersect, as demonstrated by case studies examining the relationship between liminal spaces, associated emotions, and empty shots (Agustin, 2021).

Firstly, liminal space, as an esthetic concept, refers to a place or state of transition, uncertainty, and ambiguity (Agustin, 2021). It is often associated with a process's threshold or initial stage, where old rules and norms have lapsed in applicability, yet new ones have not emerged (Agustin, 2021). The term "liminal" originally denoted transitional states but evolved into an esthetic evoking a feeling of eeriness (Gerow, 1999). Anthropologist Victor Turner first coined the term "liminal" to describe an "interstitial" space that is "betwixt and between" (Brandt (2009)). Psychologists and architects later appropriated the term to signify thresholds. In film studies, Deleuze (1986) introduced the term "any space whatever" to capture the transformative essence of empty space in cinema, where a purely visual or auditory situation can manifest in a disconnected or vacant manner. This concept emphasizes cinema's ability to transcend conventional notions of time and physicality, creating a distinct reality. It underscores the immersive and transformative power of the cinematic experience, transporting viewers to new dimensions of perception and experience. A liminal space, often manifested by empty shots in films of group B, is a transitional zone through which characters move but in which they do not remain (Gerow, 1999). It is a realm governed by its internal logic at odds with everyday conventions (Hawskworth, 2022).

Secondly, empty shots often portray liminal spaces in horror thriller films and elicit cognitive arousal (Duan, 2021). In horror or thriller genres, these shots align with common tropes such as startle effects, the anticipation of gore, or the gradual revelation of
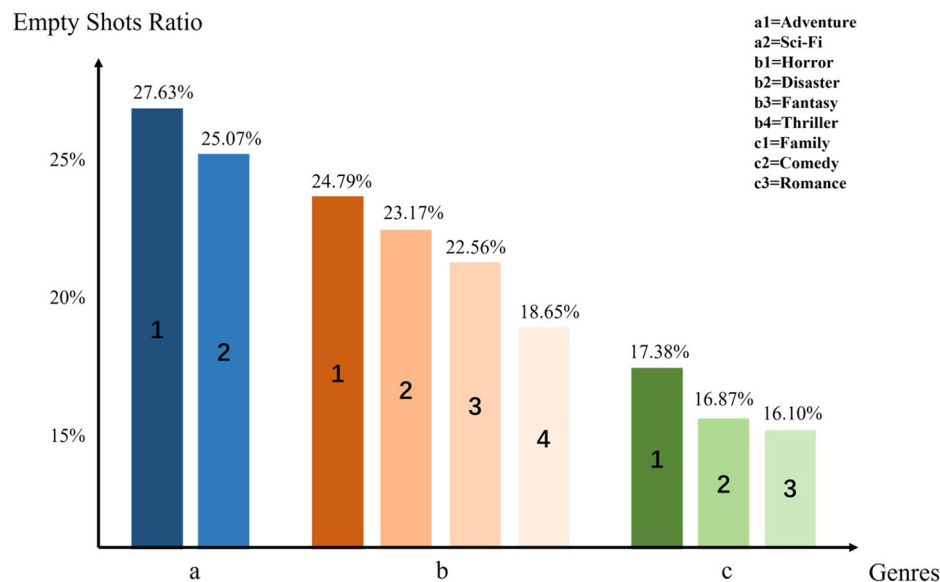
Fig. 5 Empty shots as a percentage of total shot duration across film genres.

Fig. 6 The corridor scenes in The Shining.

danger (Olliver, 2015). Scholars have long demonstrated how spaces hold meaning and provide insight into characters' worlds (Agustin, 2021). Space not only serves as a setting but also acts as a character and shapes the very fabric of the narrative, whether in prose or film (Corbett (1998)).

Liminal spaces, as Augoustakis (2016) observes, create a specific mood, and evoke psychological and emotional effects on the screen. In horror films, empty shots invoke emotions such as fear, sadness, and ambivalence. These films aim to instill fear through techniques like suspense and uncertainty (Bartsch et al., 2010). For example, early Hammer horror films employed approximately 80% static shots, held for longer durations compared to their competitors (Olliver, 2015). By keeping threats off-screen but implied, empty shots have the potential to generate suspense. By evoking fear, these shots captivate viewers and allow their imagination to fill in the unknown, creating a sense of uncertainty (Corbett (1998)). Creating liminal narrative space transporting audiences to transitional "in-betweenness" poses challenges requiring intentional choices (Augoustakis, 2016). The liminal space effectuates an estranging viewer experience incongruous with audience expectations and extant knowledge (Keyan et al., (2022)). It signifies egress from a familiar territory where novel horizons emerge (Hawksworth, 2022). There, audiences wrestle with unfamiliarity as comprehension metamorphoses when familiarity yields undefined new forms. Audiences depart accustomed hermeneutic ground yet gain no bearings, ensnared in ambiguity and openness holding potential (Augoustakis, 2016).

When spectators observe liminal spaces, they engage with a visual world that transcends conventional boundaries, inviting them to experience a state of in-betweenness where the familiar and the unfamiliar coexist (Gerow, 1999). Drawing on acquired experiential knowledge, they interpret the relationships represented by signs, evoking emotions such as fear, hope, joy, and sorrow (Keyan et al., (2022)). For example, in the horror film *The Shining*, the use of empty shots as symbolic elements heightens the overall atmosphere of horror (see Fig. 6). At the beginning of the film, the audience is positioned behind a vehicle, silently witnessing its journey into the remote mountains. The juxtaposition of snowcapped mountains, forests, sunlight, and ominous music creates a contrast that conveys a sense of oppression and foreboding. Additionally, the elongated corridors depicted in the film serve as liminal spaces, evoking feelings of insecurity and the unknown. In contrast, in the dramatic film *Green Book*, empty shots, such as those featuring the piano, primarily serve to showcase the personalities of the characters. The presentation of these object symbols in the film predominantly revolves around character development, placing the focus squarely on the characters themselves (He, 2022).

