An illusive approach engaging colour, lighting and interior design

Vien Cheung[1], Andrea Siniscalco[2], Maurizio Rossi[2]
[1]University of Leeds, UK
[2]Politecnico di Milano, Italy
Contact: Vien Cheung, t.l.v.cheung@leeds.ac.uk

Abstract

Optical illusions challenge the boundaries between physical reality and human perception. Some widely known examples of optical illusions include ambiguous images, impossible objects, colour confusion, and size uncertainty. While optical illusions usually bring in positive experiences for which viewers take pleasure in the surprises, they could also cause disturbance if were applied unintentionally. Design students who specialise in colour, lighting and interior are responsible for creating spaces that communicate and represent their identity effectively. Visual experience is important for indoor spaces since it significantly impacts our interaction with the surroundings. By studying the ways our visual system responds to the external signals and how our brain processes the visual information, students will develop a deeper understanding of the formation of visual perception and its by-product optical illusions. This project presents a case study of visual perception learning through the curiosity, understanding, and application of optical illusions in a 5-day design student workshop. The workshop consisted of demonstrating a range of optical illusions, lectures on the fundamental bases of special visual effects, exercises on analysing optical illusion examples, and reimaging an Olympic site into an effective illusion-themed hotel.

Keywords: perception, illusion, colour, lighting, interior design.

Introduction

In the context of the School of Design's workshop programme at the Politecnico di Milano, the design theme related to visual phenomenologies in interior design has been proposed to students.

The identified area is the design of the hospitality spaces. Still, the main attention required of the students, rather than the mere aesthetic aspect of the spaces, was to create an environment with distinctive morphological characteristics. The decision was made to develop the interior design for a themed hotel focused on optical illusions.

In everyday contexts, optical illusions are often associated with playfulness, surprise, and aesthetic pleasure. However, when they emerge unintentionally in designed environments, they may lead to disorientation, discomfort, or misinterpretation of space. This dual nature is particularly relevant in the fields of colour, lighting, and interior design, where professionals deliberately shape visual experiences that influence how users perceive, navigate, and emotionally respond to spaces. Designers therefore carry a significant responsibility: to understand not only the physical properties of light and colour, but also the perceptual processes through which the human visual system interprets these properties.

The Colour Workshop

The five-day workshop was designed for students in spatial design disciplines, such as architecture, interior design, and urban planning. It aimed to inform them with both theoretical knowledge and practical considerations for applying optical-illusion effects to maximise the intended purpose across different types of spaces.

The workshop encouraged students to think critically about the mechanisms of visual *trickery* and to apply these strategies creatively in the designated space. The workshop consisted of demonstrations, lectures, hands-on exercises, and group work. The structure was designed to help students observe

phenomena, understand the fundamentals, identify and appropriately explain existing examples, and apply their learning in practice.

Teachings in the Colour Workshop
Workshops and flipped classrooms have been proven to be powerful learning tools; students have the opportunity to tackle real case studies and engage in fast-paced activities that help them to grasp notions in a quick, satisfying way (Amresh, Carberry and Femiani, 2013). In our case, the final aim was for the students to produce projects of hospitality interior design with a focus on optical illusions at a concept level of definition. However, the heterogeneity of students' skills has made it essential to introduce fundamental concepts in lighting, colour, and visual perception to enable them to work effectively. Then, after presenting the workshop project and stating the deadlines for the various steps, some alignment lessons were held.

Ice breaking
The first exercise, to break the ice, was proposed to prompt the class with choices that can be made when choosing a specific shade of colour instead of another, when the choice falls on a hue, according to a concept one wants to express, etc.

