

Visual Attention and Cognitive Processing in Fashion Brand Pop-up Retail Environments: An Eye-Tracking Study of Spatial Design Strategies

Yi Zhang*, Chuling Wang*

College of Art and Design, Shenzhen University, Shenzhen, Guangdong, China

**Corresponding Author*

Abstract: Pop-up retail environments have emerged as a significant strategy in contemporary fashion brand retail design, wherein visual communication and spatial design play pivotal roles in cultivating immersive consumer experiences. Nevertheless, empirical research examining how spatial design strategies influence consumer visual attention and cognitive processing remains limited. To address this gap, the present study employs eye-tracking methodology to observe the visual behavior of 34 participants across four simulated pop-up retail environments. Experimental scenarios were categorized into two design strategies — global decoration and focal spatial decoration — based on the visual intensity and spatial distribution of decorative elements. Visual attention and cognitive engagement were assessed through metrics including fixation count, fixation duration, and pupil diameter, while questionnaire data were collected to measure perceived visual appeal and purchase intention. Results indicate that product display zones attracted the highest proportion of visual attention, accounting for approximately 32% of total fixations. Compared with environments featuring evenly distributed decoration, spatially focused designs elicited longer fixation durations and more concentrated gaze patterns. Cluster analysis further identified three distinct visual engagement profiles. These findings suggest that clear visual hierarchy and focal spatial design enhance the efficiency of consumers' attentional allocation and facilitate environmental comprehension, offering empirical reference for the optimization of pop-up retail spatial design.

Keywords: Fashion Brand; Pop-up Retail Environment; Eye Tracking; Visual Attention;

Design Strategy; Consumer Perception

1. Introduction

In recent years, the retail industry has increasingly adopted flexible spatial configurations in response to shifting consumer markets and evolving patterns of brand engagement. Scholarly interest in the designed retail environment can be traced to Kotler's foundational concept of "atmospherics," which proposed that ambient environmental cues, encompassing sensory elements such as lighting, sound, scent, and spatial arrangement, exert a systematic influence on consumer affect and purchasing behavior [1]. Within this theoretical lineage, spatial design has gradually emerged as one of the most consequential instruments through which brands construct and communicate experiential identities. Among the diverse spatial formats that have arisen from this turn toward experience-centered retail, the pop-up retail format has attracted considerable practitioner and scholarly attention as a strategy for capturing consumer interest and generating immersive brand encounters.

Unlike conventional brick-and-mortar stores, which rely on accumulated familiarity and long-term spatial habituation, pop-up retail environments operate on a logic of temporality and novelty. These short-term installations characteristically attract consumers through heightened visual stimulation, interactive experiential offerings, and a carefully cultivated sense of urgency and exclusivity. Because such environments are defined by their brevity, often operating for periods ranging from a single day to several weeks, they are unable to rely on the cumulative reputational infrastructure of permanent retail establishments. Instead, they depend heavily on spatial design to transmit brand narratives rapidly and to stimulate consumer curiosity within severely compressed timeframes. This dependency raises a critical

question for designers and researchers alike: how can visual information be most effectively organized within a limited spatial and temporal window to direct consumer attention and optimize the overall experiential impact [2].

Research in environmental psychology has consistently demonstrated that spatial settings exert a significant influence on consumers' emotional states, perceptual responses, and behavioral patterns. Design factors such as lighting, color, merchandise display, and decorative elements all shape how consumers interpret a retail environment and navigate its space [3]. Thoughtful spatial design not only enhances product visibility but can also, by establishing a coherent visual hierarchy, guide consumers toward more efficient information processing within complex environments—ultimately improving the overall shopping experience.

Existing research on retail design, however, has largely relied on questionnaire surveys or observational methods. While these approaches are capable of capturing consumer attitudes and subjective evaluations, they remain limited in their ability to reveal patterns of visual attention allocation and real-time cognitive processing. Eye-tracking technology, by contrast, offers a more objective basis for investigating visual attention and information processing by recording gaze movements and fixation behavior [4]. In the fields of marketing and design research, this technology has been widely applied to visual studies of advertising, digital interfaces, and product packaging [5].