Compared with Group B, science fiction films often explore futuristic or fantastical settings removed from ordinary human experiences (Meng, He (2021)). This emotional detachment from everyday life may influence directors' stylistic choices, leading them to prioritize visually stunning yet empty shots. In contrast, family, comedy, and romance genres typically center around relatable characters and situations, creating stronger emotional connections with audiences (Benini et al., 2016; Tan, 1996). This connection may drive directors to focus on scenes with greater emotional resonance and relevance to human concerns, resulting

in fewer empty shots (Grindon, 2011). Films across genres such as war, historical, comedy, and family foreground human characters yet differ in affective distance from viewers' quotidian experiences (Rawls et al., 2019). This variance may influence directors' decisions to employ empty shots of varying proportions. Specifically, Akira Kurosawa's oeuvre exhibits abundant implementation of empty shots. One hallmark of Ozu's directorial signature is frequent empty shots, distinguished by prolonged and "unmotivated" removal of human figures from the screen (Burch, 1979). Such shots reject the anthropocentric focus of Hollywood dramaturgy centering on human characters' thoughts and actions (Lapworth, 2016).

To sum up, the current study tries to make several contributions. First, by utilizing quantitative statistical methods to consolidate indicators from the viewers' perspective, the study tackles the absence of a clear definition of empty shots. Second, examining the use of empty shots may provide a new lens through which to analyze film classification that transcends conventional genre limitations. This approach offers insights into distinguishing between human-centered narratives rooted in everyday experiences and allegorical tales that celebrate the wonders of the natural environment. By combining past narrative categorizations with the esthetic experiences evoked by specific shot compositions, a more nuanced understanding of how filmmakers utilize empty shots to shape the cinematic experience across diverse storytelling modes can be gained. Third, this study also indicates that there is still significant room for exploration in the realm of interdisciplinary film research and computer vision. To fully grasp the changes in numerical values and differences in information graphics, film scholars may contextualize their interpretations by considering film history, theory, and the creation patterns of film art. This research also emphasizes the importance of interdisciplinary approaches in understanding transcultural visuality as embodied by film language and technology (Zhang, 2006).

Conclusion

In general, this study introduces a mixed protocol that facilitates large-scale content analysis of empty shot distribution in popular films. Several important considerations emerged from our study. Firstly, we analyzed 2,464 critically acclaimed films from 1905 to 2019, each with IMDb and Douban scores above 8.0 and more than 2,000 reviews, indicating their popularity among mainstream audiences. As a result, our conclusions may primarily apply to widely viewed films with large audiences. Future research should incorporate more diverse samples to draw broader conclusions about the esthetics of empty shots.

Additionally, understanding how audiences perceive and cognitively process empty shots requires further psychological research. Our study begins to define viewers' perspectives on empty shots but highlights the need for more research into the esthetic experiences these shots evoke. Given the importance of facial depiction in fostering empathy (Lankhuizen et al., 2022), empty shots, which lack human subjects or faces, may challenge viewers' empathic engagement. Future research could explore how the strategic placement of empty shots within other shot patterns influences empathy, ensuring narrative coherence while preventing viewer disengagement.

We plan to deepen our analysis of emotional dynamics in films by employing computer vision techniques and examining the broader context in which empty shots appear. Analyzing the timing and placement of these shots within the narrative structure may uncover nuanced patterns that enhance their esthetic appeal across different genres. Additionally, exploring stylistic elements such as camera angles, lighting, and editing techniques associated with empty shots could provide further insights into their role in

film esthetics. Advancing computer recognition technology will be essential for a more comprehensive analysis of these factors across a wider range of films (Pustu-Iren et al., 2020).

Finally, future research could extend quantitative methods to visual esthetics beyond filmmaking. For example, exploring the impact of action-driven versus dialog-driven scenes on our findings could be particularly intriguing. This would involve using advanced computer technology to detect variations in shot speed and extract dialog, enabling the differentiation between these scene types. Currently, esthetic experiences are frequently assessed qualitatively using manual annotation and plot analysis, which requires substantial labor and time investment (Bakels et al., 2020).

By integrating film genres with the characteristics of empty shot distribution, we have identified three distinct genre groups, offering deeper insights into the interplay between empty shots, genres, and film narratives—insights that are not readily apparent through simple observation. The prevalence of empty shots can be linked to their narrative significance, technical considerations shaped by film technology, and their emotional impact on viewers. Our findings suggest that analyzing empty shots quantitatively provides a valuable enhancement to film studies methodologies. This approach offers a novel perspective for categorizing movie genres based on their use of empty shots, thereby enriching the field of film analysis.

Data availability

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Author contributions
Yao Song: conceptualization, writing original draft, reviewing and editing, supervision; Weilin Li: conceptualization, data curation, investigation, writing original draft, reviewing and editing; Zhongrui Wang: data curation, methodology, visualization; Yirong Hu: resources and supervision.

Competing interests
The authors declare no competing interests.

Ethical Approval
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The ethics approval was obtained from the Institutional Review Board (IRB) of the College of Literature and Journalism of Sichuan University on March 01, 2022 (YJ202203).

Informed consent
Written informed consent was obtained from all participants prior to their participation. Participants were fully informed about the purpose of the study, the use of their data, their right to withdraw at any time, and the compensation provided for their participation. No vulnerable individuals were involved in the study.

Additional information