They were therefore asked to produce a 5×5 grid of full colours that best described a concept they chose, and to add a comment and their thoughts on the reasons for their choices.
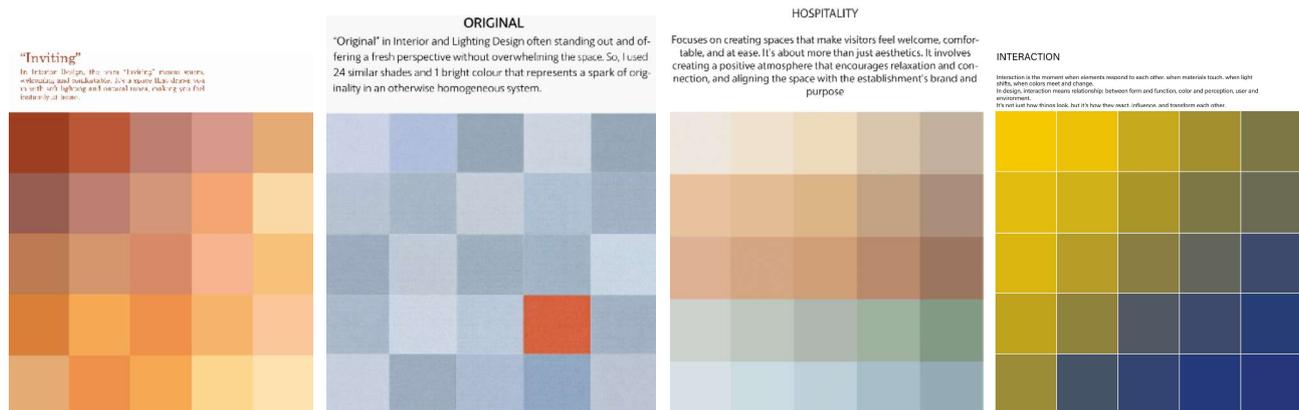

Fig. 1 - Examples of exercises on creating chromatic grids based on words chosen by students. From left to right, the works of *Elisabetta Ampollini, Sara Livio, Anna Locatelli* and *Nicole Volpinari*.

Fundamentals of photometry and lighting design for hospitality
The lessons on the design of light began with a description of the physics of light, followed by a historical account of the steps that led to the modern definition of light as we know it today. In addition to the nature of energy radiation, the fundamentals of photometry have been described: the main light measurement quantities (luminous flux, illuminance, luminous intensity, and luminance) and the basic parameters to be known, such as colour temperature, colour rendering, and the efficiency of lighting sources.

The lesson then moved on to the more practical side: lighting hospitality spaces, with a strong emphasis on hotel lighting design. Numerous examples were presented, and some "tricks of the trade" were seen to illuminate the various areas that generally make up these spaces. Finally, the regulatory aspects related to the lighting of reception facilities were also discussed: the amount of light required for various types of activities, glare containment, and more.

Demonstrations
A number of different optical illusions were demonstrated, focusing on raising students' awareness and attention to detail through observation. The demonstrations are also expected to bring inspiration to students in terms of their creativity and "thinking out of the box". Key takeaway messages from the demonstrations were:

- Negative space (background) can be as functional as positive space (foreground), especially for subliminal influences;

- Beware of ambiguous presentations, such as a single image with two (or more) plausible interpretations;

- Our brain prefers a single unique solution and, therefore, presentation with ambiguity could cause confusion or discomfort;

- Our brain can, and will, also modify information that we perceive to *make sense* for us. An example is our adaptation to changes in light intensity;

- In addition, our brain has the ability to manipulate information to create different or new contexts.

The experience through these demonstrations informed the students that although our visual system receives information about the actual physics of the world, our brain does not necessarily process that information accordingly.

Visual perception
After the students realised that the word as they usually see it is the product of a reelaboration by the visual system (eye, optic nerve and brain), more extensive lectures on the phenomenon of vision took place. These lectures aimed to explain the visual effects observed during the demonstration. They further assist students in developing a deeper understanding of the formation of visual perception and its byproduct, optical illusions. The topics cover:

- Contrast and assimilation - the two commonly found effects, which are both results of the lateral inhibition of the retina influenced by the background of the area of interest, despite being in opposite ways;

- After image - an essential phenomenon that is based on opponency, complementary colours, and the fatigue of photoreceptors in our retina;

- Lighting - not only from the point of view of lighting design and technology, but also the intensity and colour temperature of light sources, as well as their impact on appearance;

- Metamersim - when two material samples match when viewed under one condition but not another; a phenomenon related to spectral power distributions and materials;

- Colour constancy - the ability of our visual system to perceive the approximately same colour of an object regardless of the changes in illumination, attenuating chromatic influence from the light sources;

- Interference of the environment - the surrounding context influences the perception of the observed image, such as the brightness of what we perceive also depends on the background;

- Saccadic eye movements - the ability to perceive contrasts also depends on the involuntary and constant eye movements and results in the visual vibration of static images.