Despite this, the application of eye-tracking methods to temporary retail environments remains comparatively sparse. Existing studies have largely focused on long-standing retail formats such as supermarkets, department stores, and shopping centers, with relatively little attention directed toward the visual experience of fashion brand pop-up spaces. Compared with traditional retail settings, pop-up environments typically operate over shorter durations and are designed to generate intense visual impact within a brief window of time. They also tend to foreground experiential and narrative qualities rather than the long-term functional layouts characteristic of permanent retail. These attributes may give rise to visual exploration patterns among consumers that differ meaningfully from those observed in conventional retail contexts.

Against this backdrop, the present study aims to investigate how different spatial design strategies influence the distribution of consumer visual attention in pop-up retail environments. By combining eye-tracking experiments with questionnaire-based assessments, this research attempts to analyze consumer visual-cognitive processes from both objective behavioral and subjective evaluative perspectives. In doing so, it seeks to contribute empirical evidence on the relationship between spatial design strategies and consumer perception, and to offer practical reference for design work in pop-up retail settings.

2. Related Work

Pop-up retail is a flexible retail format characterized by temporary operation and experiential design, commonly employed by brands to launch new products, test market responses, or construct differentiated brand experiences. Compared with traditional retail environments, pop-up spaces are defined by their temporal constraints, which make them especially reliant on rapid visual expression and the quick establishment of spatial atmosphere to attract consumer attention and reinforce brand memory in a short period of time [6]. Within this context, spatial design serves not only the functional purpose of merchandise presentation but also enhances consumer engagement through visual storytelling and experiential design.

Prior research has shown that temporary retail spaces typically employ innovative spatial layouts, thematic installations, and interactive design experiences to heighten a sense of novelty and immersion—strategies that strengthen emotional engagement and enrich the overall brand experience. However, because pop-up environments are inherently transient, consumers' time for interaction with the space is limited. Spatial design must therefore communicate brand information and product value clearly and efficiently, enabling rapid consumer comprehension [7].

Meanwhile, with the rise of experiential retail, an increasing number of brands have begun to use pop-up spaces to construct distinctive consumption scenarios that enhance immersive experiences. In this process, spatial design does not merely function as a medium for product presentation; it also constructs brand narratives through visual symbols, thematic installations, and spatial circulation. Previous studies have

indicated that well-organized spatial visual structures can help consumers rapidly identify key information within complex environments, thereby improving environmental comprehension and strengthening brand perception. From this perspective, examining pop-up retail environments through the lens of visual cognition provides meaningful insights into how consumers process spatial information in short-term experiential settings.

In this process, visual attention emerges as an important theoretical lens for understanding consumer spatial behavior. Visual attention refers to the cognitive process by which individuals selectively process specific information within a complex visual environment. In retail spaces, the allocation of attention shapes consumers' browsing trajectories, their mode of product exploration, and their comprehension of spatial information [8]. Investigating patterns of visual attention in retail environments helps to reveal how different spatial design elements influence cognitive responses and behavioral decision-making. In addition, visual attention is closely related to the efficiency of environmental information processing. When individuals enter a complex spatial setting, attentional mechanisms help prioritize visually salient stimuli, allowing observers to filter irrelevant information and focus on elements that are most meaningful to their goals. In retail environments, this selective processing mechanism plays a crucial role in shaping how consumers interpret spatial cues and locate product-related information.

Research in environmental psychology has demonstrated that visually salient design elements—such as product displays, wayfinding signage, and lighting contrasts—can effectively capture consumer attention and serve as visual anchors within the space, guiding browsing paths [9]. When a retail environment possesses a clear visual hierarchy, consumers tend to identify key areas and process environmental information more efficiently.

On the methodological front, eye-tracking technology has become an increasingly important tool in consumer research in recent years. By recording metrics such as gaze trajectories, fixation counts, and fixation durations, it enables researchers to objectively analyze how consumers allocate attention and process information when confronted with visual stimuli [10,11]. Compared with conventional

questionnaire or interview-based methods, eye tracking provides behavioral data that is both more immediate and more objective.