The number of notions related to visual perception was clearly too vast to cover in a short time (Wagemans, 2015). Still, students had been given sufficient competence to start working hands-on with the project. With the theoretical grounding the lecture offers, students were guided to evaluate and appreciate the variety of optical illusion effects and the mechanisms that underpin them.

Identify and Explain
After the theoretical lectures, a task was assigned to the class. In this exercise (named "*Find and Why*"), carried out before the students started working on the projects, involved a hands-on search for and identification of valid optical illusion examples. Students were requested to find valid examples of optical illusions. Drawing on the theoretical content introduced in the lectures, they had to analyse the illusions, identify the observed phenomena, share their findings and explain them, and engage in constructive debate with their peers.

Fig. 2 - Examples of illusions selected as case studies by students in the "Find and Why" exercise. From left to right *Shigeo Fukuda "Images of Illusion 1984 (detail)", Regina Silveira "Abyssal"*, and *Maurits Cornelis Escher "Sky and Water I (detail)"*.

Group Work
After all the alignment lectures were completed, students were distributed into groups and began working actively on the project. A total of twelve groups of three to five students each worked on a project to put their learning into practice through a hypothetical scenario after the conclusion of the 2026 Winter Olympic Games in Italy. The proposed scenario was the requalification of the Olympic village in Predazzo (Trento, Italy). Each group will reimagine parts of the ground-floor interior spaces of the Olympic village, which will be converted into an *optical-illusion-themed hotel*.

Each group selected two spaces for reimaging, with options: two guest rooms, one guest room and the corridor, or one guest room and the hotel reception.

The expected outcome was *to provide users with a distinctive optical-illusion experience while in the spaces*. In addition to the structural areas such as walls, ceiling and floor, students were required to include the furnishings, colour, and lighting details in accordance with the appropriate functions of the spaces. At least one optical illusion principle needed to be demonstrated.

Fig. 3 - Renderings of the pavilion of the Olympic village of Predazzo, whose ground floor was used as a case study. Image courtesy of Archivio Ufficio stampa Provincia Autonoma di Trento.

An unexpected challenge

Optical illusions do not represent failures of the human visual system, but rather reveal the inferential strategies through which perception is constructed (Gregory, 1997). By exploiting prior assumptions and statistical regularities of the natural environment, illusions expose the predictive and interpretative nature of vision, making them a powerful tool for investigating visual perception.

One of the main challenges faced by the students was balancing the experiential potential of optical illusions with the comfort expectations typically associated with hotel rooms. While optical illusions introduce perceptual ambiguity, surprise, and dissonance (Friston, 2010), hospitality spaces require legibility, predictability, and a sense of control to support users' well-being (Mehrabian and Russell, 1974). The design task, therefore, shifted from the mere application of illusionistic effects to the careful modulation of perceptual dissonance.

Balancing these two seemingly irreconcilable aspects proved to be a complex challenge for the various working groups, which ultimately resulted in works that fully embraced the dissonance induced by optical illusions, creating dramatic environments that are intended to be like "*movie sets*" where the user is called upon to live a very peculiar experience, or on the contrary, trying to dilute the bewilderment of illusions into events of more moderate influence, creating welcoming spaces, where illusion is perceived, but not dominant.

Outcomes

The students participating in the Colour Workshop were mainly enrolled in the Bachelor's degree course in Interior Design. The vast majority of groups opted to try their hand at one of the rooms, then chose the corridor and reception as their second spaces. Despite the greater geometric complexity of the reception compared to the corridors, the latter were nevertheless selected in large numbers, probably because of the geometric characteristics that made them ideal for applying solutions that create the typical sense of tension and amazement induced by optical illusions.