Recent studies have confirmed the value of eye-tracking technology in illuminating consumer decision-making processes and visual-cognitive mechanisms [12]. Bibliometric analyses indicate that its application in retail research has grown steadily. Nonetheless, existing work has concentrated largely on traditional retail formats—supermarkets, shopping centers, and e-commerce interfaces—while eye-tracking studies focused specifically on pop-up retail environments remain scarce [13]. Given that pop-up spaces differ from conventional retail contexts in their design objectives and experiential structure, consumer visual exploration patterns in such environments may exhibit distinctive characteristics. Because consumers usually spend only a short period of time within temporary retail environments, their visual exploration behavior is likely to be more goal-directed and selective than in conventional retail spaces. Understanding how spatial design influences these rapid perceptual and cognitive processes can therefore contribute to the development of more effective design strategies for pop-up retail environments. Further investigation into how spatial design strategies shape consumer visual attention and cognitive processing in pop-up retail settings is therefore warranted.

3. Methodology

A total of 35 participants were recruited for the experiment. One data record was excluded due to calibration error during the eye-tracking procedure, yielding 34 valid samples for subsequent analysis. All participants had normal or corrected-to-normal vision and were briefed on the experimental procedure and instructions prior to the session.

The experimental stimuli comprised four retail scenes representing different spatial visual design strategies. Based on the visual intensity and spatial distribution of decorative elements, these scenes were classified into two design strategy types: Global Decoration Strategy and Focal-Area Decoration Strategy. Each scene simulated a pop-up retail environment and exhibited distinct characteristics with respect to decorative intensity and the emphasis placed on product display.

The experiment employed a total of 12 images

as stimuli, with three scene images per design strategy. These images were constructed to preserve the authenticity of the retail environment while maintaining relative control over visual variables, thereby ensuring comparability across experimental conditions.

To analyze the distribution of visual attention across different spatial zones, six Areas of Interest (AOIs) were defined in accordance with the key functional regions of the retail space: AOI1 (entrance signage), AOI2 (central display area), AOI3 (shelf product display area), AOI4 (floor decoration area), AOI5 (brand identity display area), and AOI6 (window display area). This delineation enabled a clear analysis of participants' attentional distribution across different spatial elements. The definition of AOIs followed common practices in eye-tracking research, where spatial regions corresponding to functional or perceptual elements are segmented to facilitate the interpretation of gaze behavior. Such segmentation allows researchers to compare attentional allocation across different design components within a complex visual environment.

The experiment was conducted in a controlled laboratory environment using a screen-based eye-tracking system. Participants viewed the stimuli from a distance of approximately 60 centimeters from the display screen. Following calibration, images were presented in a randomized order.

Throughout the experiment, the system recorded multiple eye-tracking metrics, including fixation count, fixation duration, and pupil diameter. These measures were used to analyze participants' visual attention patterns and cognitive engagement as they viewed the different retail scenes. Fixation-based metrics are widely regarded as reliable indicators of attentional allocation in visual cognition research, while variations in pupil diameter are often associated with changes in cognitive load and emotional arousal during visual processing.

To ensure the stability and validity of the experimental data, lighting conditions and screen brightness were kept consistent throughout the experiment, and external disturbances were minimized. Before the formal experiment, all participants completed a short practice task to familiarize themselves with the procedure and viewing method. During data processing, abnormal eye-tracking data, such as extremely

short fixation events or gaze records falling outside the screen area, were removed to ensure that the final dataset accurately reflected participants' visual attention patterns. Through these control measures, the reliability and internal validity of the experimental results were enhanced.

Upon completion of the eye-tracking task, participants completed a questionnaire assessing their perceptions of each scene's visual appeal, spatial clarity, and purchase intention. Reliability analysis indicated that the questionnaire demonstrated high internal consistency, with Cronbach's α coefficients exceeding 0.90 across all scales.