The operational work phase of the students lasted for about two and a half days, with back-and-forth revisions with the teachers. Numerous aspects were evaluated during these reviews, including materials, furnishings, feasibility principles regarding optical illusions, and factors related to hospitality lighting. At the end of the workshop, each group presented its work to their peers and visitors in a public presentation of about ten minutes. The projects were laid out on A1 boards and printed for illustration and presentation to the other classes that were tackling the same workshop, but on different aspects of interior design. Given the short time available, the works did not reach the level of executive design; however, their feasibility was verified during the review phase.

Fig. 4 - A complex wall decoration is presented under regular lighting, but the pattern of a specific plant is revealed under different coloured lights. The effect is generated through colour mixing. Project: Chromalusion. Students: Chiara De Gennaro, Gloria Di Gregorio, Giulia Fogli, Alice Livio, Francesca Trevisan.
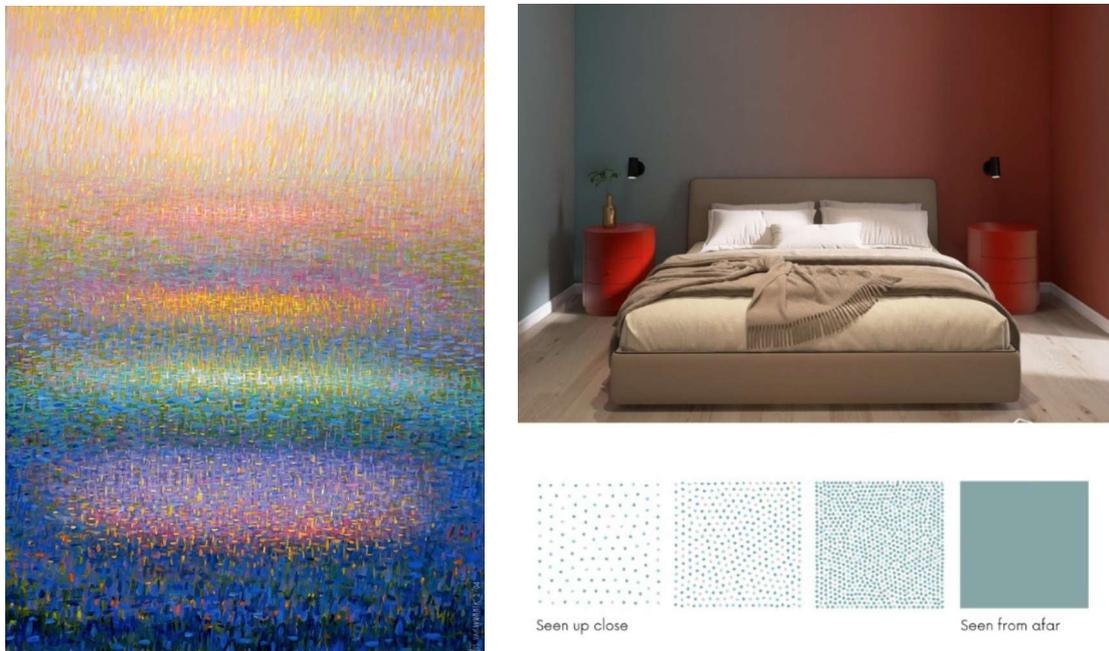