4. Findings and Discussion

Descriptive statistics indicated that participants' eye-tracking behavior was generally stable across the experimental conditions. The mean fixation count was 2.84, and the mean fixation duration was 1.89 seconds. The standard deviation of fixation duration was moderate (SD = 0.76), suggesting a relatively consistent pattern of visual attention among participants during the observation task.

AOI analysis further revealed that product display zones attracted the highest level of visual attention, accounting for approximately 32% of total fixations. By contrast, decorative elements and background spatial areas received considerably less attention, with fixation proportions of approximately 18% and 14% respectively. This distribution indicates that participants tended to prioritize areas containing product-related visual information when viewing retail scenes.

Cluster analysis identified three distinct patterns of visual engagement: high engagement, moderate engagement, and low engagement. The high-engagement group exhibited longer mean fixation durations ($M = 2.41$ s) and more concentrated fixation distributions centered on areas featuring focal design elements, whereas the low-engagement group displayed shorter fixation durations ($M = 1.32$ s) and more dispersed gaze trajectories across the spatial scene. The silhouette coefficient of the cluster model was 0.72, indicating a reliable and well-differentiated cluster structure.

These findings underscore the importance of visual hierarchy in pop-up retail environments. Product display areas function as primary visual anchors within the space, effectively directing

consumer attention and facilitating the visual processing of product information [3,7]. Because these areas contain information most directly relevant to purchasing decisions, they are naturally more likely to attract consumer gaze.

Scenes with clearly defined focal design elements also tended to elicit longer fixation durations and more concentrated gaze patterns. This suggests that when a space possesses a clear visual hierarchy and focal elements, the visual search cost for consumers navigating the environment is reduced, thereby improving cognitive efficiency. In pop-up retail contexts, where consumer dwell time is relatively brief, this kind of visual guidance mechanism is particularly consequential.

Conversely, when decorative elements were distributed evenly across the space, participants' gaze tended to be more dispersed. In these scenes, participants exhibited more saccadic transitions and shorter fixation sequences, suggesting that in the absence of a clear visual structure, consumers may need to invest greater cognitive effort to make sense of the spatial environment.

Taken together, the findings of this study indicate that spatial visual design strategies significantly influence consumer visual behavior and environmental cognition. By establishing clear visual focal points and hierarchical structures, designers can improve the efficiency of consumer attentional allocation and enhance the overall perceptual experience within pop-up retail environments.

Further analysis also suggests that visual search behavior in retail environments demonstrates a clear goal-oriented characteristic. When a space contains well-defined visual focal points, consumers are able to locate information relevant to purchasing decisions more quickly, thereby reducing attentional distraction caused by irrelevant decorative elements. At the same time, focalized design strengthens spatial hierarchy and visual contrast, enabling consumers to form a clearer cognitive schema of the environment. Such visual organization not only enhances the visibility of product information but also reinforces consumers' memory of brand image and spatial atmosphere within a limited browsing time. Therefore, in the design practice of pop-up retail environments, establishing clear visual hierarchies and focal areas plays an important role in improving the efficiency of spatial experience.

These findings also contribute to the broader understanding of how spatial design mediates the relationship between environmental stimuli and consumer cognition in temporary retail contexts. By aligning visual hierarchy with product information and brand identity cues, designers can create environments that not only capture attention but also support more efficient perceptual processing and stronger experiential engagement.

5. Conclusion

This study employed eye-tracking methodology to examine how spatial design strategies influence the distribution of consumer visual attention in pop-up retail environments. The results demonstrate that product display zones attract the highest proportion of visual attention, and that spatial layouts with well-defined visual focal points generate more concentrated gaze patterns, thereby enhancing cognitive efficiency in environmental information processing to a meaningful degree. These findings indicate that clear visual hierarchies and spatially focused design approaches can effectively guide consumer visual exploration in pop-up retail contexts. The study provides empirical evidence for understanding the relationship between spatial design and consumer visual cognition, and offers practical reference for spatial design and experiential optimization in pop-up retail settings.

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