Fig. 5 - The walls of the bathroom seemingly appear to be in solid gradient colours (right). However, when observed closely, the structure of numerous tiny dots is revealed. The effect is generated through pointillism – a result of our eyes being unable to resolve the fine details at a certain level. Project: Deconstruct to Reconstruct. Students: Giulia Artioli, Martina Confalonieri, Francesca Mariani, Davide Ramundo, Chiara Sica
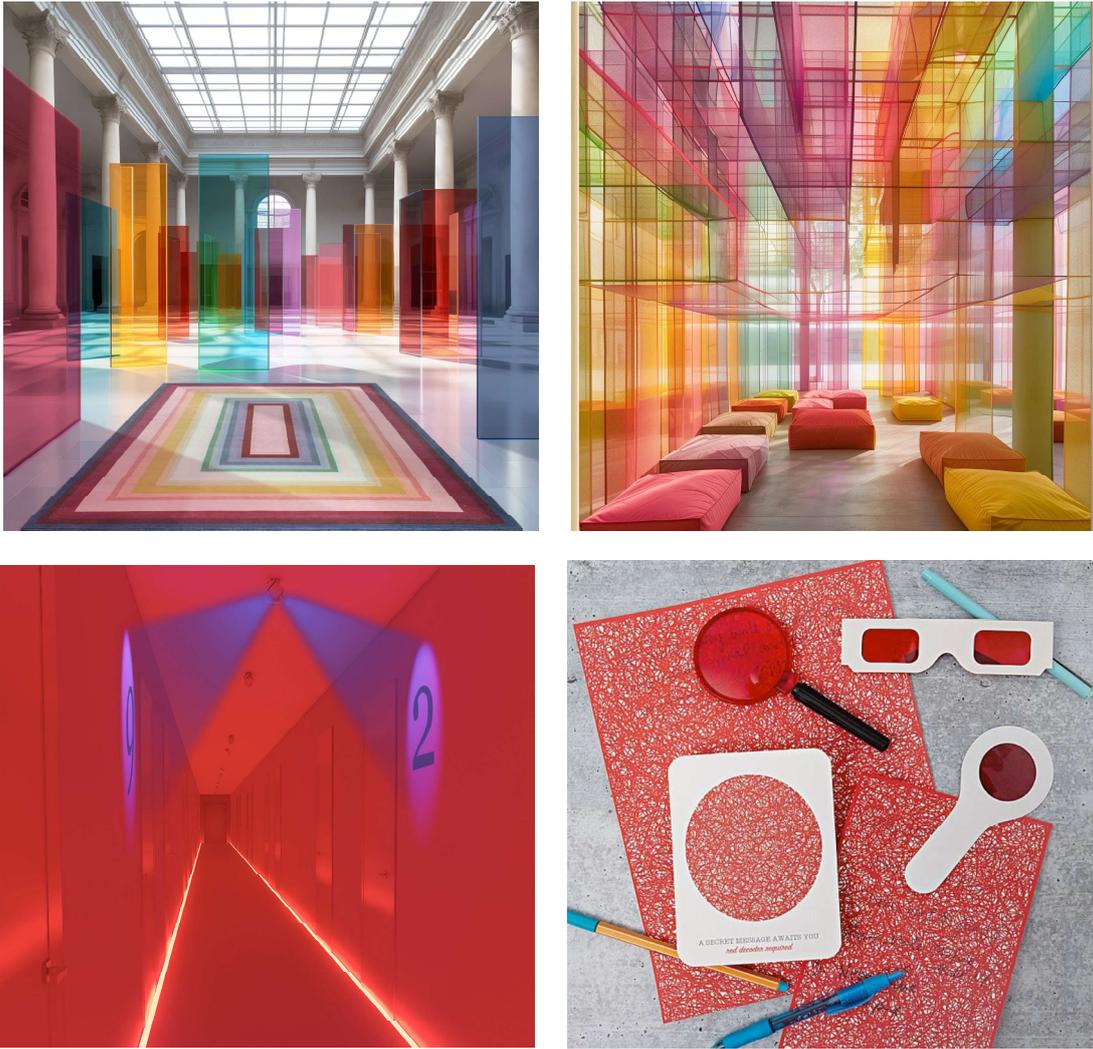
Fig. 6 – Coloured filters are used to reveal or conceal visual elements such as text or graphic shapes. The corridor (below left) employed lighting to simulate a red filter placed over a red illustration with blue text, thereby visually cancelling the red and revealing the blue text. Project: Echo Room. Students: Fabia Elisabetta Ampollini, Sara Livio, Anna Locatelli, Sara Piazzolla, Nicole Volpinari
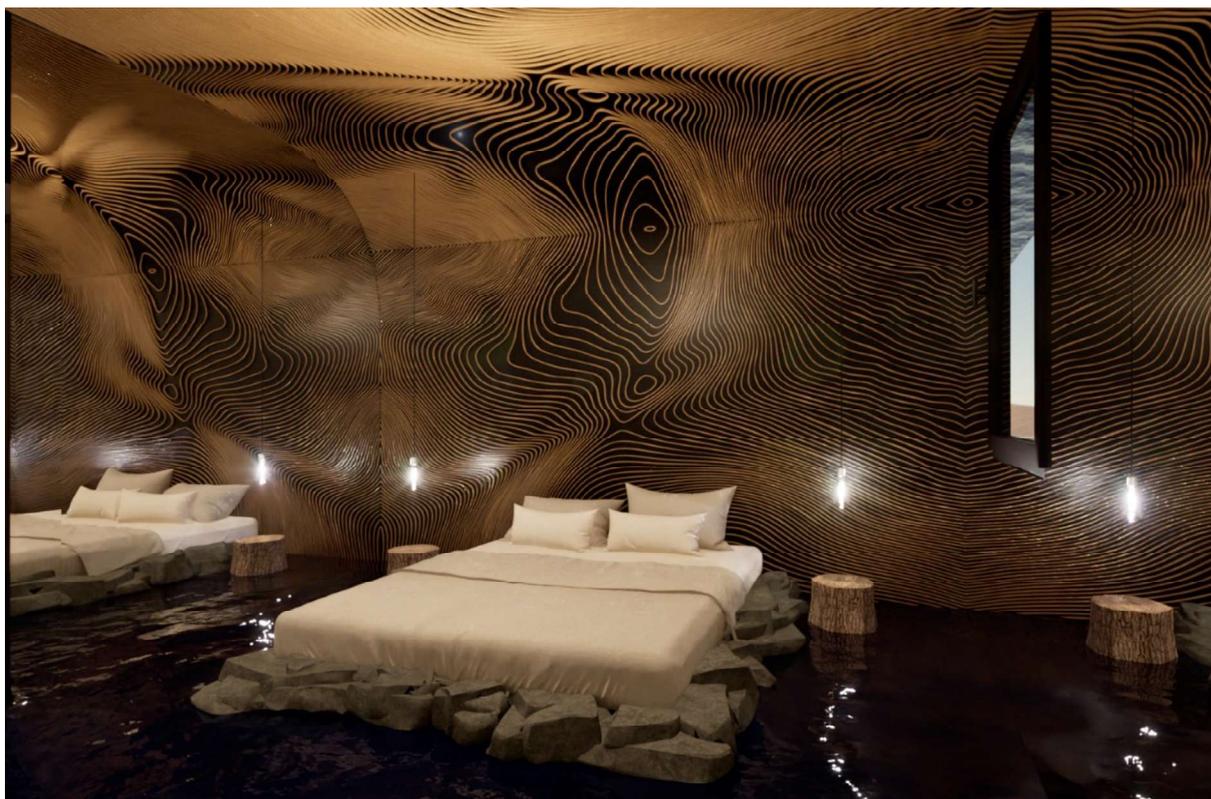
Fig. 7 – The room and corridor offer an immersive journey with natural textures of the Dolomites. The room uses the wood's veins to create an illusionistic effect all over the wall behind the bed, which lies on rocks. Also, mirrored walls offer a broader perspective. Project: The mountain illusion. Students: Benedetta Gagliandro, Michel Guilavogui, Kim Hackmon, Sveva Magatti, Kaisa Vulli.

Conclusions

The Colour Workshop offered an exploration of optical illusions with the aim of generating interest and curiosity in the learning of visual perception. Through the understanding of how visual information is processed and interpreted, more dynamic and engaging environments can be realised. Also trying to find that fleeting balance between the comfort of space and the tension and amazement generated by illusions. Guiding students from observation to identification and analysis, and finally to application, the workshop encourages critical thinking and creative design.

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